Supporting Information

Synthesis of Difluoromethylselenoesters from Aldehydes via a Radical Process

Rui-Li Guo, Xue-Qing Zhu, Xing-Long Zhang and Yong-Qiang Wang*

Key Laboratory of Synthetic and Natural Functional Molecule Chemistry of Ministry of Education, College of Chemistry & Materials Science, Northwest University, Xi'an 710069, People's Republic of China

Table of Contents

1. General information

All reactions were carried out underone atmosphere. All reagents were used as received unless otherwise noted. Flash chromatography was performed with silica gel (200-300 mesh). NMR spectra were recorded on a Bruker Ascend 400 spectrometer at 400 MHz (^{1}H NMR), 101 MHz (^{13}C NMR), 376 MHz (^{19}F NMR), on a BrukerAscend 600 spectrometer at 600 MHz (^{1}H NMR), 151 MHz (^{13}C NMR) or on a JEOL ECZ*400*R spectrometer at 376 MHz (^{19}F NMR). ^{1}H NMR chemical shifts are reported in delta (δ) units, in parts per million (ppm) downfield from tetramethylsilane. Splitting patterns are designated as s, singlet; d, doublet; t, triplet; m, multiplet, br, broad. Coupling constants *J* are quoted in Hz. Spectra are referenced internally to the residual proton resonance in $CDCl_3$ (δ 7.26 ppm), or with tetramethylsilane (TMS, δ 0.00 ppm) as the internal standard. ^{13}C NMR chemical shifts are reported in ppm relative to the center line of a triplet at 77.16 ppm for chloroform-*d*. ^{19}F NMR chemical shifts are reported relative to inter standard $CFCl_3$ at 0.0 ppm. Infrared (IR) data were recorded as films on potassium bromide plates on a Bruker Tensor 27 FT-IR spectrometer. Absorbance frequencies are reported in reciprocal centimeters (cm^{-1}). Mass spectra were acquired on a BrukerDaltonics S2 MicroTof-Q II mass spectrometer. X-ray crystal structure analyses were measured on Bruker Smart APEXIICCD instrument using Mo-Kα radiation. The structures were solved and refined using the SHELXTL software package. **2a**,[1] **2b**,[1] **2c**, **2d**,[2] **1ad**,[3] **1ae**,[4] **1ca**,[5] **1cb**,[6] **1cc**[7]were prepared according to literature methods.

2. General procedure

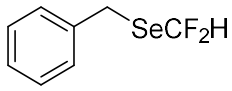
Synthesis of **2b**: To a dry two-necked 100 mL flask bottomed flask equipped with a magnetic stirrer were added(benzylselanyl)carbonitrile (15.76 g, 80 mmol, 1.0 equiv). The flask was

evacuated and refilled with argonthree times. Then, anhydrous DMF (40 mL), $TMSCF_2H$ (20 mL, 160 mmol, 2.0 equiv) were sequentially added to thesystem via syringe. The reaction mixture was cooled to 0 °C, and CsF (36.45 g,240 mmol, 3.0 equiv) was carefully added. The reaction was stirred at 0 °C under an argon atmosphere for 72 h. The reaction mixture was then partitioned between water and pentane. The layers wereseparated and the organic layer was washed with aqueoussaturated brine solution, and then dried over $MgSO_4$. After removing the pentane by rotary evaporation, theresidue was purified by flash chromatography on silica gel to give **2b** as a colorless oil.

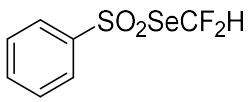
Synthesis of **2c**: To a flask equipped with a magnetic stir bar were added the benzyl(difluoromethyl)selane (2.21g, 10 mmol, 1.0 equiv.), sulfuryl chloride (0.8 mL, 10 mmol, 1.0 equiv.) and anhydrous THF (5 mL). The reaction mixture was stirred at 0 °C for 1h and then cooled down to -78 °C. Anhydrous DCM (25 mL) was added followed by sodium benzenesulfinate (1.81g, 11 mmol, 1.1 equiv.). The reaction was stirred until complete conversion of the active reagent $ClSeCF_2H$ at -78 °C. The reaction mixture was then filtered over a pad of silica (rinsed with DCM) and the filtrate was concentrated to dryness. The crude residue was purified by chromatography to afford the desired product **2c** as a yellow oil.

For **3a-3cc**: A 10 mL round bottomed flask equipped with a stirring bar was charged with benzyl(difluoromethyl)selane (121 mg, 0.5 mmol, 1.0 equiv), aldehydes (0.75 mmol, 1.5 equiv), and DCE (2.5 mL) followed by sequential addition of AIBN (164 mg, 1.0 mmol, 2.0 equiv). The reaction was allowed to stir at 50 °C under an argon atmosphere for 24 h. The solvent was filtered and the filtrate was evaporated in vacuo. The residue was purified by flash chromatography on silica gel.

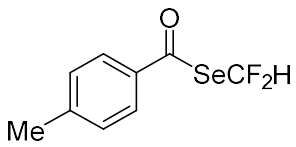
3. Characterization datas for compounds 2b – 3cc



Benzyl(difluoromethyl)selane (2b). Colorless oil (36%).Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.40). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 – 7.23 (m, 5H), 7.05 (t, *J* = 55.2 Hz, 1H), 4.09 (s, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -92.88 (d, *J* = 55.2 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.4, 129.1 (2C), 128.9 (2C), 127.5, 115.8 (t, *J* = 287.0 Hz), 26.4 (t, *J* = 2.9 Hz). IR (KBr): ν = 3030, 1495, 1454, 1295, 1191, 1059, 911, 759, 697, 607 cm^{-1}. HRMS (ESI) for $C_8H_8F_2SeNa$+ ($M+Na^+$): Calcd: 244.9651, Found: 244.9652.

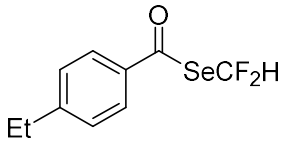


***Se*-(difluoromethyl)-benzenesulfonoselenoate (2c)**. Yellow oil (65%).Eluant: ethyl acetate/petroleum ether (1:50, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 7.7 Hz, 2H), 7.68 (t, *J* = 7.4 Hz, 1H), 7.64 (t, *J* = 54.2 Hz, 1H), 7.58 (t, *J* = 7.8 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -90.44 (d, *J* = 54.1 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 147.9, 134.6, 129.7 (2C), 126.6 (2C), 120.6 (t, *J* = 293.7 Hz). IR (KBr): ν = 2926, 1448, 1329, 1138, 1064, 906, 681, 650, 577, 528 cm^{-1}. HRMS (ESI) for $C_7H_6F_2O_2SSeNa$+ ($M+Na^+$): Calcd: 294.9114, Found: 294.9113.

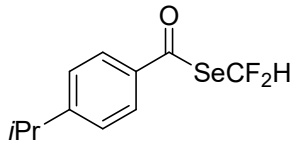


***Se*-(difluoromethyl)-4-methylbenzoselenoate (3a)**. Yellow solid (113 mg, 90%). Mp: 46-47 °C. Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, *J* = 8.2 Hz, 2H), 7.61 (t, *J* = 53.6 Hz, 1H), 7.30 (d, *J* = 8.1 Hz, 2H), 2.43 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.08 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.5 (t, *J* = 2.8 Hz), 146.3, 135.4 (t, *J* = 2.5 Hz), 130.0 (2C), 127.9 (2C), 120.4 (t, *J* = 283.3 Hz), 22.0. IR (KBr): ν =

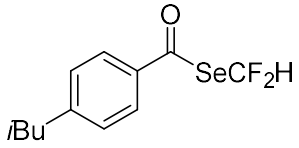
2922, 1690, 1603, 1456, 1269, 1177, 1051, 816, 621 cm^{-1}. HRMS (ESI) for $C_9H_8F_2OSeNa$ ($M+Na^+$): Calcd: 272.9601, Found: 272.9598.



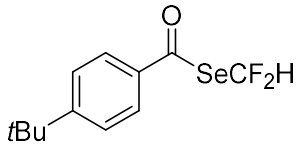
***Se*-(difluoromethyl)-4-ethylbenzoselenoate (3b)**. Yellow oil (109 mg, 82%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^1H NMR (600 MHz, $CDCl_3$) δ 7.73 (d, *J* = 8.2 Hz, 2H), 7.61 (t, *J* = 53.6 Hz, 1H), 7.32 (d, *J* = 8.2 Hz, 2H), 2.72 (q, *J* = 7.6 Hz, 2H), 1.27 (t, *J* = 7.6 Hz, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.09 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (151 MHz, $CDCl_3$) δ 190.5(t, *J* = 4.2 Hz), 152.4, 135.6(t, *J* = 2.5 Hz), 128.9 (2C), 128.0 (2C), 120.4 (t, *J* = 283.2 Hz), 29.2, 15.1. IR (KBr): ν = 2926, 1696, 1604, 1270, 1210, 1176, 1073, 880, 842, 767, 691, 611 cm^{-1}. HRMS (ESI) for $C_{10}H_{10}F_2OSeNa$ ($M+Na^+$): Calcd: 286.9757, Found: 286.9760.



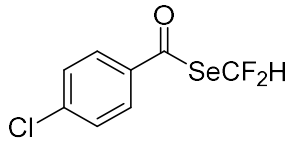
***Se*-(difluoromethyl)-4-isopropylbenzoselenoate (3c)**. Yellow oil (102 mg, 73%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^1H NMR (400 MHz, $CDCl_3$) δ 7.74 (d, *J* = 8.3 Hz, 2H), 7.61 (t, *J* = 53.6 Hz, 1H), 7.35 (d, *J* = 8.3 Hz, 2H), 3.20 – 2.76 (m, 1H), 1.27 (d, *J* = 6.9 Hz, 6H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.08 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.5 (t, *J* = 2.9 Hz), 157.0, 135.7 (t, *J* = 2.6 Hz), 128.0 (2C), 127.5 (2C), 120.4(t, *J* = 283.3 Hz), 34.6, 23.7 (2C). IR (KBr): ν = 2962, 2925, 1690, 1603, 1463, 1414, 1269, 1210, 1179, 1055, 875, 841, 747, 689, 626, 610 cm^{-1}. HRMS (ESI) for $C_{11}H_{12}F_2OSeNa$ ($M+Na^+$): Calcd: 300.9914, Found: 300.9907.



***Se*-(difluoromethyl)-4-isobutylbenzoselenoate (3d)**. Yellow oil (135 mg, 92%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, *J* = 8.3 Hz, 2H), 7.61 (d, *J* = 53.6 Hz, 1H), 7.27 (d, *J* = 8.1 Hz, 2H), 2.54 (d, *J* = 7.2 Hz, 2H), 1.96 – 1.85 (m, 1H), 0.91 (d, *J* = 6.6 Hz, 6H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.08 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.5 (t, *J* = 2.9 Hz), 150.0, 135.6 (t, *J* = 2.6 Hz) 130.0 (2C), 127.8 (2C), 120.4(t, *J* = 283.3 Hz), 45.6, 30.2, 22.4 (2C). IR (KBr): ν = 2957, 2925, 1687, 1604, 1466, 1413, 1270, 1207, 1176, 1071, 879, 818, 792, 691, 652, 623 cm^{-1}. HRMS (ESI) for $C_{12}H_{14}F_2OSeNa$ ($M+Na^+$): Calcd: 315.0070, Found: 315.0070.

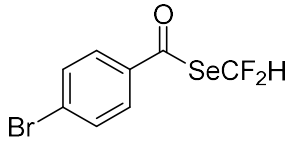


***Se*-(difluoromethyl)-4-(tert-butyl)benzoselenoate (3e)**. Yellow solid (130 mg, 89%). Mp: 58-59 °C. Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (d, *J* = 8.3 Hz, 2H), 7.62 (t, *J* = 53.6 Hz, 1H), 7.51 (d, *J* = 8.4 Hz, 2H), 1.35 (s, 9H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.08 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.5 (t, *J* = 2.9 Hz), 159.2, 135.2 (t, *J* = 2.6 Hz), 127.7 (2C), 126.3 (2C), 120.4 (t, *J* = 283.2 Hz), 35.5, 31.1 (3C). IR (KBr): ν = 2965, 1683, 1597, 1267, 1215, 1180, 1106, 1072, 1050, 881, 721, 690, 590 cm^{-1}. HRMS (ESI) for $C_{12}H_{14}F_2OSeNa$ ($M+Na^+$): Calcd: 315.0070, Found: 315.0071.

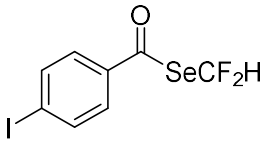


***Se*-(difluoromethyl)-4-chlorobenzoselenoate (3f)**. Yellow solid (103 mg, 76%). Mp: 35-36 °C. Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (d, *J* = 8.7 Hz, 2H), 7.61 (t, *J* = 53.6 Hz, 1H), 7.49 (d, *J* = 8.7 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.78 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.0 (t, *J* = 2.9 Hz), 141.6, 136.2 (t,

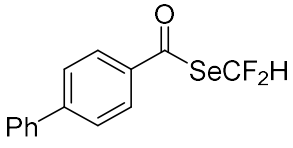
J= 2.6 Hz), 129.7 (2C), 129.0 (2C), 120.1 (t, *J* = 284.3 Hz). IR (KBr): ν = 2924, 1689, 1587, 1573, 1486, 1399, 1269, 1202, 1070, 875, 834, 688 cm^{-1}. HRMS (ESI) for $C_8H_5ClF_2OSeNa$ ($M+Na^+$): Calcd: 292.9054, Found: 292.9066.



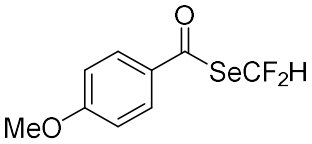
***Se*-(difluoromethyl)-4-bromobenzoselenoate (3g)**. Yellow solid (85 mg, 54%). Mp: 57-58 °C. Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^1H NMR (400 MHz, $CDCl_3$) δ 7.69 – 7.64 (m, 4H), 7.60 (d, *J* = 53.5 Hz, 1H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.78 (d, *J* = 53.4 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.3 (t, *J* = 2.9 Hz), 136.7(t, *J* = 2.4 Hz), 132.7 (2C), 130.3, 129.0 (2C), 120.1 (t, *J* = 284.4 Hz). IR (KBr): ν = 2923, 1682, 1582, 1482, 1395, 1268, 1199, 1174, 1065, 1009, 874, 816, 705, 686, 615 cm^{-1}. HRMS (ESI) for $C_8H_6BrF_2OSe$ ($M+H^+$): Calcd: 314.8730, Found: 314.8729.



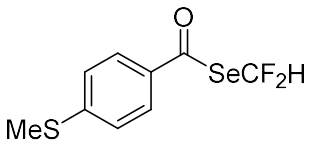
***Se*-(difluoromethyl)-4-iodobenzoselenoate (3h)**. Yellow solid (85 mg, 47%). Mp: 50-51 °C. Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^1H NMR (600 MHz, $CDCl_3$) δ 7.88 (d, *J* = 8.6 Hz, 2H), 7.60 (t, *J* = 53.5 Hz, 1H), 7.51 (d, *J* = 8.6 Hz, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.79 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.6 (t, *J* = 2.9 Hz), 138.7 (2C), 137.2 (t, *J* = 2.3 Hz), 128.8 (2C), 120.0 (t, *J* = 284.4 Hz), 103.2. IR (KBr): ν = 2921, 2851, 1672, 1578, 1561, 1477, 1389, 1263, 1204, 1175, 1114, 1044, 1005, 872, 826, 686, 617 cm^{-1}. HRMS (ESI) for $C_8H_5IF_2OSeNa$ ($M+Na^+$): Calcd: 384.8411, Found: 384.8414.



***Se*-(difluoromethyl)-[1,1'-biphenyl]-4-carboselenoate (3i)**. Yellow solid (131 mg, 84%). Mp: 77-78 °C. Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, *J* = 8.5 Hz, 2H), 7.68 (d, *J* = 8.5 Hz, 2H), 7.63 (t, *J* = 53.6 Hz, 1H), 7.62 – 7.57 (m, 2H), 7.49 – 7.44 (m, 2H), 7.44 – 7.38 (m, 1H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.89 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.5 (t, *J* = 2.8 Hz), 147.8, 139.3, 136.4 (t, *J* = 2.4 Hz), 129.2 (2C), 128.9, 128.3 (2C), 127.9 (2C), 127.4 (2C), 120.3 (t, *J* = 283.7 Hz). IR (KBr): ν = 2922, 1680, 1600, 1200, 1182, 1085, 1047, 891, 768, 688 cm^{-1}. HRMS (ESI) for $C_{14}H_{10}F_2OSeNa$ ($M+Na^+$): Calcd: 334.9757, Found: 334.9753.

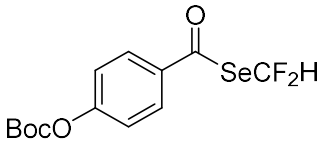


***Se*-(difluoromethyl)-4-methoxybenzoselenoate (3j)**. Yellow solid (100 mg, 75%). Mp: 38-39 °C. Eluant: ethyl acetate/petroleum ether (1:30, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 (d, *J* = 8.9 Hz, 2H), 7.60 (t, *J* = 53.6 Hz, 1H), 6.95 (d, *J* = 8.9 Hz, 2H), 3.88 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.95 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 188.8 (t, *J* = 2.8 Hz), 165.1, 130.6 (t, *J* = 2.5 Hz), 130.2 (2C), 120.5 (t, *J* = 283.0 Hz), 114.5 (2C), 55.8. IR (KBr): ν = 2936, 1686, 1596, 1575, 1507, 1265, 1211, 1165, 1059, 1026, 878, 835, 784, 691, 648, 611 cm^{-1}. HRMS (ESI) for $C_9H_8F_2O_2SeNa$ ($M+Na^+$): Calcd: 288.9550, Found: 288.9548.

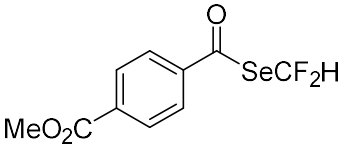


***Se*-(difluoromethyl)-4-(methylthio)benzoselenoate (3k)**. Yellow solid (115 mg, 81%). Mp: 65-66 °C. Eluant: ethyl acetate/petroleum ether (1:50, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 (d, *J* = 8.7 Hz, 2H), 7.61 (t, *J* = 53.6 Hz, 1H), 7.27 (d, *J* = 8.7 Hz, 2H), 2.52 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.90 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.6 (t,

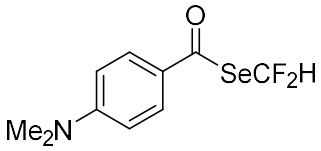
J= 2.6 Hz), 149.0, 133.8 (t, *J* = 2.4 Hz), 128.0 (2C), 125.3 (2C), 120.4 (t, *J* = 283.5 Hz), 14.8. IR (KBr): ν = 2923, 1679, 1586, 1488, 1434, 1401, 1322, 1268, 1214, 1185, 1072, 1036, 883, 821, 733, 712, 689, 619 cm^{-1}. HRMS (ESI) for $C_9H_8F_2OSSeNa$ ($M+Na^+$): Calcd: 304.9321, Found: 304.9316.



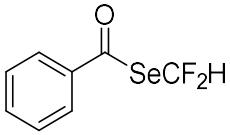
***Se*-(difluoromethyl)-4-((tert-butoxycarbonyl)oxy)benzoselenoate (3l)**. Yellow solid (127 mg, 72%). Mp: 33-34 °C. Eluant: ethyl acetate/petroleum ether (1:30, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (d, *J* = 8.8 Hz, 2H), 7.61 (t, *J* = 53.5 Hz, 1H), 7.33 (d, *J* = 8.8 Hz, 2H), 1.57 (s, 9H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.88 (d, *J* = 53.4 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.8 (t, *J* = 2.8 Hz), 156.1, 150.8, 135.1 (t, *J* = 2.4 Hz), 129.3 (2C), 122.1 (2C), 120.2 (t, *J* = 284.0 Hz), 84.8, 27.8 (3C). IR (KBr): ν = 2983, 1759, 1686, 1599, 1504, 1371, 1272, 1222, 1202, 1140, 1069, 875, 843, 779, 690, 646, 621 cm^{-1}. HRMS (ESI) for $C_{13}H_{14}F_2O_4SeNa$ ($M+Na^+$): Calcd: 374.9918, Found: 374.9918.



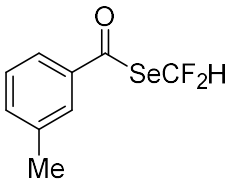
Methyl-4-(((difluoromethyl)selanyl)carbonyl)benzoate (3m). Yellow gum (103 mg, 70%).Eluant: ethyl acetate/petroleum ether (1:50, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, *J* = 8.1 Hz, 2H), 7.87 (d, *J* = 8.1 Hz, 2H), 7.62 (t, *J* = 53.4 Hz, 1H), 3.96 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.85 (d, *J* = 53.4 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.1 (t, *J* = 2.9 Hz), 165.8, 140.9 (t, *J* = 2.4 Hz), 135.6, 130.5 (2C), 127.6 (2C), 120.0 (t, *J* = 284.6 Hz), 52.8. IR (KBr): ν = 2925, 2854, 1728, 1688, 1280, 1198, 1109, 1072, 885, 821, 773, 731, 690 cm^{-1}. HRMS (ESI) for $C_{10}H_9F_2O_3Se$ ($M+H^+$): Calcd: 294.9679, Found: 294.9685.



***Se*-(difluoromethyl)-4-(dimethylamino)benzoselenoate (3n)**. Yellow solid (97 mg, 69%). Mp: 101-102 °C. Eluant: ethyl acetate/petroleum ether (1:50, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 8.8 Hz, 2H), 7.60 (t, *J* = 53.9 Hz, 1H), 6.61 (d, *J* = 8.8 Hz, 2H), 3.06 (s, 6H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.93 (d, *J* = 53.9 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 186.9 (t, *J* = 2.6 Hz), 154.7, 130.3 (2C), 124.7 (t, *J* = 2.4 Hz), 121.0 (t, *J* = 281.7 Hz), 111.0 (2C), 40.1 (2C). IR (KBr): ν = 2925, 1675, 1593, 1553, 1531, 1376, 1167, 1066, 875, 821 cm^{-1}. HRMS (ESI) for $C_{10}H_{11}F_2NOSeNa$ ($M+Na^+$): Calcd: 301.9866, Found: 301.9868.

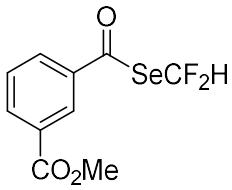


***Se*-(difluoromethyl)-benzoselenoate (3o)**. Yellow gum (102 mg, 86%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (d, *J* = 7.5 Hz, 2H), 7.67 (t, *J* = 7.4 Hz, 1H), 7.62 (d, *J* = 53.5 Hz, 1H), 7.53 – 7.48 (m, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.06 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.2 (t, *J* = 2.8 Hz), 137.8 (t, *J* = 2.3 Hz), 135.0, 129.4 (2C), 127.7 (2C), 120.3 (t, *J* = 283.6 Hz). IR (KBr): ν = 2923, 1689, 1449, 1270, 1203, 1073, 877, 767, 670, 624 cm^{-1}. HRMS (ESI) for $C_8H_6F_2OSeNa$ ($M+Na^+$): Calcd: 258.9444, Found: 258.9444.

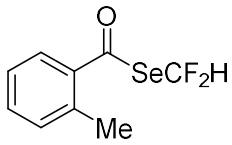


***Se*-(difluoromethyl)-3-methylbenzoselenoate (3p)**. Yellow gum (80 mg, 64%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (t, *J* = 53.6 Hz, 1H),

7.61 – 7.60 (m, 2H), 7.48 – 7.45 (m, 1H), 7.38 (t, J = 7.9 Hz, 1H), 2.43 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.14 (d, J = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.2 (t, J = 2.7 Hz), 139.5, 137.9 (t, J = 2.2 Hz), 135.8, 129.2, 128.1, 125.1, 120.4 (t, J = 283.5 Hz), 21.4. IR (KBr): ν = 2924, 1687, 1600, 1457, 1270, 1242, 1148, 1058, 947, 930, 808, 790, 769, 686, 665 cm^{-1}. HRMS (ESI) for $C_9H_8F_2OSeNa$ ($M+Na^+$): Calcd: 272.9601, Found: 272.9590.

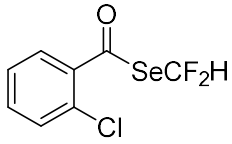


Methyl-3-(((difluoromethyl)selanyl)carbonyl)benzoate (3q). Yellow gum (109 mg, 74%). Eluant: ethyl acetate/petroleum ether (1:50, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.44 (t, J = 1.5 Hz, 1H), 8.33 – 8.30 (m, 1H), 8.00 – 7.97 (m, 1H), 7.63 (t, J = 53.4 Hz, 1H), 7.61 (t, J = 7.8 Hz, 1H), 3.97 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.83 (d, J = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.7 (t, J = 3.0 Hz), 165.7, 138.2 (t, J = 2.5 Hz), 135.6, 131.6, 131.5, 129.6, 128.8, 120.1 (t, J = 284.5 Hz), 52.8. IR (KBr): ν = 2924, 1725, 1692, 1600, 1440, 1280, 1181, 1059, 983, 914, 823, 757, 722, 682, 650, 632 cm^{-1}. HRMS (ESI) for $C_{10}H_8F_2O_3SeNa$ ($M+Na^+$): Calcd: 316.9499, Found: 316.9499.

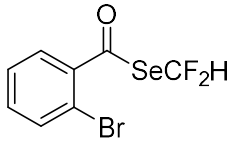


***Se*-(difluoromethyl)-2-methylbenzoselenoate (3r)**. Yellow oil (108 mg, 86%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 – 7.69 (m, 1H), 7.55 (t, J = 53.5 Hz, 1H), 7.48 (t, J = 7.5 Hz, 1H), 7.35 – 7.28 (m, 2H), 2.52 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.71 (d, J = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 192.3 (t, J = 2.8 Hz), 137.6, 137.4 (t, J = 2.3 Hz), 133.4, 132.3, 129.5, 126.6, 120.8 (t, J = 283.3 Hz), 21.1. IR

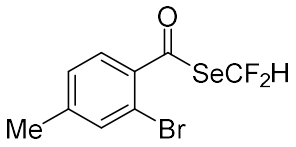
(KBr): ν = 2924, 1699, 1601, 1569, 1457, 1382, 1269, 1205, 1189, 1057, 873, 761, 715, 670, 664, 630 cm^{-1}. HRMS (ESI) for $C_9H_8F_2OSeNa$ ($M+Na^+$): Calcd: 272.9601, Found: 272.9605.



***Se*-(difluoromethyl)-2-chlorobenzoselenoate (3s)**. Yellow oil (98 mg, 72%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^1H NMR (400 MHz, $CDCl_3$) δ 7.69 – 7.67 (m, 1H), 7.58 (t, *J* = 53.3 Hz, 1H), 7.51 – 7.49 (m, 2H), 7.42 – 7.38 (m, 1H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.77 (d, *J* = 53.3 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.2 (t, *J* = 3.1 Hz), 137.2 (t, *J* = 2.3 Hz), 133.9, 131.7, 131.1, 129.7, 127.4, 120.3 (t, *J* = 284.7 Hz). IR (KBr): ν = 2925, 1701, 1586, 1467, 1434, 1263, 1191, 1055, 878, 760, 727, 687, 651, 625 cm^{-1}. HRMS (ESI) for $C_8H_5ClF_2OSeNa$ ($M+Na^+$): Calcd: 292.9054, Found: 292.9061.

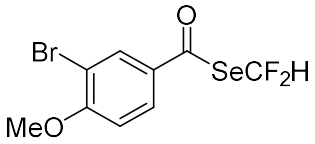


***Se*-(difluoromethyl)-2-bromobenzoselenoate (3t)**. Yellow oil (110 mg, 70%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^1H NMR (400 MHz, $CDCl_3$) δ 7.69 (dd, *J* = 7.7, 1.3 Hz, 1H), 7.63 (dd, *J* = 7.4, 1.9 Hz, 1H), 7.58 (t, *J* = 54.9 Hz, 1H), 7.47 – 7.38 (m, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.45 (d, *J* = 53.3 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.3 (t, *J* = 3.1 Hz), 139.4 (t, *J* = 2.4 Hz), 135.0, 133.8, 129.7, 127.9, 120.3 (t, *J* = 285.0 Hz), 118.6. IR (KBr): ν = 2924, 1698, 1584, 1461, 1430, 1267, 1195, 1049, 875, 759, 721, 680, 642, 624 cm^{-1}. HRMS (ESI) for $C_8H_5BrF_2OSeNa$ ($M+Na^+$): Calcd: 336.8549, Found: 336.8553.

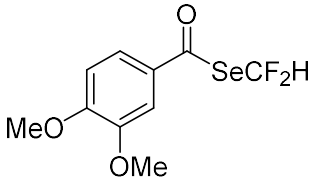


***Se*-(difluoromethyl)-2-bromo-4-methylbenzoselenoate (3u)**. Yellow gum (114 mg, 69%).

Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (t, *J* = 53.4 Hz, 1H), 7.55 (d, *J* = 8.0 Hz, 1H), 7.52 (s, 1H), 7.23 (d, *J* = 8.0 Hz, 1H), 2.39 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.59 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.5 (t, *J* = 2.9 Hz), 145.4, 136.3 (t, *J* = 2.5 Hz), 135.7, 130.1, 128.6, 120.5 (t, *J* = 284.5 Hz), 118.9, 21.4. IR (KBr): ν = 2922, 1718, 1691, 1595, 1475, 1379, 1267, 1190, 1045, 894, 802, 686, 610 cm^{-1}. HRMS (ESI) for $C_9H_7BrF_2OSeNa$ ($M+Na^+$): Calcd: 350.8706, Found: 350.8711.

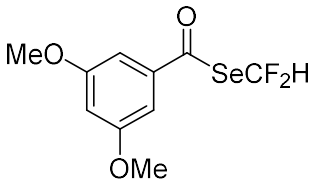


***Se*-(difluoromethyl)-3-bromo-4-methoxybenzoselenoate (3v)**. Yellow solid (131 mg, 76%). Mp: 78-79 °C. Eluant: ethyl acetate/petroleum ether (1:30, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 (s, 1H), 7.75 (d, *J* = 8.7 Hz, 1H), 7.59 (t, *J* = 53.5 Hz, 1H), 6.95 (d, *J* = 8.7 Hz, 1H), 3.98 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.70 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 188.1 (t, *J* = 2.8 Hz), 161.1, 132.9, 131.5 (t, *J* = 2.4 Hz), 129.2, 120.3 (t, *J* = 283.9 Hz), 112.8, 111.6, 56.9. IR (KBr): ν = 2921, 1714, 1681, 1591, 1557, 1493, 1399, 1281, 1259, 1188, 1068, 1015, 926, 909, 787, 688, 670, 644, 622 cm^{-1}. HRMS (ESI) for $C_9H_7BrF_2O_2SeNa$ ($M+Na^+$): Calcd: 366.8655, Found: 366.8657.

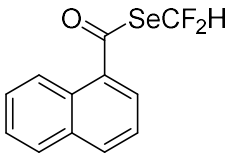


***Se*-(difluoromethyl)-3,4-dimethoxybenzoselenoate (3w)**. Yellow solid (123 mg, 83%). Mp: 51-52 °C. Eluant: ethyl acetate/petroleum ether (1:30, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (t, *J* = 53.6 Hz, 1H), 7.47 – 7.45 (m, 1H), 7.31 (d, *J* = 1.9 Hz, 1H), 6.92 (d, *J* = 8.5 Hz, 1H), 3.95 (s, 3H), 3.92 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.93 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR

(101 MHz, $CDCl_3$) δ 189.0 (t, *J* = 2.7 Hz), 154.9, 149.5, 130.7 (t, *J* = 2.5 Hz), 123.2, 120.5 (t, *J* = 283.2 Hz), 110.7, 109.2, 56.4, 56.2. IR (KBr): ν = 2936, 1683, 1586, 1511, 1463, 1415, 1264, 1245, 1142, 1064, 1020, 975, 950, 790, 757, 691, 648 cm^{-1}. HRMS (ESI) for $C_{10}H_{11}F_2O_3Se$ ($M+H^+$): Calcd: 296.9836, Found: 296.9834.

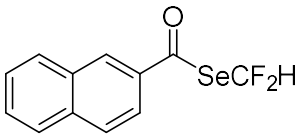


***Se*-(difluoromethyl)-3,5-dimethoxybenzoselenoate (3x)**. Yellow solid (120 mg, 81%). Mp: 41-42 °C. Eluant: ethyl acetate/petroleum ether (1:30, R_f = 0.30). ^1H NMR (400 MHz, $CDCl_3$) δ 7.59 (t, *J* = 53.5 Hz, 1H), 6.93 – 6.92 (m, 2H), 6.71 (s, 1H), 3.83 (s, 6H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.18 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.1 (t, *J* = 3.0 Hz), 161.4 (2C), 139.8 (t, *J* = 2.3 Hz), 120.3 (t, *J* = 283.8 Hz), 107.0, 105.4 (2C), 55.8 (2C). IR (KBr): ν = 2941, 1688, 1590, 1457, 1426, 1354, 1299, 1269, 1206, 1159, 1058, 980, 926, 846, 752, 688 cm^{-1}. HRMS (ESI) for $C_{10}H_{10}F_2O_3SeNa$ ($M+Na^+$): Calcd: 318.9655, Found: 318.9652.

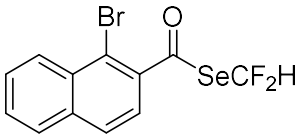


***Se*-(difluoromethyl)-naphthalene-1-carboselenoate (3aa)**. Yellow gum (125 mg, 87%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^1H NMR (400 MHz, $CDCl_3$) δ 8.61 (d, *J* = 8.6 Hz, 1H), 8.08 (d, *J* = 8.2 Hz, 1H), 8.00 (d, *J* = 7.2 Hz, 1H), 7.90 (d, *J* = 8.1 Hz, 1H), 7.66 (t, *J* = 53.6 Hz, 1H), 7.65 (t, *J* = 7.1 Hz, 1H), 7.58 (t, *J* = 7.5 Hz, 1H), 7.53 (t, *J* = 7.8 Hz, 1H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.69 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 192.5 (t, *J* = 2.9 Hz), 135.2 (t, *J* = 2.4 Hz), 135.0, 134.0, 129.6, 129.2, 128.6, 128.5, 127.4, 125.0, 124.7, 120.9 (t, *J* = 283.6 Hz). IR (KBr): ν = 2923, 1695, 1507, 1267, 1221, 1171, 1047, 888, 803, 771, 745, 689, 657

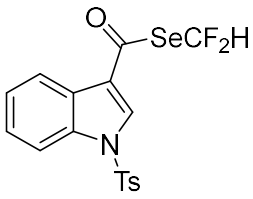
cm^{-1}. HRMS (ESI) for $C_{12}H_8F_2OSeNa$ (M+Na$^+$): Calcd: 308.9601, Found: 308.9605.



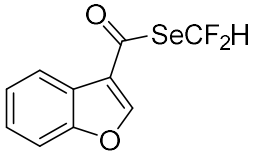
***Se*-(difluoromethyl)-naphthalene-2-carboselenoate (3ab)**. Yellow solid (129 mg, 90%). Mp: 41-42 °C. Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36 (s, 1H), 8.00 (d, *J* = 8.1 Hz, 1H), 7.92 (t, *J* = 9.4 Hz, 2H), 7.84 – 7.82 (m, 1H), 7.68 (t, *J* = 54.5 Hz, 1H), 7.69 – 7.59 (m, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.91 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.0 (t, *J* = 2.8 Hz), 136.5, 135.1 (t, *J* = 2.4 Hz), 132.5, 130.1, 129.9, 129.6, 129.4, 128.1, 127.6, 122.7, 120.4 (t, *J* = 283.7 Hz). IR (KBr): ν = 2923, 1686, 1260, 1159, 1046, 970, 913, 814, 775, 682 cm^{-1}. HRMS (ESI) for $C_{12}H_8F_2OSeNa$ (M+Na$^+$): Calcd: 308.9601, Found: 308.9604.



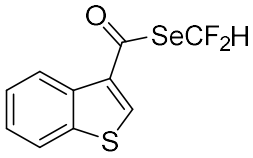
***Se*-(difluoromethyl)-1-bromonaphthalene-2-carboselenoate (3ac)**. Yellow solid (146 mg, 80%). Mp: 66-67 °C. Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.45 (d, *J* = 8.3 Hz, 1H), 7.91 (d, *J* = 8.5 Hz, 1H), 7.88 (d, *J* = 7.8 Hz, 1H), 7.66 (t, *J* = 53.3 Hz, 1H), 7.72 – 7.64 (m, 2H), 7.56 (d, *J* = 8.5 Hz, 1H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.32 (d, *J* = 53.4 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 192.7 (t, *J* = 2.9 Hz), 137.8 (t, *J* = 2.5 Hz), 135.6, 132.3, 129.1, 129.0 (2C), 128.8, 128.5, 123.6, 120.3 (t, *J* = 285.3 Hz), 119.8. IR (KBr): ν = 2922, 1717, 1456, 1258, 1193, 1071, 996, 928, 766, 689 cm^{-1}. HRMS (ESI) for $C_{12}H_7BrF_2OSeNa$ (M+Na$^+$): Calcd: 386.8706, Found: 386.8711.



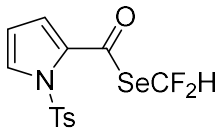
***Se*-(difluoromethyl)-1-tosyl-1H-indole-3-carboselenoate (3ad)**. Yellow solid (176 mg, 82%). Mp: 126-127 °C. Eluant: ethyl acetate/petroleum ether (1:60, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (s, 1H), 8.08 (d, *J* = 7.5 Hz, 1H), 7.94 (d, *J* = 8.3 Hz, 1H), 7.85 (d, *J* = 8.3 Hz, 2H), 7.67 (t, *J* = 53.5 Hz, 1H), 7.38 (dt, *J* = 20.4, 7.4 Hz, 2H), 7.30 (d, *J* = 8.0 Hz, 2H), 2.37 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.26 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 182.0 (t, *J* = 2.9 Hz), 146.6, 134.9, 134.2, 132.9, 130.5 (2C), 127.5 (2C), 126.6, 126.0, 125.5, 122.4 (t, *J* = 2.8 Hz), 122.2, 120.1 (t, *J* = 284.2 Hz), 113.5, 21.8. IR (KBr): ν = 2925, 1683, 1531, 1446, 1380, 1293, 1176, 1066, 964, 806, 749, 717, 689, 661 cm^{-1}. HRMS (ESI) for $C_{17}H_{13}F_2NO_3SSeNa$ ($M+Na^+$): Calcd: 451.9642, Found: 451.9637.



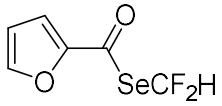
***Se*-(difluoromethyl)-benzofuran-3-carboselenoate (3ae)**. Yellow solid(105 mg, 76%).Mp: 51-52 °C. Eluant: ethyl acetate/petroleum ether (1:60, R_f = 0.30).^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (s, 1H), 8.04 – 8.02 (m, 1H), 7.71 (t, *J* = 53.5 Hz, 1H), 7.56 – 7.54 (m, 1H), 7.44 – 7.38 (m, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.28 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 181.4 (t, *J* = 2.8 Hz), 155.9, 151.9, 126.7, 125.3, 124.2 (t, *J* = 2.8 Hz), 122.7, 122.1, 119.7 (t, *J* = 284.5 Hz), 112.1. IR (KBr): ν = 2925, 1687, 1543, 1478, 1450, 1352, 1265, 1151, 1124, 1055, 853, 806, 746, 688, 643 cm^{-1}. HRMS (ESI) for $C_{10}H_6F_2O_2SeNa$ ($M+Na^+$): Calcd: 298.9393, Found: 298.9392.



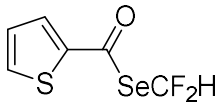
***Se*-(difluoromethyl)-benzo[b]thiophene-3-carboselenoate (3af)**. Yellow solid (110 mg, 75%). Mp: 40-41 °C. Eluant: ethyl acetate/petroleum ether (1:80, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.45 (d, *J* = 8.2 Hz, 1H), 8.29 (s, 1H), 7.84 (d, *J* = 7.8 Hz, 1H), 7.66 (t, *J* = 53.5 Hz, 1H), 7.52 – 7.42 (m, 2H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.59 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 182.9 (t, *J* = 3.0 Hz), 140.1, 139.0, 135.8 (t, *J* = 2.7 Hz), 134.7, 126.6, 126.4, 124.6, 122.7, 120.4 (t, *J* = 283.9 Hz). IR (KBr): ν = 2922, 1683, 1490, 1458, 1424, 1377, 1268, 1062, 1044, 873, 789, 756, 730, 685 cm^{-1}. HRMS (ESI) for $C_{10}H_6F_2OSSeNa$ ($M+Na^+$): Calcd: 314.9165, Found: 314.9168.



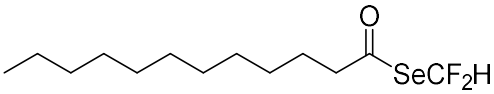
***Se*-(difluoromethyl)-1-tosyl-1H-pyrrole-2-carboselenoate (3ag)**. Yellow solid (150 mg, 79%). Mp: 107-108 °C. Eluant: ethyl acetate/petroleum ether (1:60, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.89 (d, *J* = 8.4 Hz, 2H), 7.86 (dd, *J* = 3.0, 1.7 Hz, 1H), 7.47 (t, *J* = 53.4 Hz, 1H), 7.34 (d, *J* = 7.6 Hz, 2H), 7.16 (dd, *J* = 3.9, 1.6 Hz, 1H), 6.38 (t, *J* = 3.5 Hz, 1H), 2.44 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.86 (d, *J* = 53.4 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.3 (t, *J* = 3.4 Hz), 145.9, 134.9, 131.5, 131.0 (t, *J* = 3.8 Hz), 129.8 (2C), 128.6 (2C), 126.1, 120.3 (t, *J* = 283.6 Hz), 111.3, 21.9. IR (KBr): ν = 2922, 1702, 1422, 1402, 1375, 1247, 1193, 1174, 1141, 1062, 1016, 813, 751, 691, 667 cm^{-1}. HRMS (ESI) for $C_{13}H_{11}F_2NO_3SSeNa$ ($M+Na^+$): Calcd: 401.9485, Found: 401.9484.



***Se*-(difluoromethyl)-furan-2-carboselenoate (3ah)**. Yellow gum (81 mg, 71%). Eluant: ethyl acetate/petroleum ether (1:60, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (s, 1H), 7.62 (t, *J* = 53.4 Hz, 1H), 7.25 (d, *J* = 3.3 Hz, 1H), 6.64 – 6.62 (m, 1H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.48 (d, *J* = 53.4 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 178.2 (t, *J* = 3.3 Hz), 151.0, 147.8, 119.5 (t, *J* = 283.3 Hz), 116.7, 113.5. IR (KBr): ν = 2920, 2851, 1688, 1563, 1461, 1253, 1073, 1014, 814, 763, 691 cm^{-1}. HRMS (ESI) for $C_6H_4F_2O_2SeNa$ ($M+Na^+$): Calcd: 248.9237, Found: 248.9238.

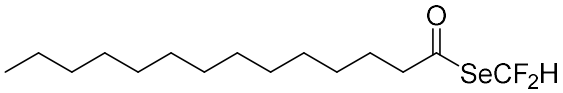


***Se*-(difluoromethyl)-thiophene-2-carboselenoate (3ai)**. Yellow gum (84 mg, 69%). Eluant: ethyl acetate/petroleum ether (1:80, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, *J* = 4.4 Hz, 1H), 7.75 (d, *J* = 3.8 Hz, 1H), 7.63 (t, *J* = 53.4 Hz, 1H), 7.18 (t, *J* = 4.4 Hz, 1H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.20 (d, *J* = 53.4 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 180.8 (t, *J* = 3.1 Hz), 142.3 (t, *J* = 3.3 Hz), 135.4, 133.3, 128.4, 120.1 (t, *J* = 284.4 Hz). IR (KBr): ν = 2924, 1669, 1511, 1407, 1351, 1270, 1233, 1198, 1045, 867, 844, 772, 723, 691, 670, 633 cm^{-1}. HRMS (ESI) for $C_6H_4F_2OSSeNa$ ($M+Na^+$): Calcd: 264.9008, Found: 264.9007.

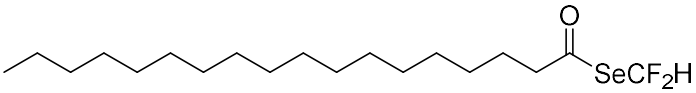


***Se*-(difluoromethyl)-dodecaneselenoate (3ba)**. Yellow oil (115 mg, 73%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (t, *J* = 53.5 Hz, 1H), 2.68 (t, *J* = 7.5 Hz, 2H), 1.71 – 1.64 (m, 2H), 1.36 – 1.26 (m, 16H), 0.88 (t, *J* = 6.9 Hz, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.27 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 198.2 (t, *J* = 1.8 Hz), 120.1 (t, *J* = 283.4 Hz), 49.2 (t, *J* = 2.5 Hz), 32.0, 29.70, 29.67, 29.5 (2C), 29.3, 28.8, 25.0, 22.8, 14.2. IR (KBr): ν = 2923, 2854, 1729, 1465, 1271, 1062, 722, 688 cm^{-1}. HRMS (ESI)

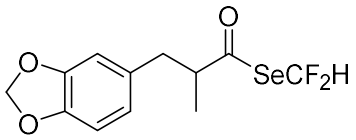
for $C_{13}H_{24}F_2OSeNa$ ($M+Na^+$): Calcd: 337.0853, Found: 337.0856.



***Se*-(difluoromethyl)-tetradecaneselenoate (3bb)**. Yellow oil (130 mg, 76%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (t, *J* = 53.5 Hz, 1H), 2.68 (t, *J* = 7.5 Hz, 2H), 1.71 – 1.64 (m, 2H), 1.36 – 1.26 (m, 20H), 0.88 (t, *J* = 6.8 Hz, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.27 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 198.2 (t, *J* = 2.1 Hz), 120.1 (t, *J* = 283.4 Hz), 49.2 (t, *J* = 2.5 Hz), 32.1, 29.80, 29.78, 29.75, 29.7, 29.49, 29.46, 29.3, 28.8, 25.0, 22.8, 14.3. IR (KBr): ν = 2922, 2853, 1729, 1465, 1271, 1063, 722, 688 cm^{-1}. HRMS (ESI) for $C_{15}H_{28}F_2OSeNa$ ($M+Na^+$): Calcd: 365.1166, Found: 365.1161.

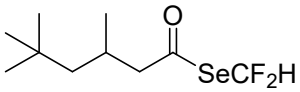


***Se*-(difluoromethyl)-octadecaneselenoate (3bc)**. Yellow gum (162 mg, 81%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (t, *J* = 53.5 Hz, 1H), 2.68 (t, *J* = 7.5 Hz, 2H), 1.71 – 1.64 (m, 2H), 1.36 – 1.26 (m, 28H), 0.88 (t, *J* = 6.8 Hz, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.26 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 198.2 (t, *J* = 1.5 Hz), 120.1 (t, *J* = 283.4 Hz), 49.2 (t, *J* = 2.5 Hz), 32.1, 29.84 (3C), 29.82, 29.81, 29.80, 29.75, 29.7, 29.51, 29.47, 29.3, 28.8, 25.0, 22.8, 14.3.IR (KBr): ν = 2921, 2852, 1730, 1465, 1271, 1064, 721, 688 cm^{-1}. HRMS (ESI) for $C_{19}H_{36}F_2OSeNa$ ($M+Na^+$): Calcd: 421.1792, Found: 421.1781.

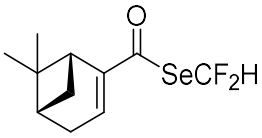


***Se*-(difluoromethyl)-3-(benzo[d][1,3]dioxol-5-yl)-2-methylpropaneselenoate (3bd)**. Yellow gum (118 mg, 73%). Eluant: ethyl acetate/petroleum ether (1:30, R_f = 0.30). ^{1}H NMR (400 MHz,

$CDCl_3$) δ 7.41 (t, *J* = 53.6 Hz, 1H), 6.74 (d, *J* = 7.8 Hz, 1H), 6.63 (s, 1H), 6.60 (d, *J* = 7.9 Hz, 1H), 5.94 (s, 2H), 3.01 (dd, *J* = 13.7, 6.4 Hz, 1H), 2.94 – 2.85 (m, 1H), 2.61 (dd, *J* = 13.6, 7.8 Hz, 1H), 1.19 (d, *J* = 6.9 Hz, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.19 (dd, *J* = 53.5, 30.7 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ202.2 (t, *J* = 1.6 Hz), 148.0, 146.6, 131.6, 122.3, 120.0 (t, *J* = 283.7 Hz), 109.4, 108.5, 101.1, 55.2 (t, *J* = 2.3 Hz), 39.0, 16.4.IR (KBr): ν = 2925, 1719, 1505, 1490, 1444, 1248, 1191, 1070, 1040, 937, 874, 809, 690 cm^{-1}. HRMS (ESI) for $C_{12}H_{12}F_2O_3SeNa$ ($M+Na^+$): Calcd: 344.9812, Found: 344.9810.

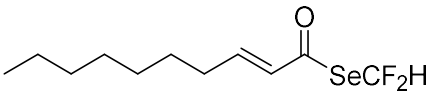


***Se*-(difluoromethyl)-3,5,5-trimethylhexaneselenoate (3be)**. Yellow oil (106 mg, 78%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (t, *J* = 53.5 Hz, 1H), 2.69 (dd, *J* = 15.1, 5.7 Hz, 1H), 2.52 (dd, *J* = 15.1, 8.2 Hz, 1H), 2.17 – 2.06 (m, 1H), 1.26 (dd, *J* = 14.1, 4.2 Hz, 1H), 1.15 (dd, *J* = 14.1, 6.3 Hz, 1H), 1.02 (d, *J* = 6.7 Hz, 3H), 0.91 (s, 9H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.28 (d, *J* = 53.5 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ197.6 (t, *J* = 1.8 Hz), 120.2 (t, *J* = 283.4 Hz), 58.4 (t, *J* = 2.4 Hz), 50.4, 31.2, 30.0 (3C), 27.6, 22.6.IR (KBr): ν = 2956, 1726, 1468, 1366, 1271, 1061, 988, 959, 687 cm^{-1}. HRMS (ESI) for $C_{10}H_{18}F_2OSeNa$ ($M+Na^+$): Calcd: 295.0383, Found: 295.0385.

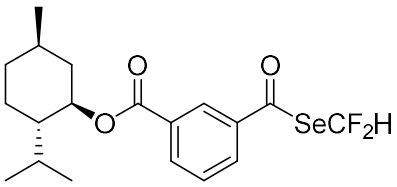


***Se*-(difluoromethyl)-(1R,5S)-6,6-dimethylbicyclo[3.1.1]hept-2-ene-2-carboselenoate(3bf)**. Yellow oil (101 mg, 72%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30).^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 (t, *J* = 53.7 Hz, 1H), 6.80 – 6.78 (m, 1H), 2.79 (td, *J* = 5.6, 1.3 Hz, 1H), 2.55 – 2.41 (m, 3H), 2.20 – 2.15 (m, 1H), 1.34 (s, 3H), 1.11 (d, *J* = 9.4 Hz, 1H), 0.78 (s, 3H); ^{19}F NMR

(376 MHz, $CDCl_3$) δ -96.19 (d, *J* = 53.7 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 188.7 (t, *J* = 2.6 Hz), 149.9 (t, *J* = 2.2 Hz), 140.5, 120.5 (t, *J* = 282.7 Hz), 41.8, 40.5, 38.1, 32.8, 31.3, 25.8, 21.0. IR (KBr): ν = 2928, 1682, 1615, 1470, 1418, 1369, 1268, 1205, 1168, 1127, 1041, 916, 806, 723, 689, 621 cm^{-1}. HRMS (ESI) for $C_{11}H_{14}F_2OSeNa$ ($M+Na^+$): Calcd: 303.0070, Found: 303.0074.

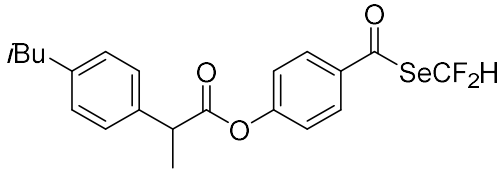


***Se*-(difluoromethyl)-(E)-dec-2-eneselenoate (3bg)**. Yellow oil (98 mg, 69%). Eluant: ethyl acetate/petroleum ether (1:100, R_f = 0.30). ^1H NMR (400 MHz, $CDCl_3$) 7.49 (t, *J* = 53.6 Hz, 1H), 6.93 – 6.86 (m, 1H), 6.08 (d, *J* = 15.4 Hz, 1H), 2.23 (q, *J* = 7.2 Hz, 2H), 1.50 – 1.46 (m, 2H), 1.30 – 1.26 (m, 8H), 0.88 (t, *J* = 6.3 Hz, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -96.07 (d, *J* = 53.6 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 188.5 (t, *J* = 2.5 Hz), 150.7, 130.6 (t, *J* = 2.7 Hz), 120.2 (t, *J* = 283.1 Hz), 32.6, 31.8, 29.2, 29.1, 27.8, 22.7, 14.2. IR (KBr): ν = 2926, 2856, 1694, 1625, 1465, 1269, 1061, 778, 690 cm^{-1}. HRMS (ESI) for $C_{11}H_{18}F_2OSeNa$ ($M+Na^+$): Calcd: 307.0383, Found: 307.0381.

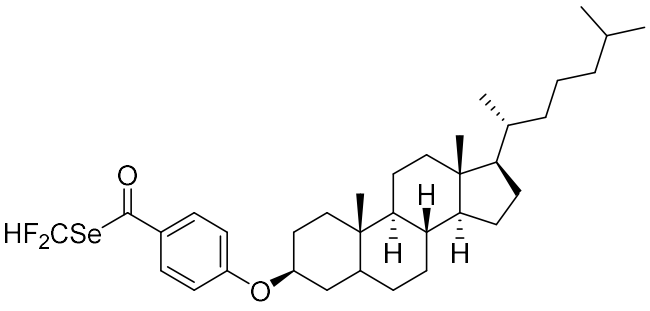


(1R,2S,5R)-2-isopropyl-5-methylcyclohexyl-3-(((difluoromethyl)selanyl)carbonyl)benzoate (3ca). Yellow oil (94 mg, 45%). Eluant: ethyl acetate/petroleum ether (1:60, R_f = 0.30). ^1H NMR (400 MHz, $CDCl_3$) δ 8.44 (s, 1H), 8.32 (d, *J* = 7.7 Hz, 1H), 7.98 (d, *J* = 7.7 Hz, 1H), 7.63 (t, *J* = 53.5 Hz, 1H), 7.60 (t, *J* = 7.8 Hz, 1H), 4.97 (td, *J* = 10.7, 4.0 Hz, 1H), 2.12 (d, *J* = 11.8 Hz, 1H), 1.95 – 1.89 (m, 1H), 1.75 (d, *J* = 11.9 Hz, 2H), 1.57 (s, 2H), 1.18 – 1.09 (m, 2H), 0.95 – 0.92 (m, 7H), 0.80 (d, *J* = 6.9 Hz, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.78 (d, *J* = 53.7 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ190.8 (t, *J* = 2.9 Hz), 164.7, 138.2 (t, *J* = 2.5 Hz), 135.6, 132.3, 131.3,

129.6, 128.8, 120.1 (t, J = 284.4 Hz), 76.0, 47.3, 41.0, 34.4, 31.6, 26.8, 23.8, 22.2, 20.9, 16.7. IR (KBr): ν = 2922, 1721, 1702, 1646, 1600, 1458, 1377, 1298, 1278, 1188, 1074, 951, 932, 884, 845, 757, 687 cm^{-1}. HRMS (ESI) for $C_{19}H_{24}F_2O_3SeNa$ ($M+Na^+$): Calcd: 441.0751, Found: 441.0751.



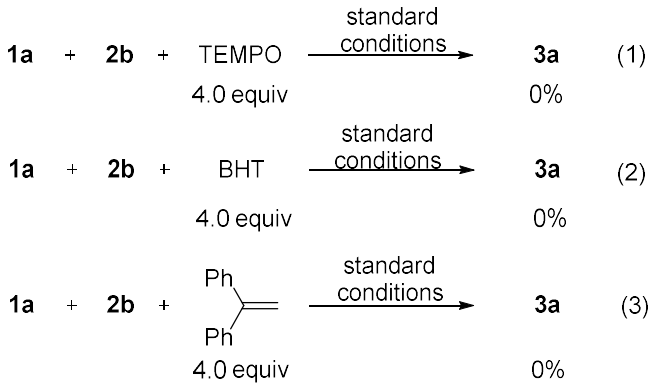
4-(((difluoromethyl)selanyl)carbonyl)phenyl-2-(4-isobutylphenyl)propanoate (3cb). Yellow oil (130 mg, 59%). Eluant: ethyl acetate/petroleum ether (1:60, R_f = 0.30). ^1H NMR (400 MHz, $CDCl_3$) δ 7.82 – 7.78 (m, 2H), 7.60 (t, J = 53.5 Hz, 1H), 7.29 (d, J = 8.1 Hz, 2H), 7.17 (s, 2H), 7.15 (d, J = 1.7 Hz, 2H), 3.96 (q, J = 7.1 Hz, 1H), 2.48 (d, J = 7.2 Hz, 2H), 1.92 – 1.82 (m, 1H), 1.62 (d, J = 7.1 Hz, 3H), 0.91 (d, J = 6.6 Hz, 6H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.80 (d, J = 53.8 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.8 (t, J = 2.9 Hz), 172.5, 156.0, 141.3, 136.8, 135.2 (t, J = 2.5 Hz), 129.8 (2C), 129.2 (2C), 127.3 (2C), 122.5 (2C), 120.2 (t, J = 284.0 Hz), 45.4, 45.2, 30.3, 22.5 (2C), 18.5. IR (KBr): ν = 2955, 1762, 1696, 1598, 1500, 1463, 1205, 1163, 1132, 1068, 883, 847, 690, 620 cm^{-1}. HRMS (ESI) for $C_{21}H_{22}F_2O_3SeNa$ ($M+Na^+$): Calcd: 463.0594, Found: 463.0615.



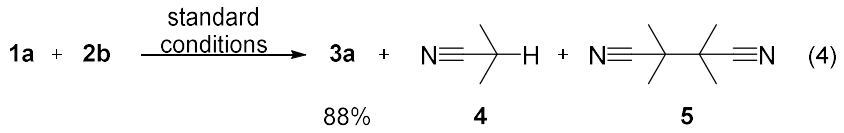
***Se*-(difluoromethyl)-4-(((3S,8R,9S,10S,13R,14S,17R)-10,13-dimethyl-17-((R)-6-meth-ylhepta n-2-yl)hexadecahydro-1H-cyclopenta[a]phenanthren-3-yl)oxy)benzoseleno-ate (3cc)**. Yellow oil (128 mg, 41%). Eluant: ethyl acetate/petroleum ether (1:80, R_f = 0.30). ^1H NMR (400 MHz,

$CDCl_3$) δ 7.75 (d, *J* = 8.8 Hz, 2H), 7.60 (d, *J* = 53.6 Hz, 1H), 6.94 (d, *J* = 8.7 Hz, 2H), 4.65 (s, 1H), 1.99 – 1.48 (m, 12H), 1.35 – 0.83 (m, 31H),0.65 (s, 3H); ^{19}F NMR (376 MHz, $CDCl_3$) δ -95.87 (d, *J* = 53.9 Hz, 2F); ^{13}C NMR (101 MHz, $CDCl_3$) δ188.7 (t, *J* = 2.7 Hz), 163.7, 130.3 (2C), 129.9 (t, *J* = 2.8 Hz), 120.6 (t, *J* = 282.3 Hz), 115.9 (2C), 73.1, 56.7, 56.4, 54.3, 42.7, 40.1, 39.74, 39.66, 36.3, 36.0, 35.9, 35.6, 32.71, 32.66, 32.1, 28.6, 28.4, 28.2, 25.8, 24.3, 24.0, 23.0, 22.7, 21.0, 18.8, 12.2, 11.6. IR (KBr): ν = 2924, 1683, 1597, 1572, 1505, 1458, 1377, 1306, 1263, 1212, 1161, 1069, 879, 837, 690, 622 cm^{-1}. HRMS (ESI) for $C_{35}H_{52}F_2O_2SeNa$ ($M+Na^+$): Calcd: 645.2993, Found: 645.2994.

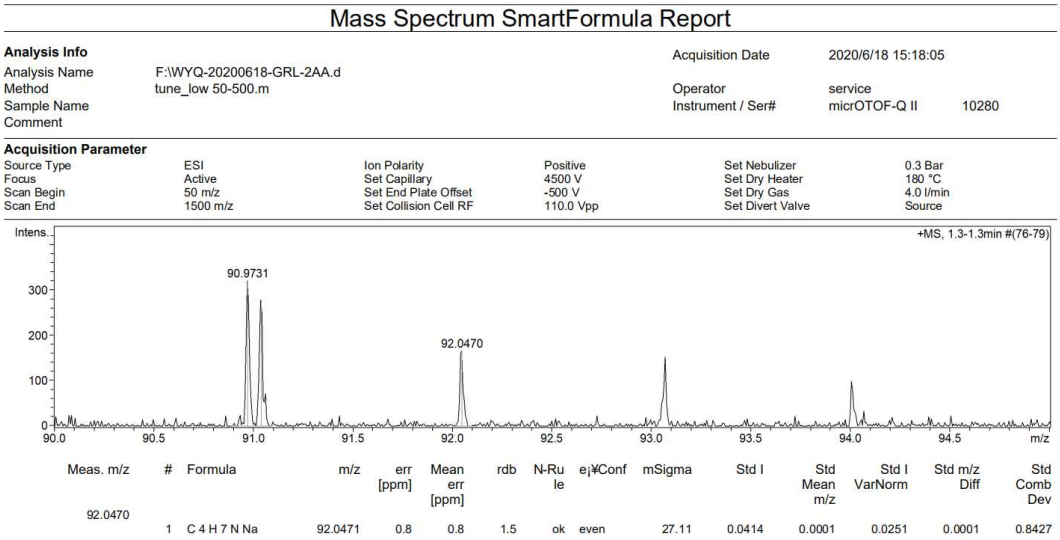
4. Procedures for radical mechanism experiment



A 5 mL round bottomed flask equipped with a stirring bar was charged with **1a** (18 mg, 0.15 mmol, 1.5 equiv), **2b** (22 mg, 0.1 mmol, 1.0 equiv), AIBN (32.8 mg, 0.2 mmol, 2.0 equiv) and DCE (1.0 mL) followed by sequential addition of three radical-trappingreagents, TEMPO (62.5 mg, 0.4 mmol, 4.0 equiv), BHT (88 mg, 0.4 mmol, 4.0 equiv) or 1,1-diphenylethylene (72 mg, 0.4 mmol, 4.0 equiv), respectively. The reaction was allowed to stir at 50 °C under an argon atmosphere. After 24 h, no product **3a**was detected (eq. 1, 2 and 3).



A 5 mL round bottomed flask equipped with a stirring bar was charged with **1a** (18 mg, 0.15 mmol, 1.5 equiv), **2b** (22 mg, 0.1 mmol, 1.0 equiv), AIBN (32.8 mg, 0.2 mmol, 2.0 equiv), and DCE (1.0 mL). The reaction was allowed to stir at 50 ºC under an argon atmosphere. After 24 h, not only **3a** is generated, but isobutyronitrile**4** and 2,2,3,3-tetramethylsuccinonitrile **5**were detected in the reaction mixture by ESI-HRMS analysis (eq. 4). **4**: HRMS (ESI) for C_4H_7NNa ($M+Na^+$): Calcd: 92.0471, Found: 92.0470;**5**: HRMS (ESI) for $C_8H_{13}N_2$ ($M+H^+$): Calcd: 137.1073, Found: 137.1073.



Mass Spectrum SmartFormula Report

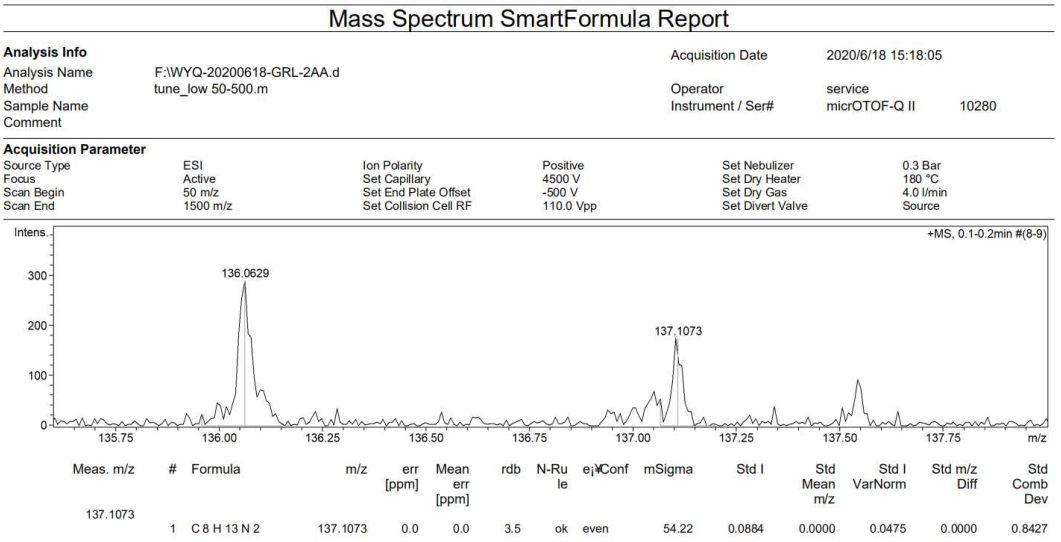
Analysis Info

Analysis Name	F:\WYQ-20200618-GRL-2AA.d	Acquisition Date	2020/6/18 15:18:05
Method	tune_low 50-500.m	Operator	service
Sample Name		Instrument / Ser#	micrOTOF-Q II 10280
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.3 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	180 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	1500 m/z	Set Collision Cell RF	110.0 Vpp	Set Divert Valve	Source

Meas. m/z	#	Formula	m/z	err [ppm]	Mean err [ppm]	rdb	N-Rule	e¡¥Conf	mSigma	Std I	Std Mean m/z	Std I VarNorm	Std m/z Diff	Std Comb Dev
92.0470														
	1	C 4 H 7 N Na	92.0471	0.8	0.8	1.5	ok	even	27.11	0.0414	0.0001	0.0251	0.0001	0.8427



Mass Spectrum SmartFormula Report

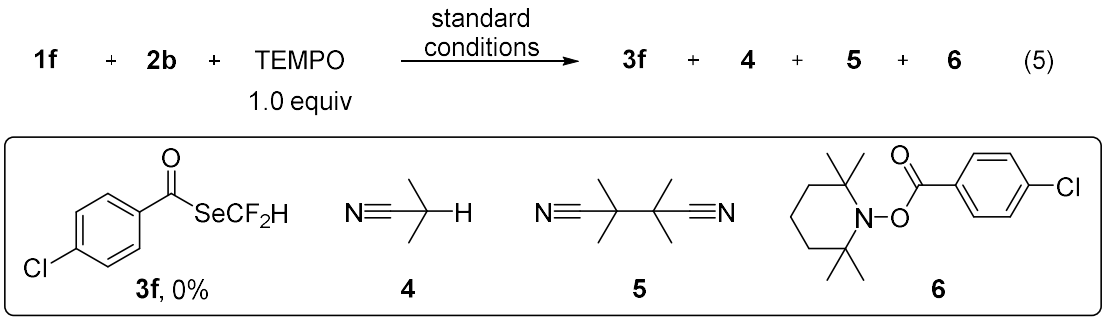
Analysis Info

Analysis Name	F:\WYQ-20200618-GRL-2AA.d	Acquisition Date	2020/6/18 15:18:05
Method	tune_low 50-500.m	Operator	service
Sample Name		Instrument / Ser#	micrOTOF-Q II 10280
Comment			

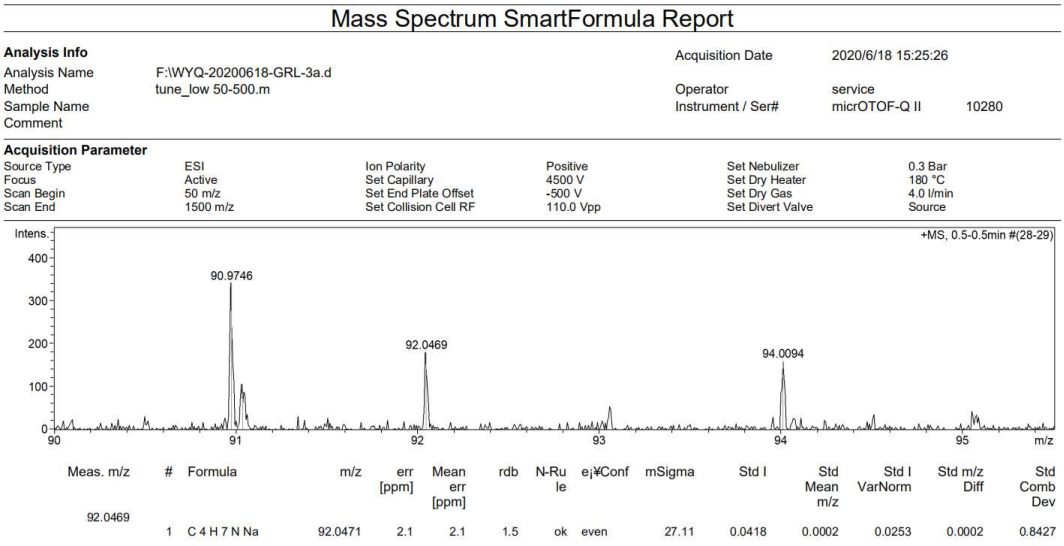
Acquisition Parameter

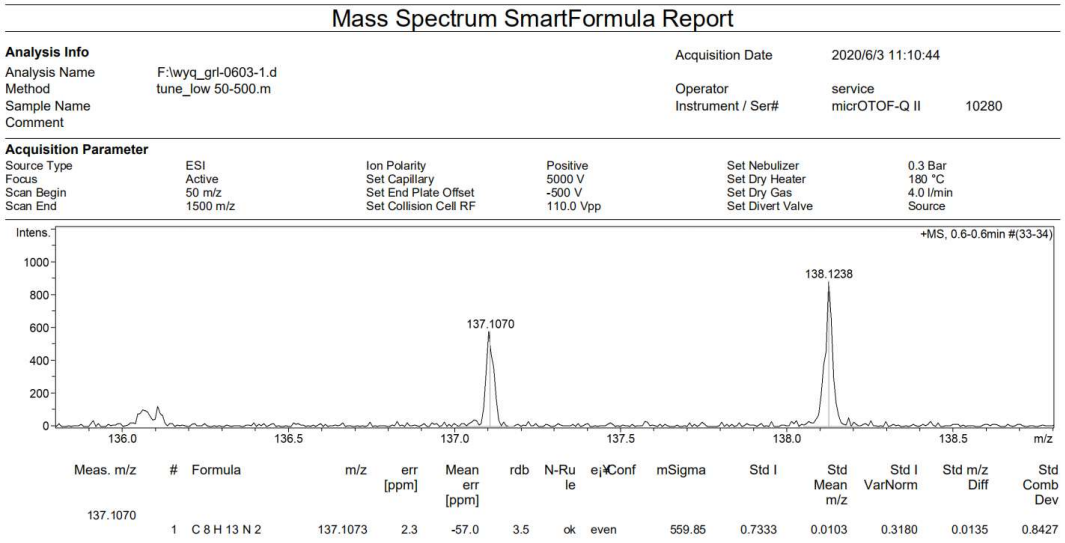
Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.3 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	180 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	1500 m/z	Set Collision Cell RF	110.0 Vpp	Set Divert Valve	Source

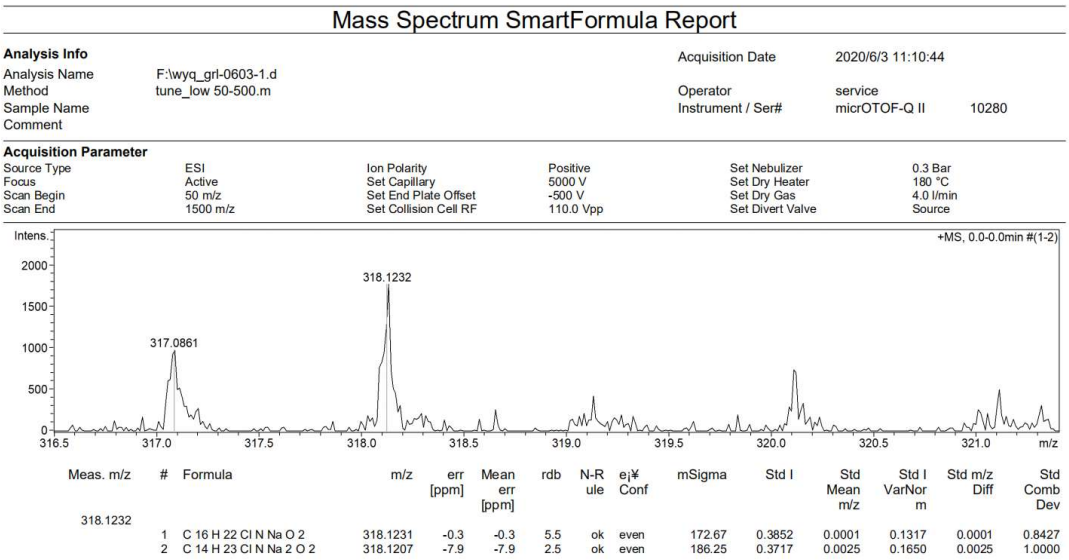
Meas. m/z	#	Formula	m/z	err [ppm]	Mean err [ppm]	rdb	N-Rule	e¡¥Conf	mSigma	Std I	Std Mean m/z	Std I VarNorm	Std m/z Diff	Std Comb Dev
137.1073														
	1	C 8 H 13 N 2	137.1073	0.0	0.0	3.5	ok	even	54.22	0.0884	0.0000	0.0475	0.0000	0.8427

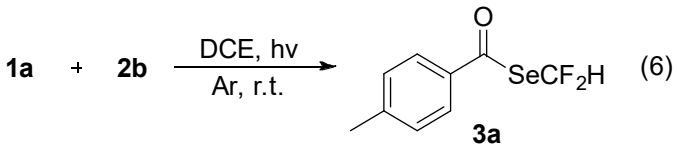


A 5 mL round bottomed flask equipped with a stirring bar was charged with **1f** (21 mg, 0.15 mmol, 1.5 equiv), **2b** (22 mg, 0.1 mmol, 1.0 equiv), AIBN (32.8 mg, 0.2 mmol, 2.0 equiv), TEMPO (15.6 mg, 0.1 mmol, 1.0 equiv), and DCE (1.0 mL). The reaction was allowed to stir at 50 °C under an argon atmosphere. After 24 h, no product **3f**was detected, while the isobutyronitrile**4**, 2,2,3,3-tetramethylsuccinonitrile **5**and 2,2,6,6-tetramethylpiperidin-1-yl 4-chlorobenzoate **6**were detected in the reaction mixture by ESI-HRMS analysis (eq. 5). **4**: HRMS (ESI) for C_4H_7NNa ($M+Na^+$): Calcd: 92.0471, Found: 92.0469;**5**: HRMS (ESI) for $C_8H_{13}N_2$ ($M+H^+$): Calcd: 137.1073, Found: 137.1070; **6**: HRMS (ESI) for $C_{16}H_{22}ClNO_2Na$ ($M+Na^+$): Calcd: 318.1231, Found: 318.1232.









no hv, 12 h: 0%;
23 W white LED bulb, 24 h: 13%;
10 W blue LED bulb, 24 h: 25%

A 5 mL round bottomed flask was charged with **1a** (18 mg, 0.15 mmol, 1.5 equiv), **2b** (22 mg, 0.1 mmol, 1.0 equiv), and DCE (0.5 mL). The reaction was stirred under an argon atmosphere at room temperature. After 12 h, it was found that no product **3a**was detected (eq. 6).

A 5 mL round bottomed flask was charged with **1a** (18 mg, 0.15 mmol, 1.5 equiv), **2b** (22 mg, 0.1 mmol, 1.0 equiv), and DCE (0.5 mL). The reaction was stirred with 23 W white LED bulb irradiation under an argon atmosphere at room temperature. After 24 h, the solvent was evaporated in vacuo. The residue was purified by flash chromatography on silica gel to afford **3a** in 13% yield.

A 5 mL round bottomed flask was charged with **1a** (18 mg, 0.15 mmol, 1.5 equiv), **2b** (22 mg, 0.1 mmol, 1.0 equiv), and DCE (0.5 mL). The reaction was stirred with 10 W blue LED bulb irradiation under an argon atmosphere at room temperature. After 24 h, the solvent was evaporated in vacuo. The residue was purified by flash chromatography on silica gel to afford **3a** in 25% yield.

5. References

(1)Q.Glenadel,E.Ismalaj andT.Billard,*J. Org. Chem.*,2016,**81**,8268.

(2)K.Lu,Q.Li,X.Xi,T.Zhou,X.Zhao,*J. Org. Chem.*, 2020, **85**, 1224.

(3)W.Zi,H.Wu,F. D.Toste,*J. Am. Chem. Soc.*,2015, **137**, 3225.

(4)J.Waser,B.Gaspar,H.Nambu,E. M.Carreira,*J. Am. Chem. Soc.*,2006, **128**, 11693.

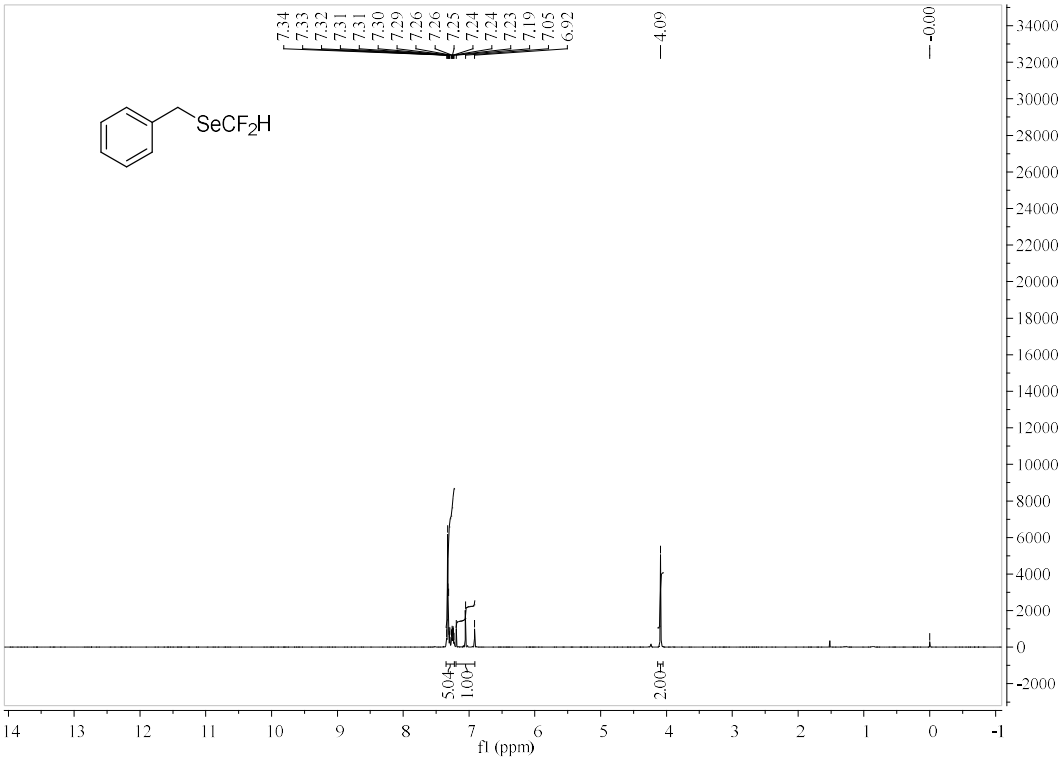
(5)M.Zhang,X. A.Yuan,C.Zhu,J.Xie,*Angew. Chem., Int. Ed.*,2019, **58**, 312.

(6)Y.Zhang,P.Ji,W.Hu,Y.Wei,H.Huang,W.Wang,*Chem.−Eur. J.*, 2019, **25**, 8225.

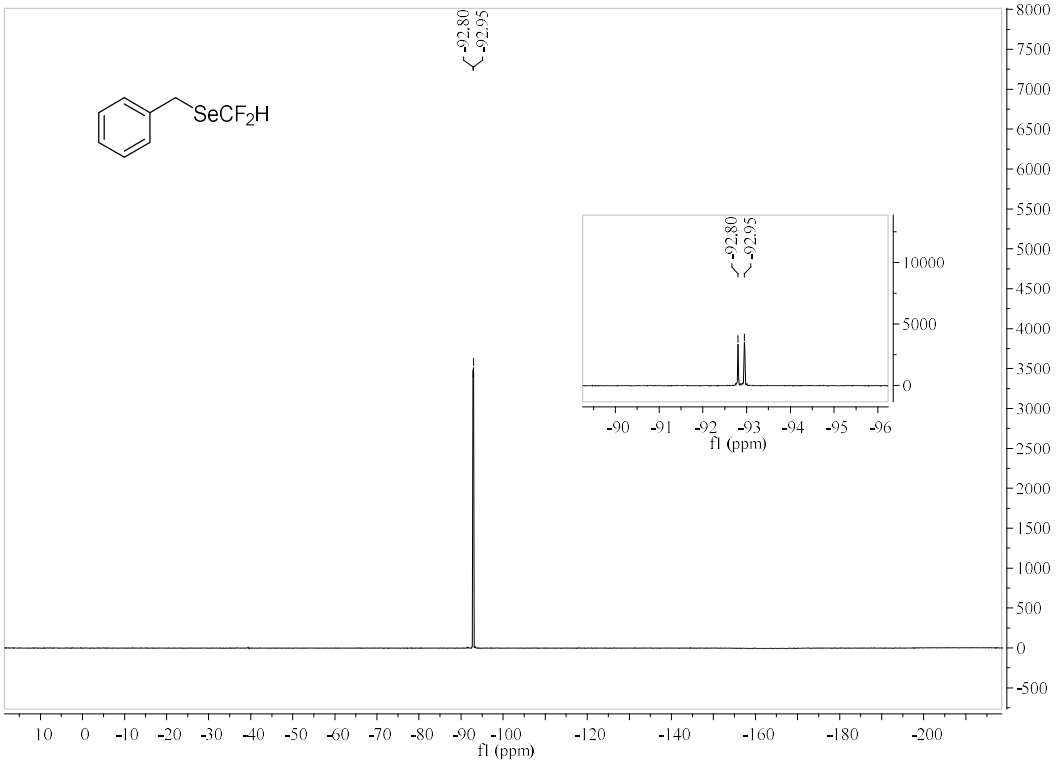
(7)S.Mukherjee,R. A.Garza-Sanchez,A.Tlahuext-Aca,F.Glorius,*Angew. Chem., Int. Ed.*, 2017, **56**, 14723.

6. ^{1}H, ^{19}F, ^{13}C NMR spectra of compounds 2b – 3cc

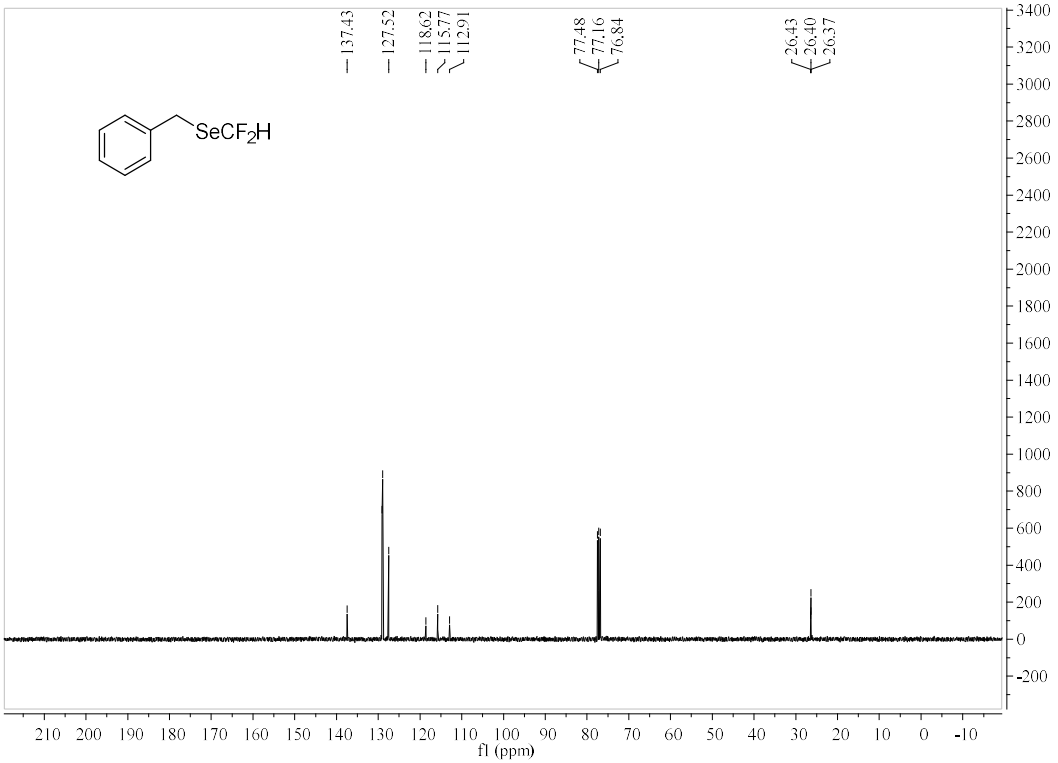
^{1}H NMR spectra of compound **2b**



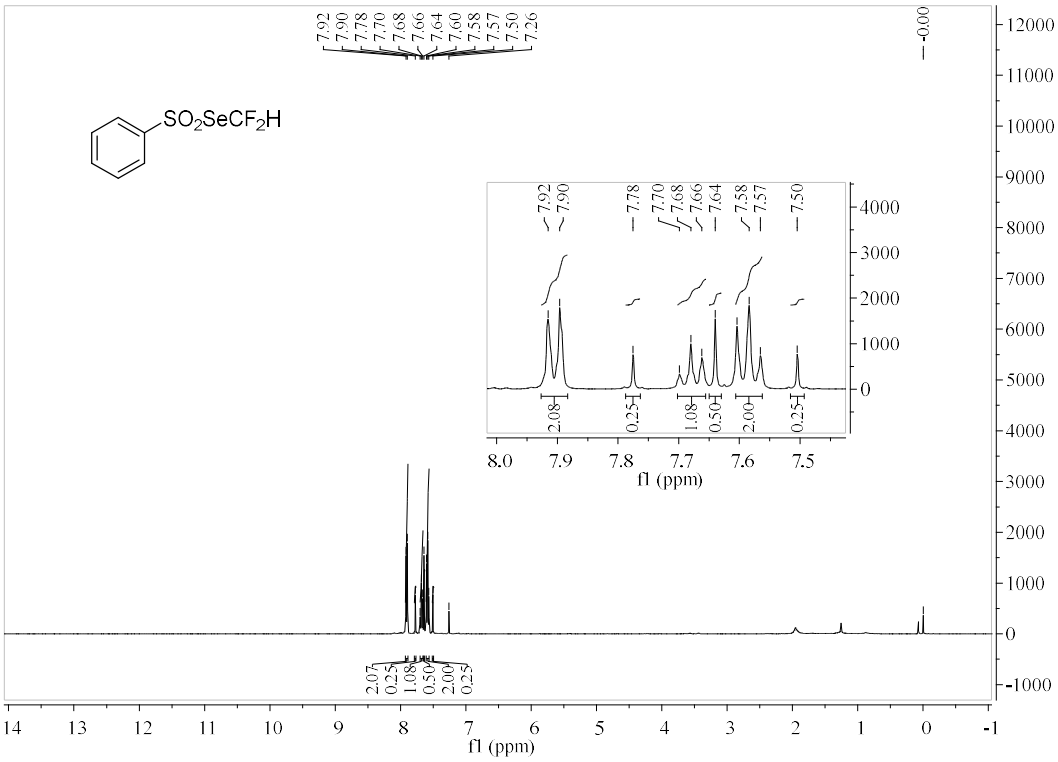
^{19}F NMR spectra of compound **2b**



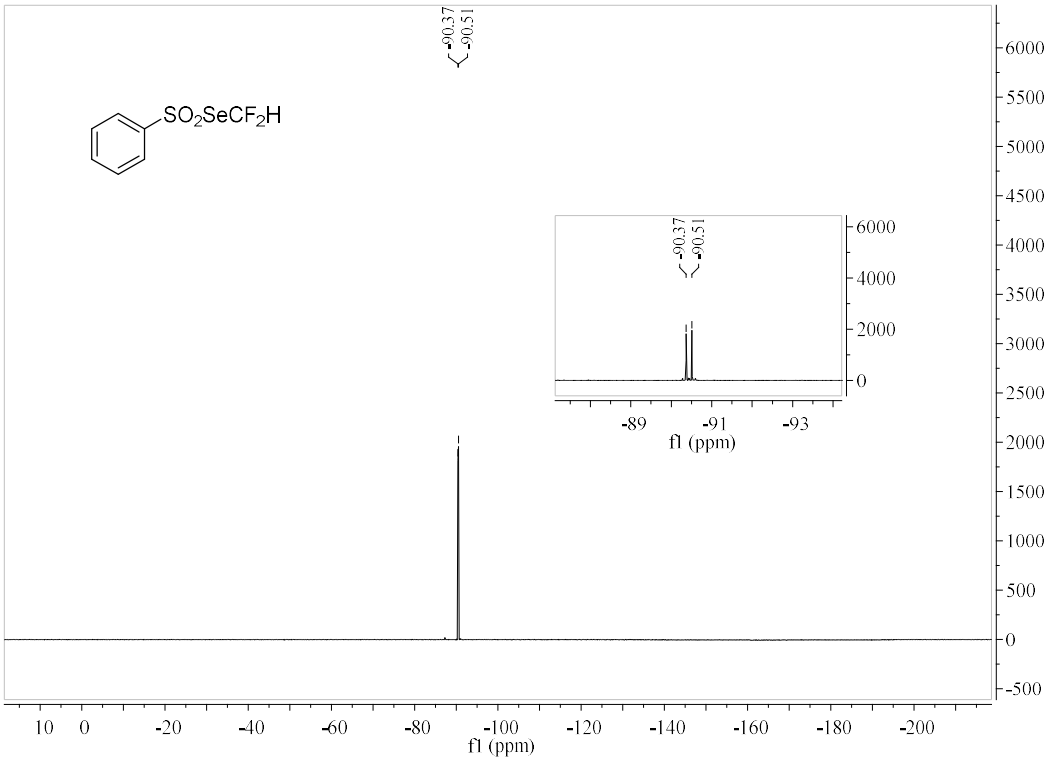
^{13}C NMR spectra of compound **2b**



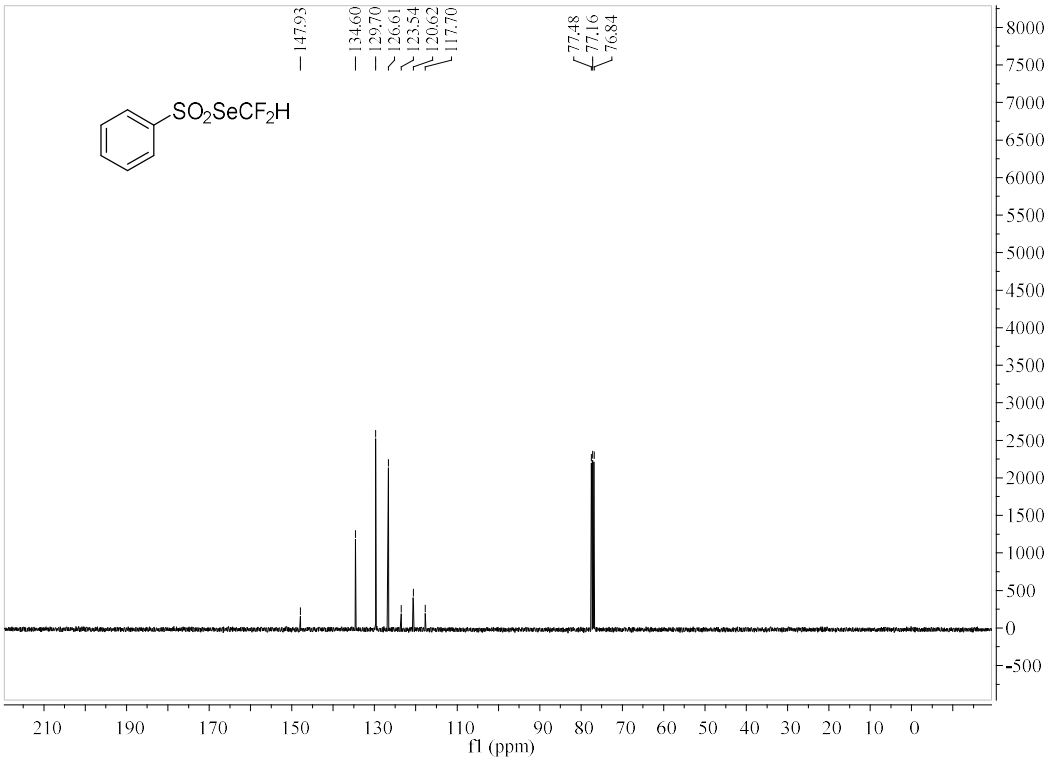
^{1}H NMR spectra of compound **2c**



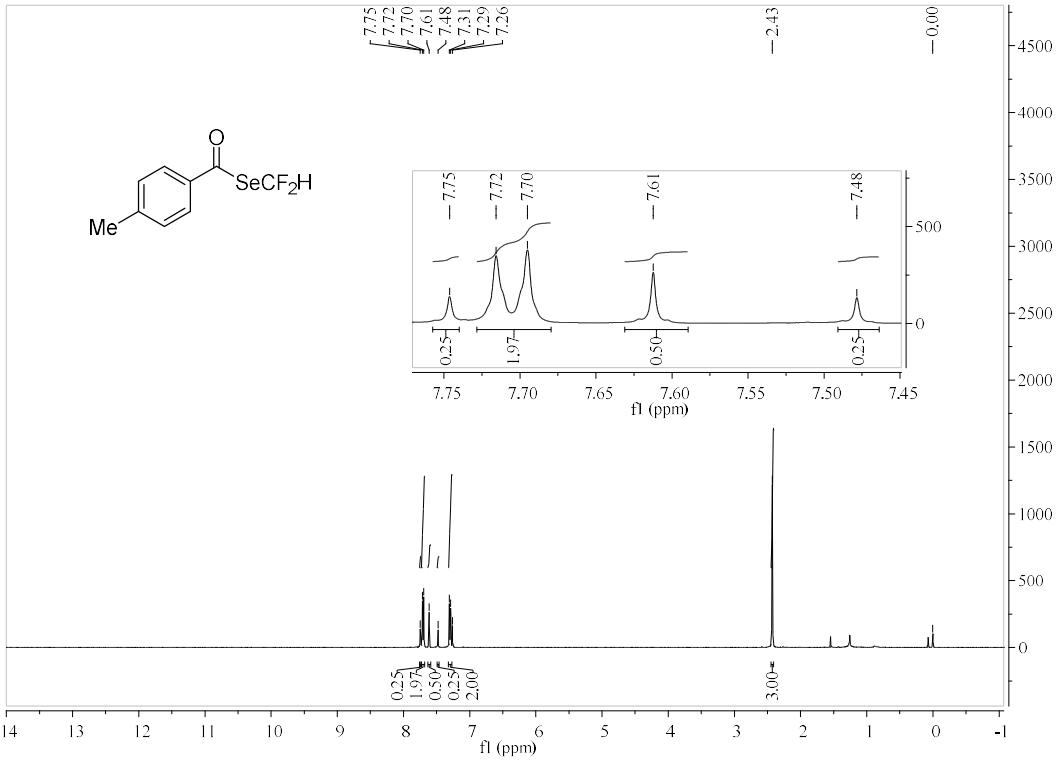
^{19}F NMR spectra of compound **2c**



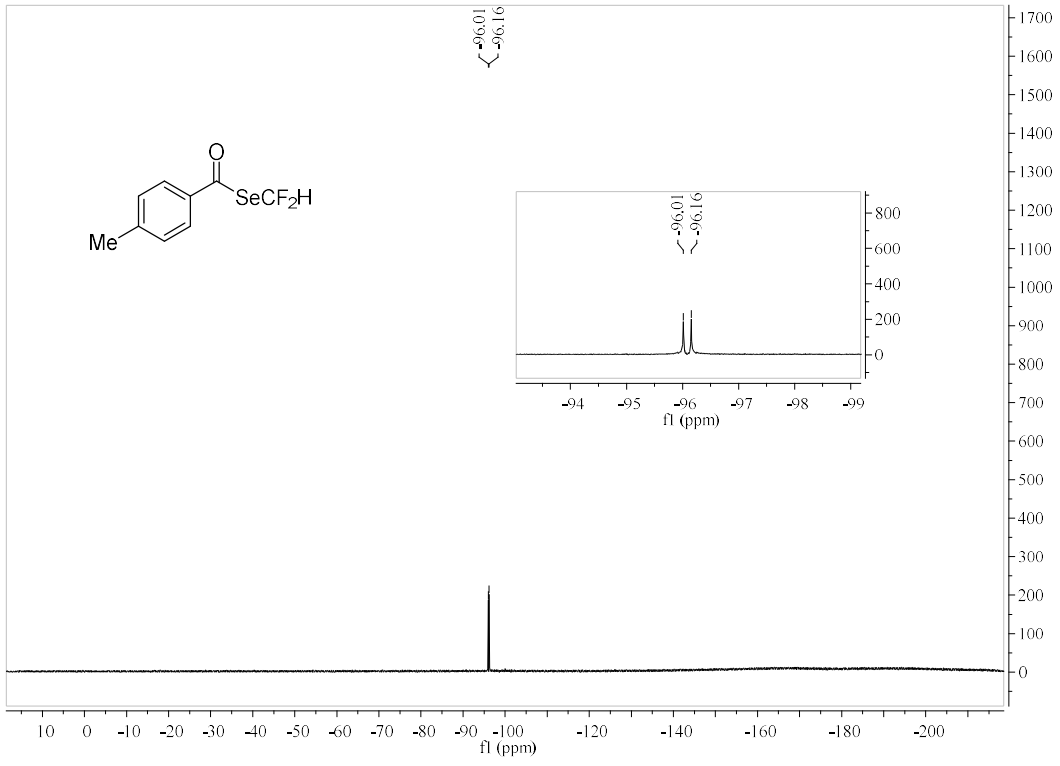
^{13}C NMR spectra of compound **2c**



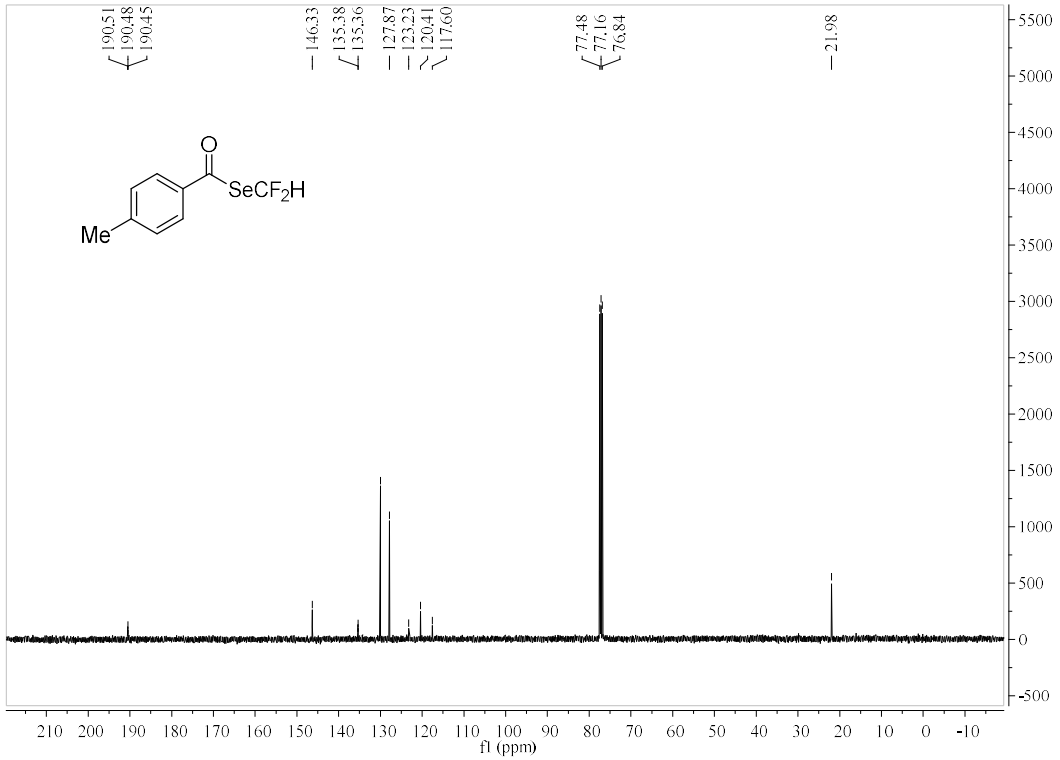
^{1}H NMR spectra of compound **3a**



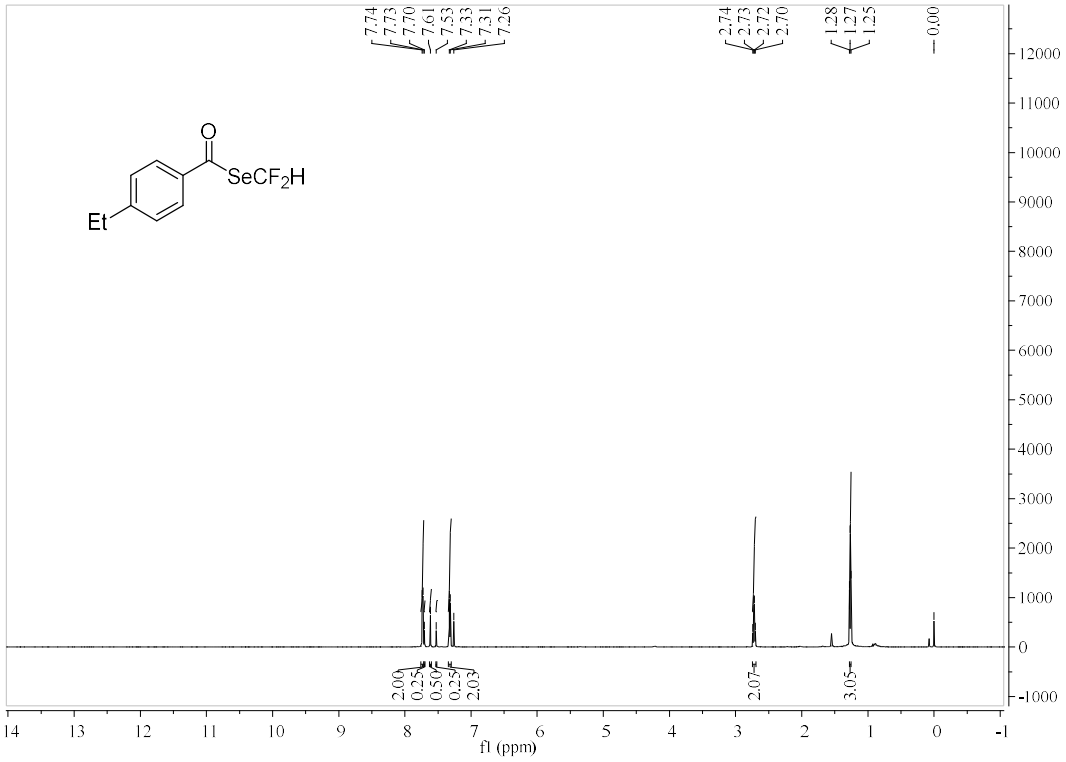
^{19}F NMR spectra of compound **3a**



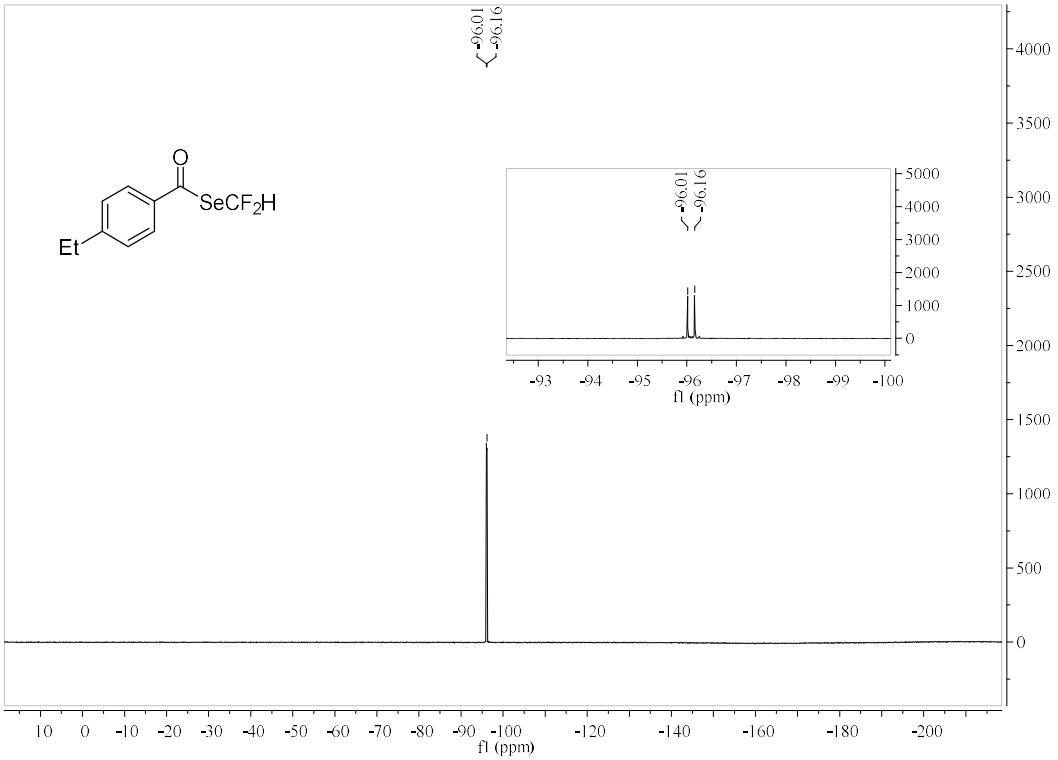
^{13}C NMR spectra of compound **3a**



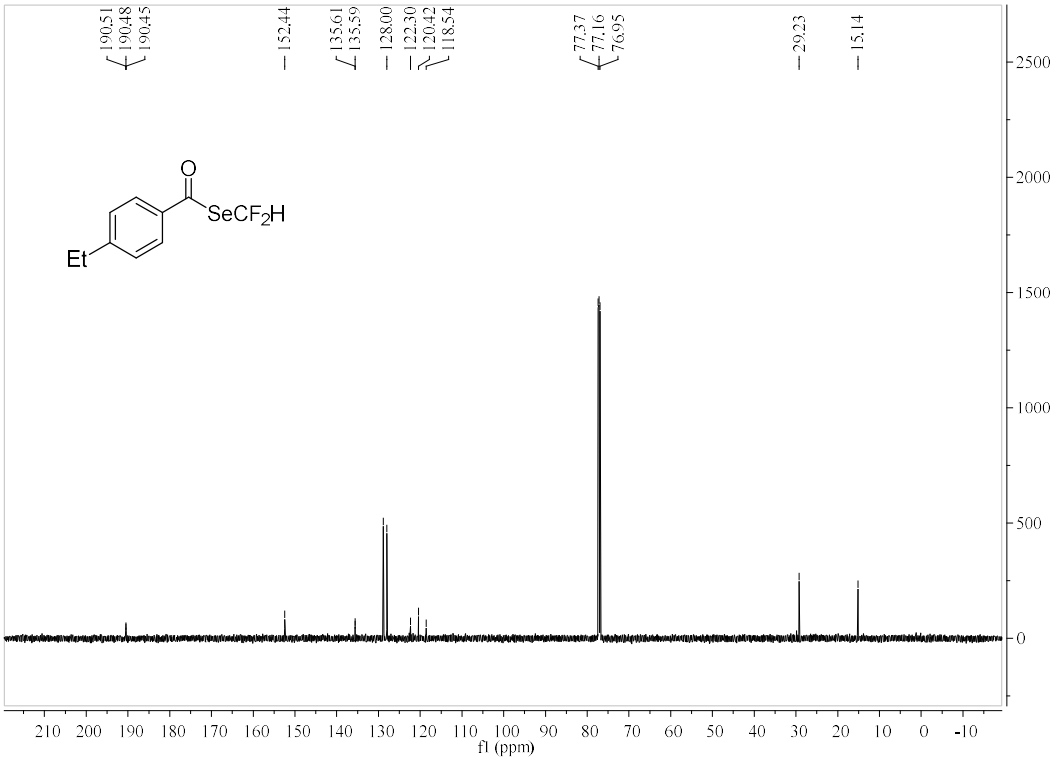
^{1}H NMR spectra of compound **3b**



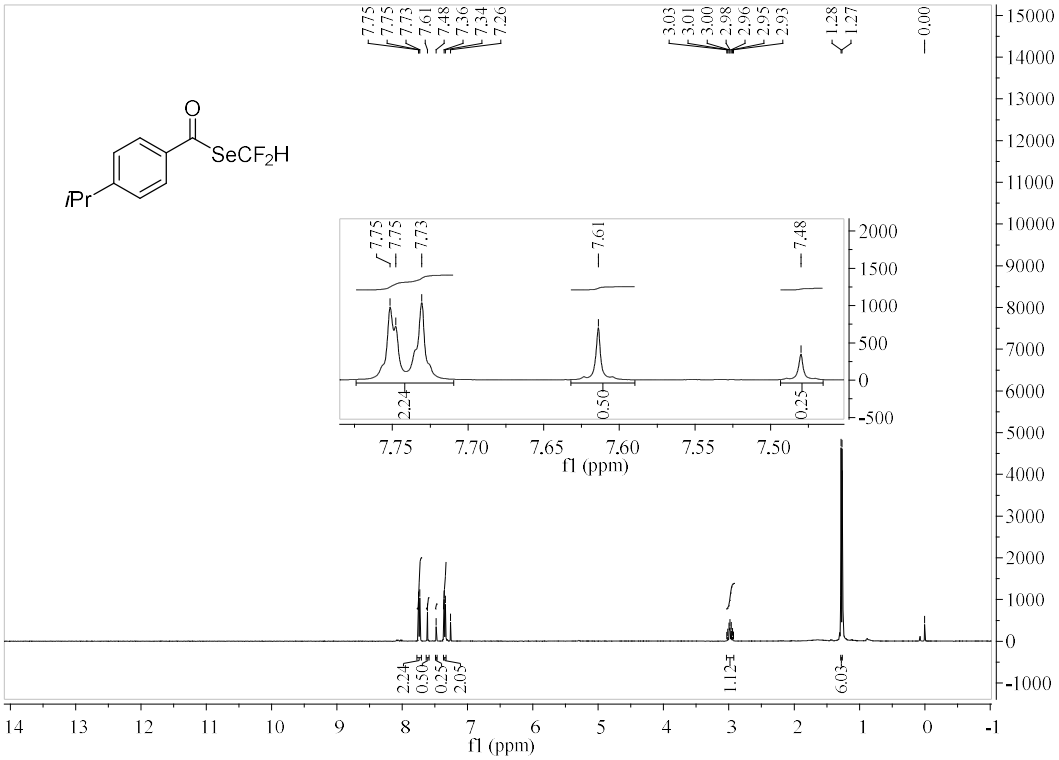
^{19}F NMR spectra of compound **3b**



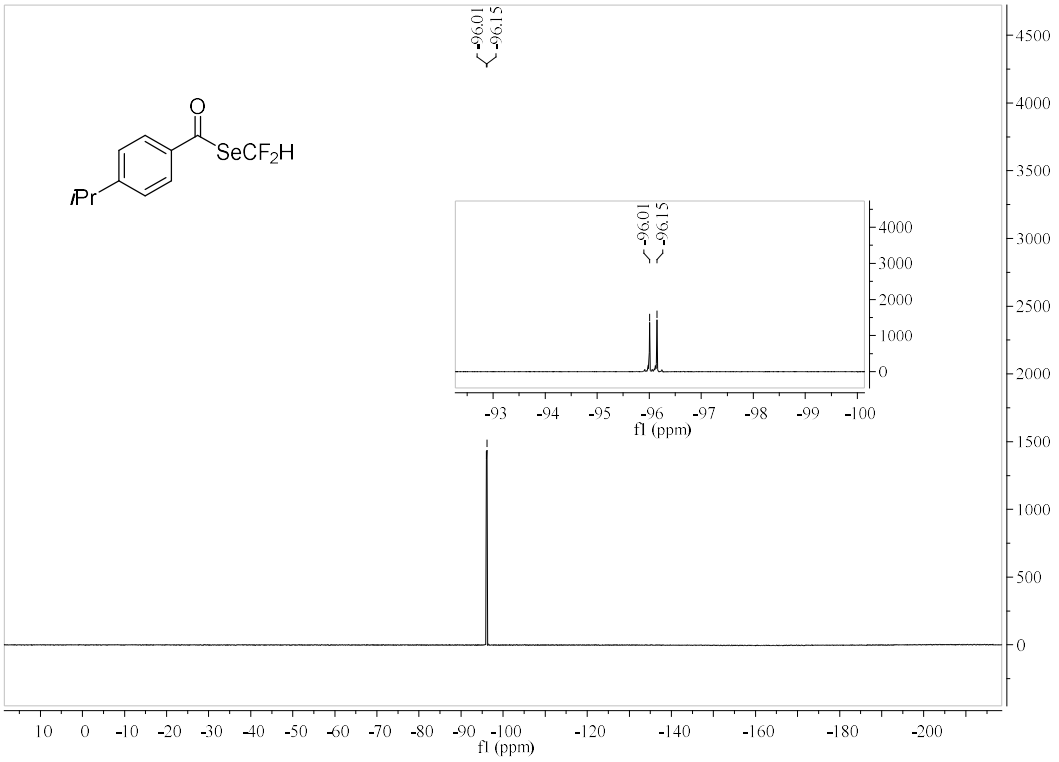
^{13}C NMR spectra of compound **3b**



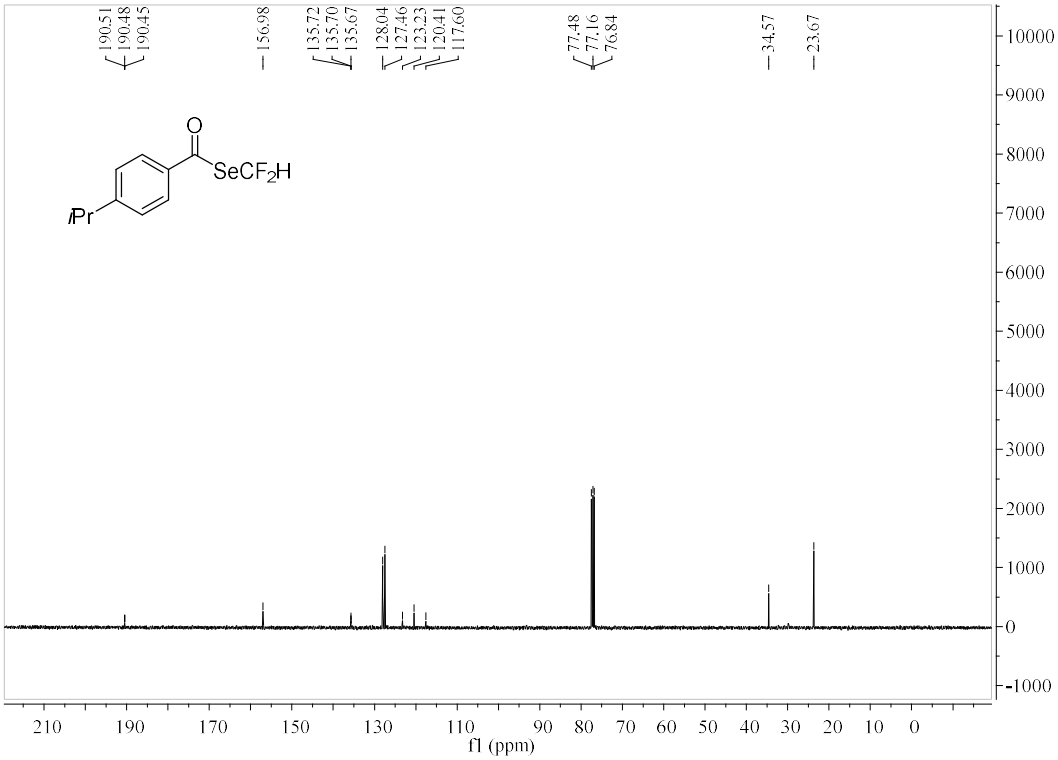
^{1}H NMR spectra of compound **3c**



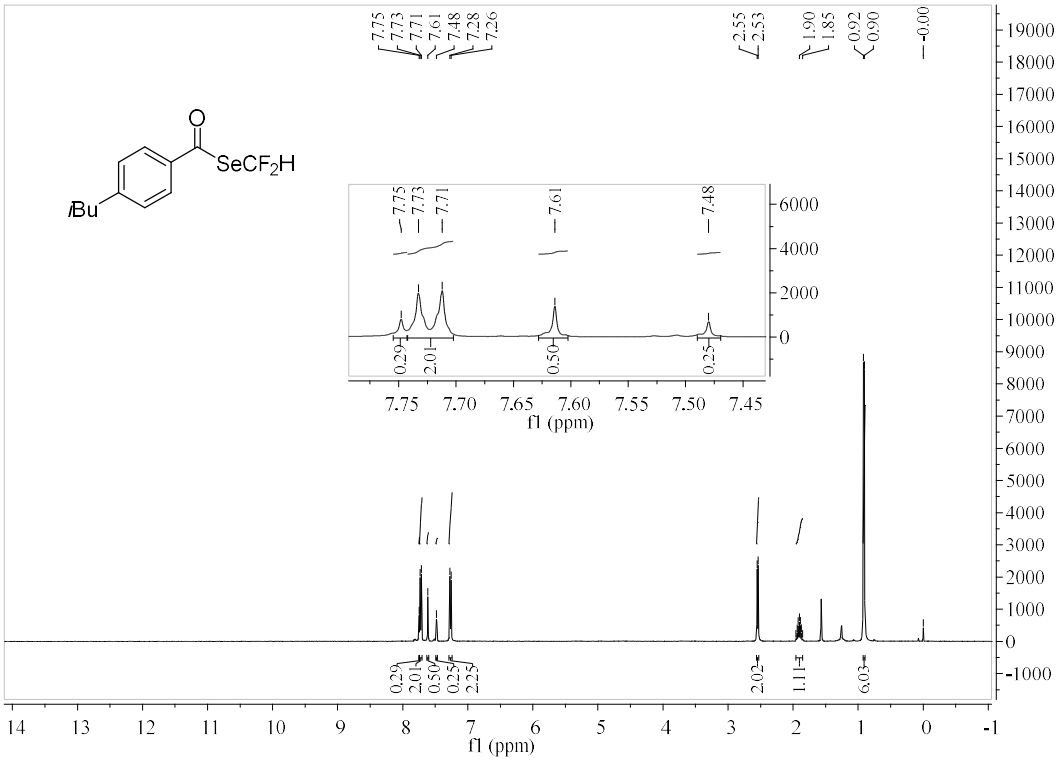
^{19}F NMR spectra of compound **3c**



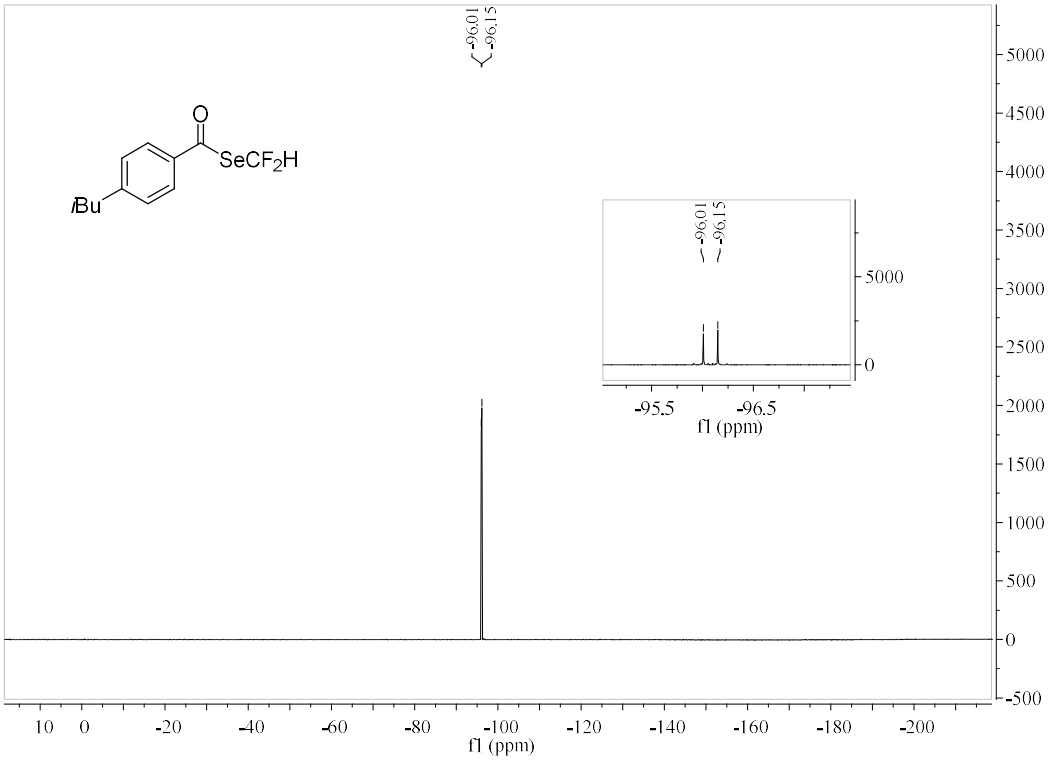
^{13}C NMR spectra of compound **3c**



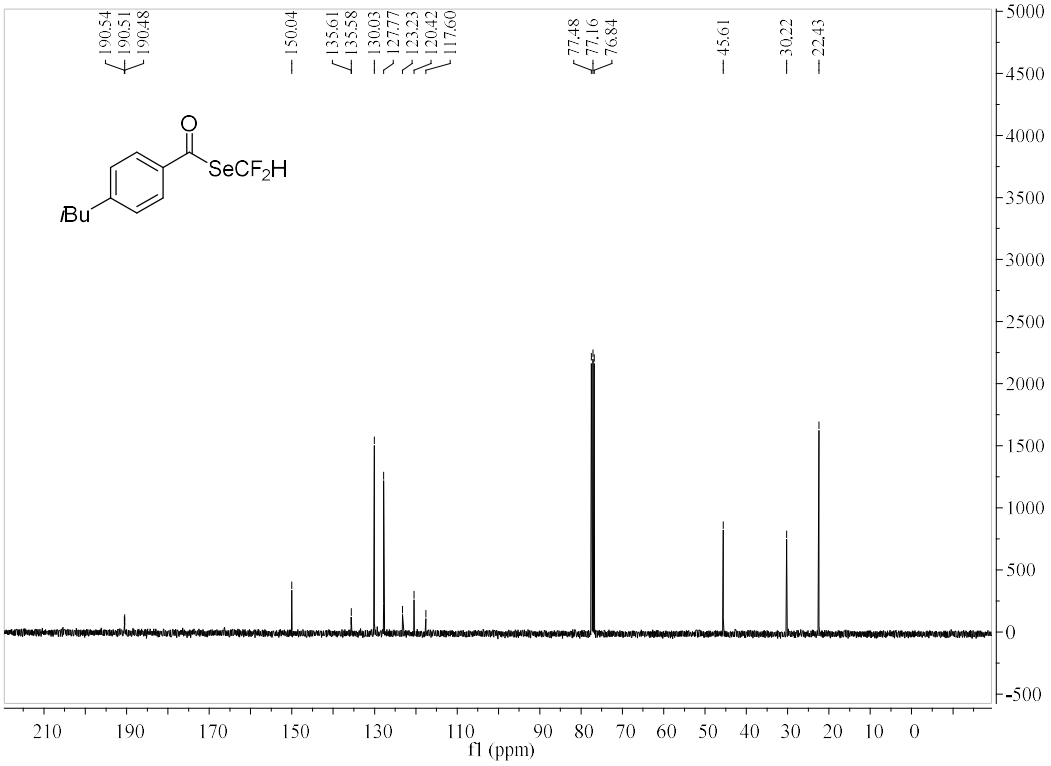
^{1}H NMR spectra of compound **3d**



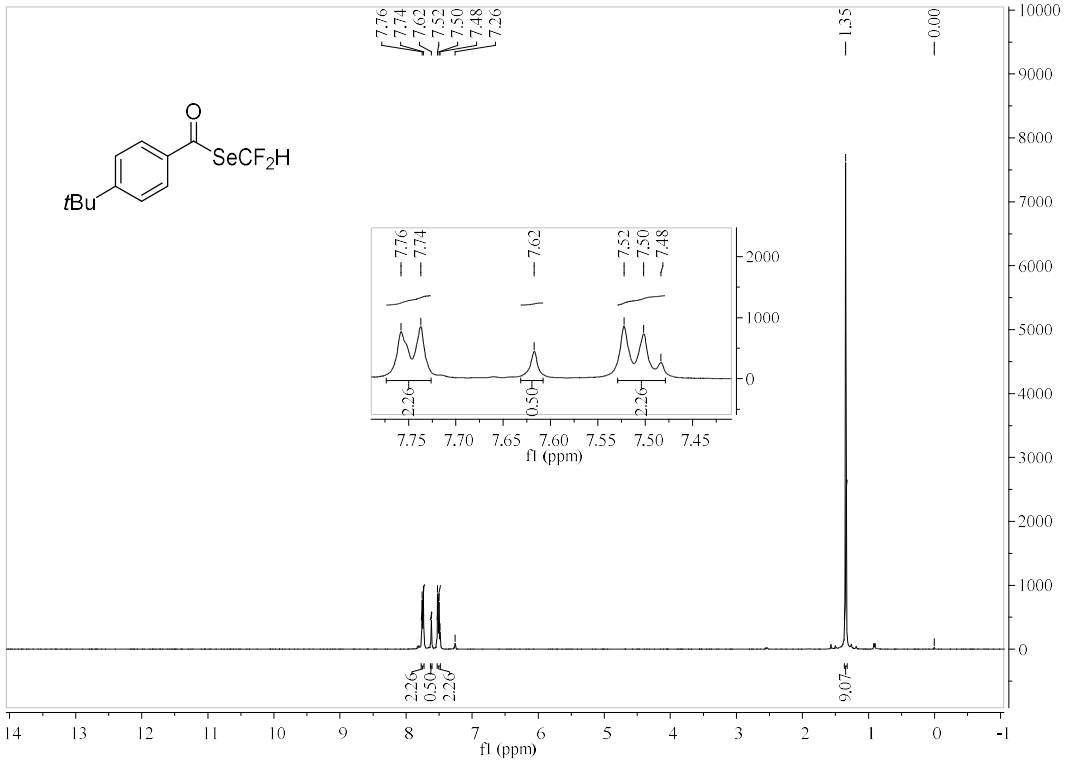
^{19}F NMR spectra of compound **3d**



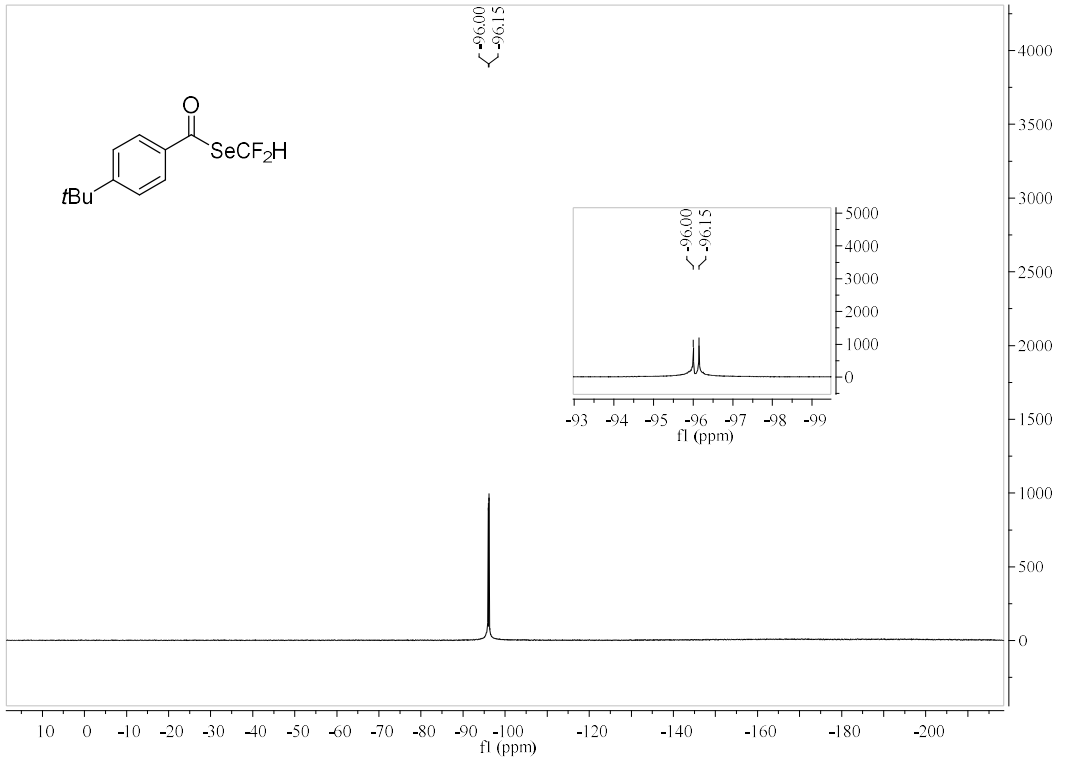
^{13}C NMR spectra of compound **3d**



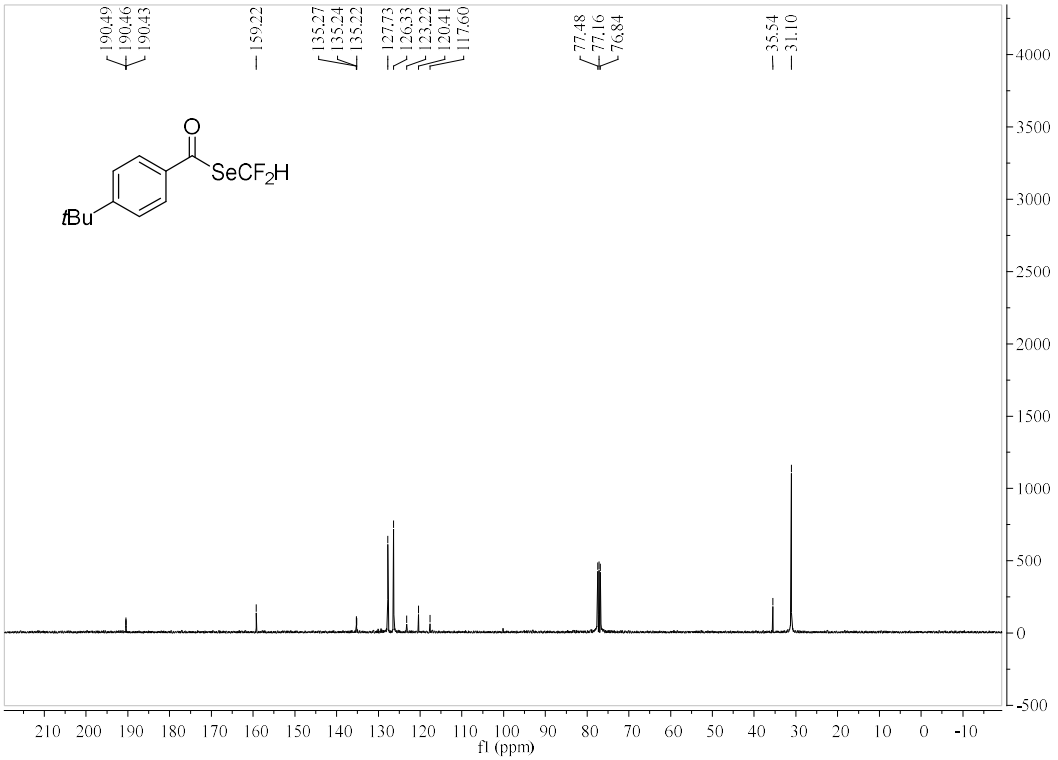
^{1}H NMR spectra of compound **3e**



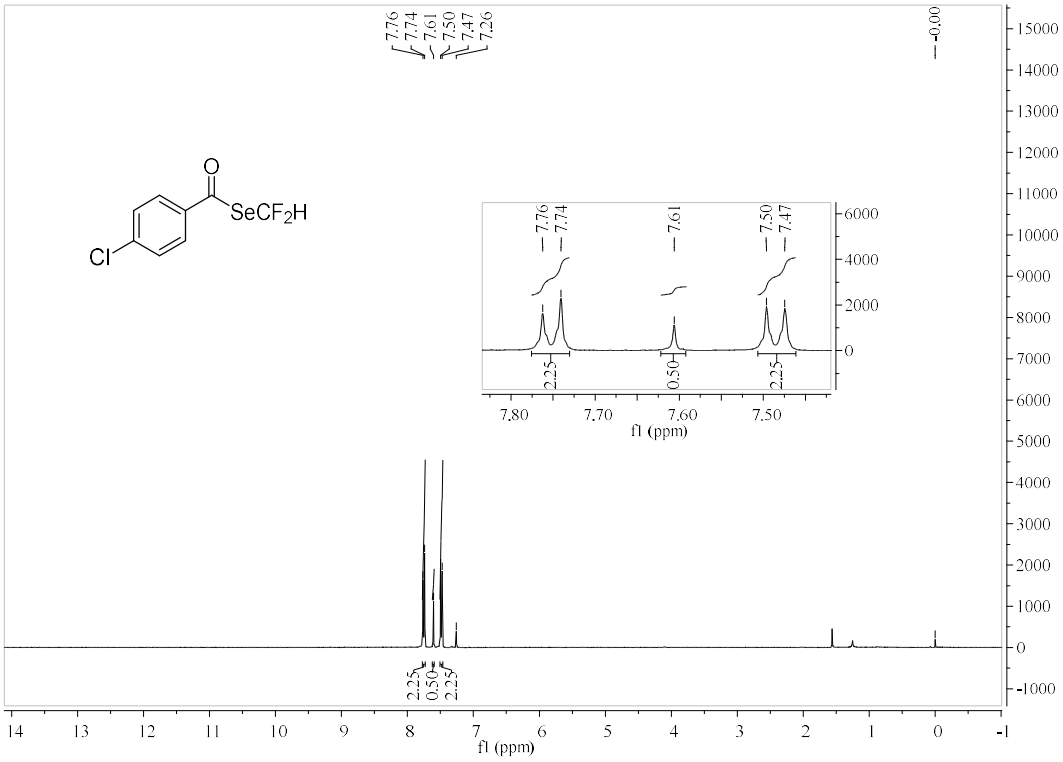
^{19}F NMR spectra of compound **3e**



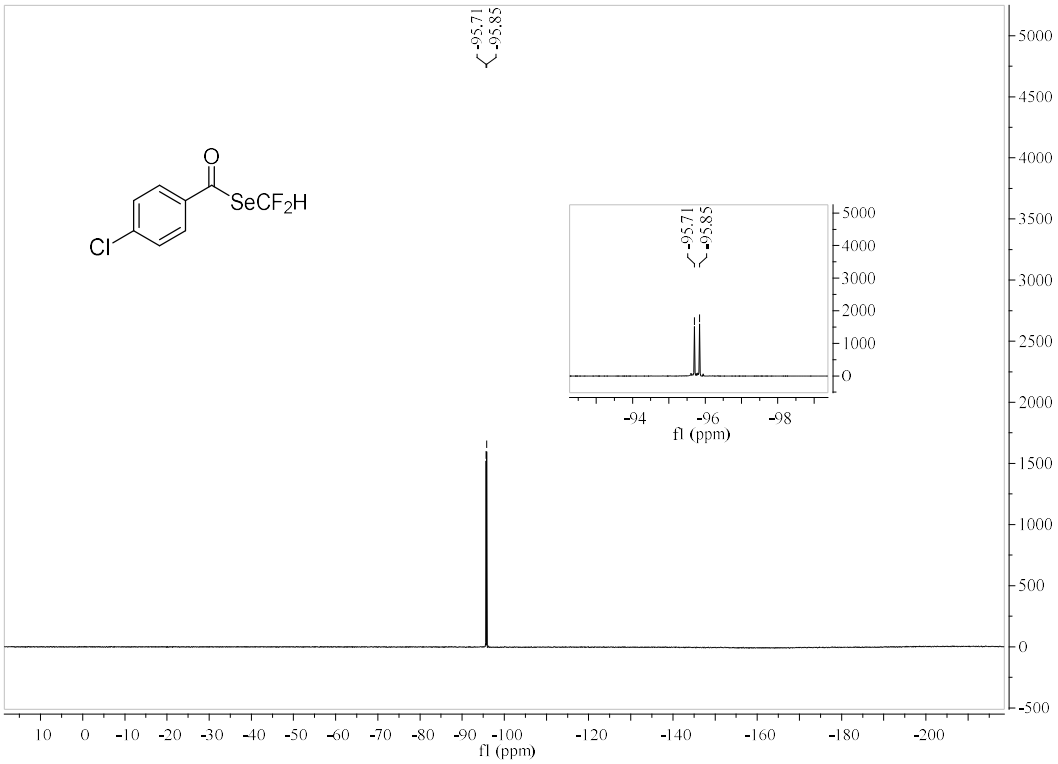
^{13}C NMR spectra of compound **3e**



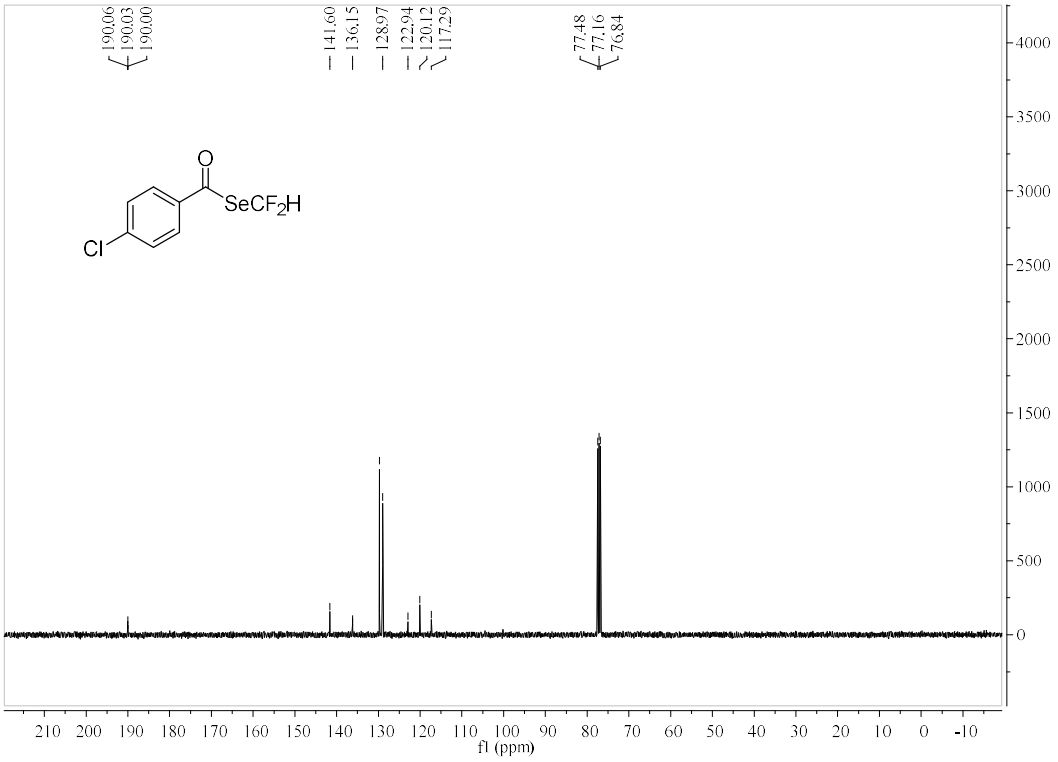
^{1}H NMR spectra of compound **3f**



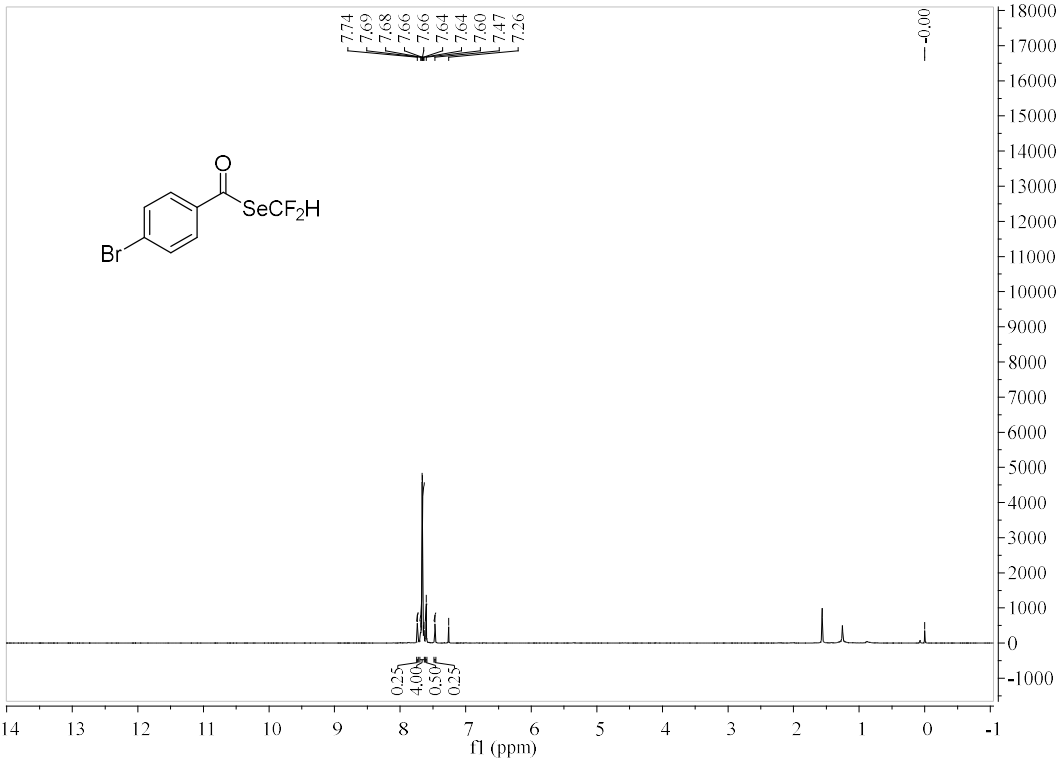
^{19}F NMR spectra of compound **3f**



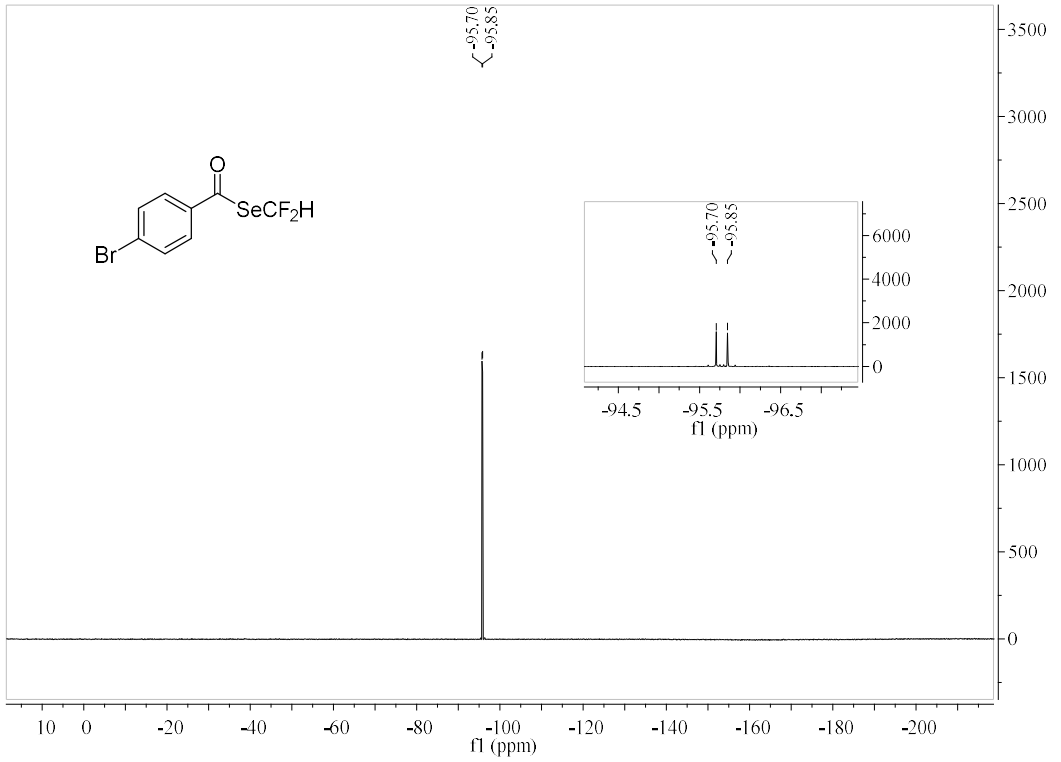
^{13}C NMR spectra of compound **3f**



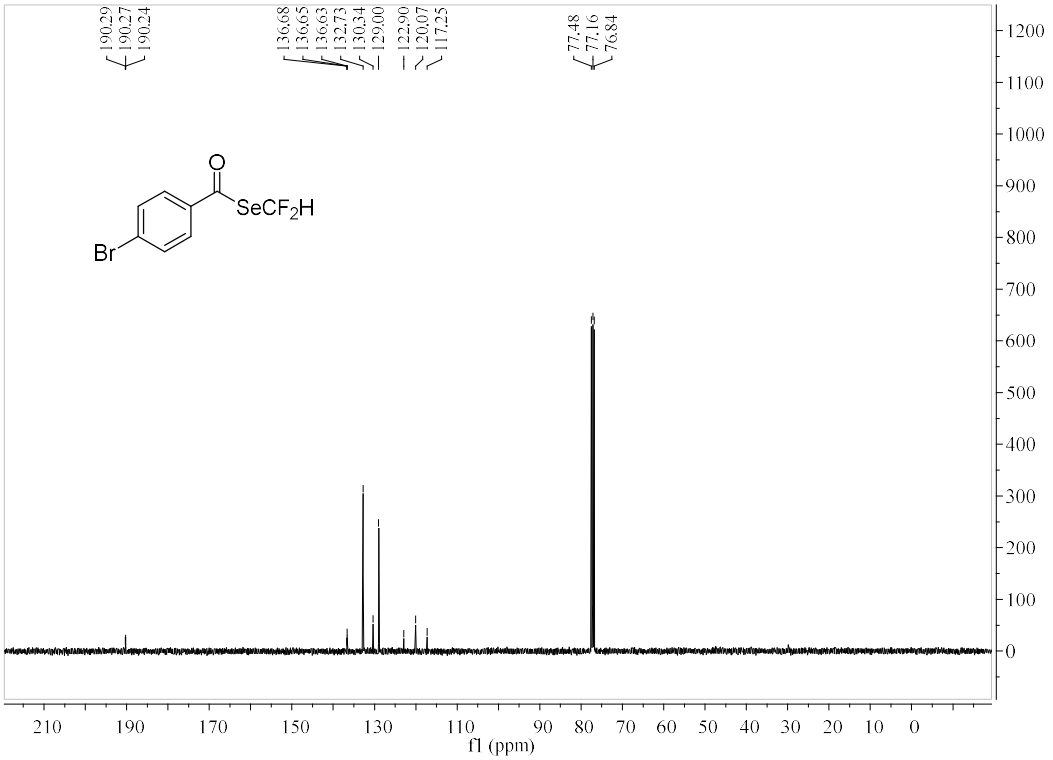
^{1}H NMR spectra of compound **3g**



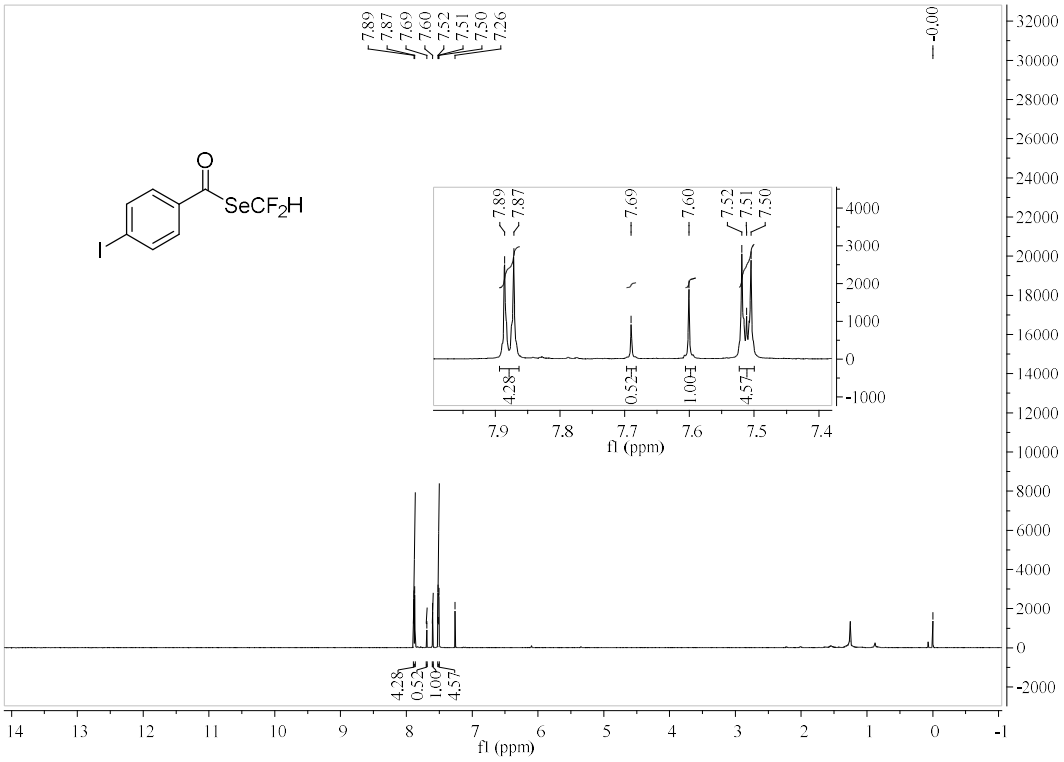
^{19}F NMR spectra of compound **3g**



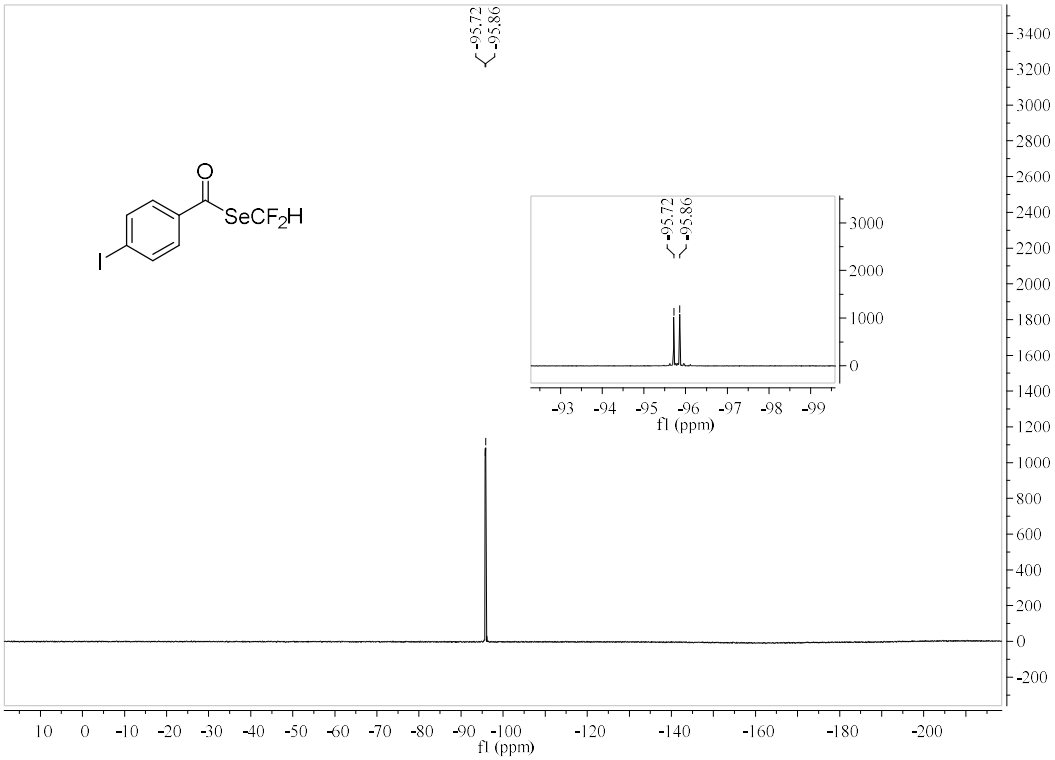
^{13}C NMR spectra of compound **3g**



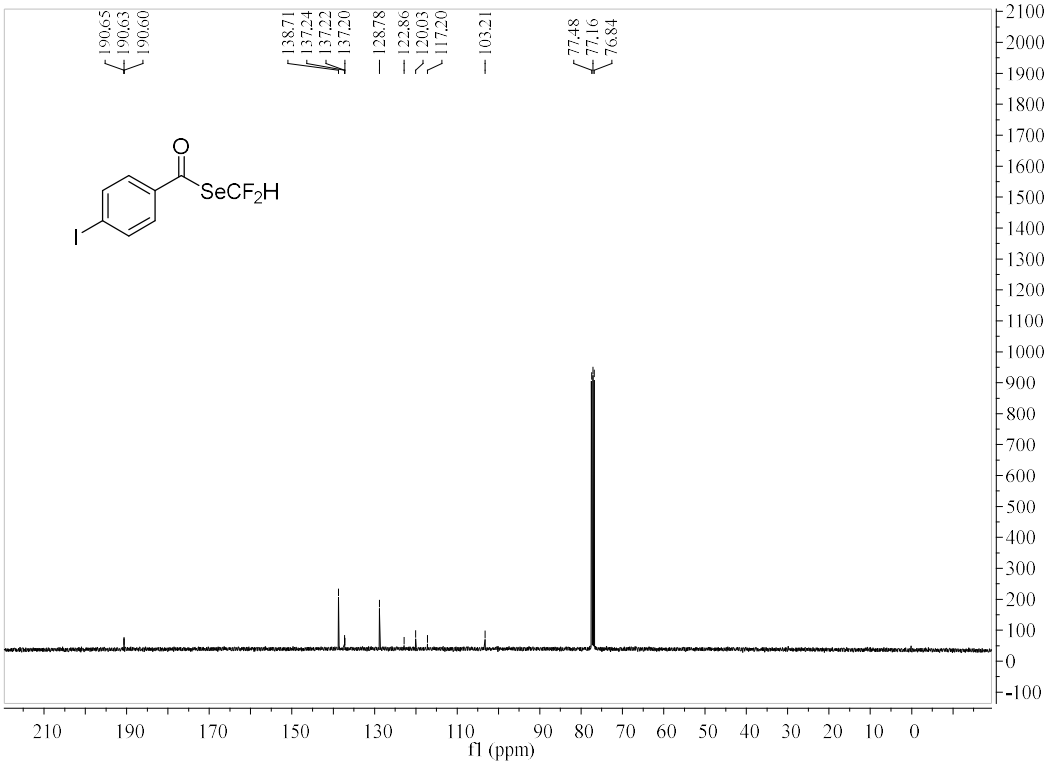
^{1}H NMR spectra of compound **3h**



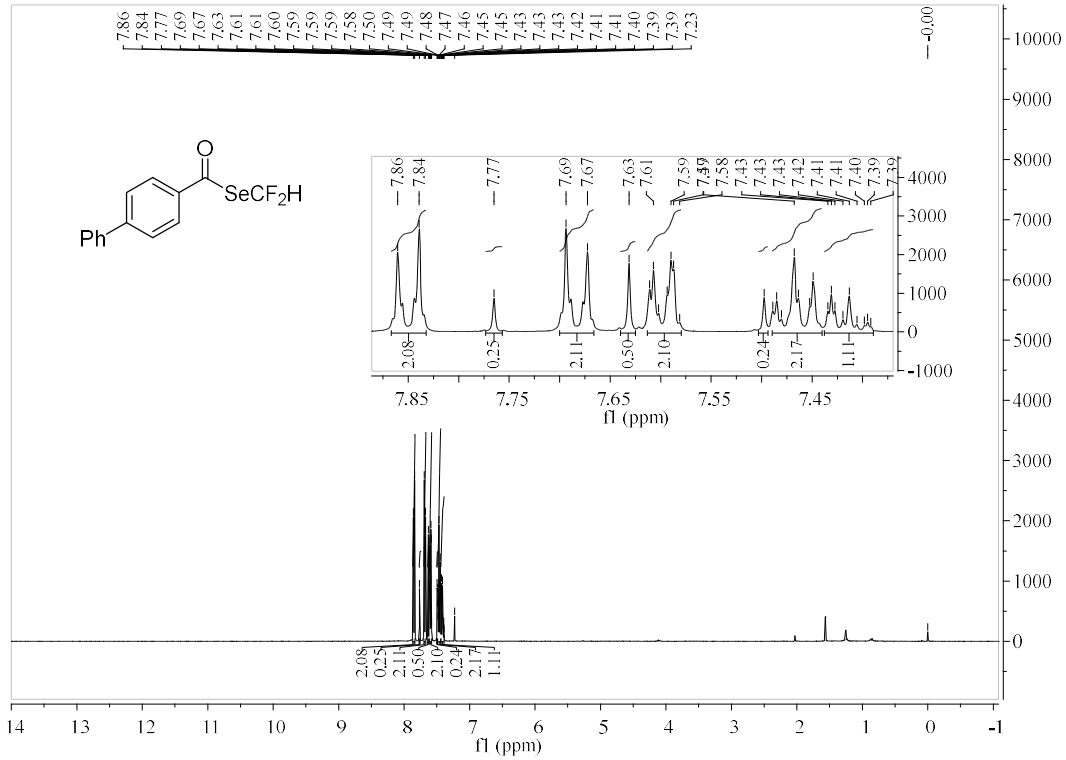
^{19}F NMR spectra of compound **3h**



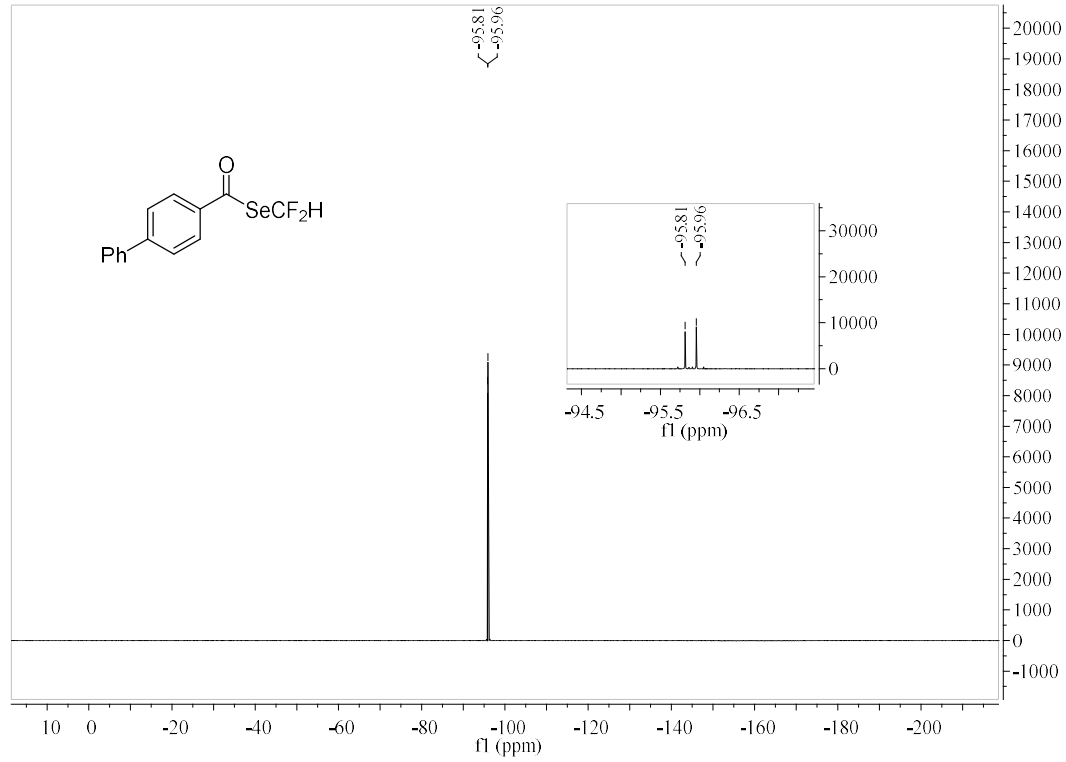
^{13}C NMR spectra of compound **3h**



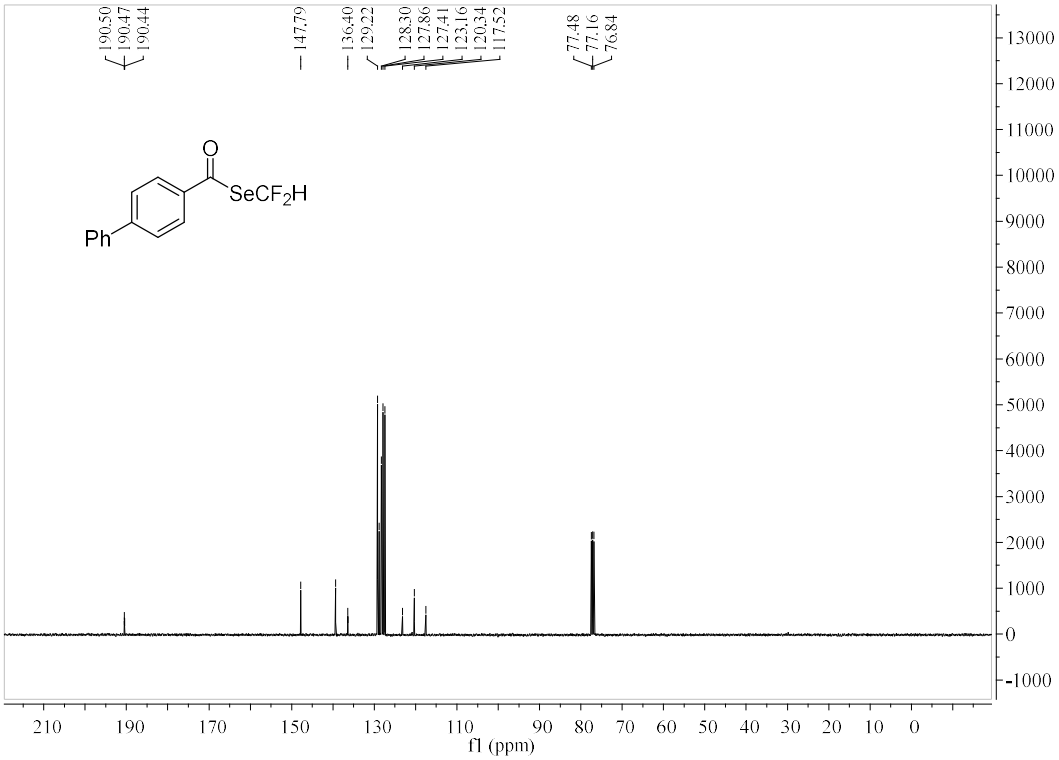
^{1}H NMR spectra of compound **3i**



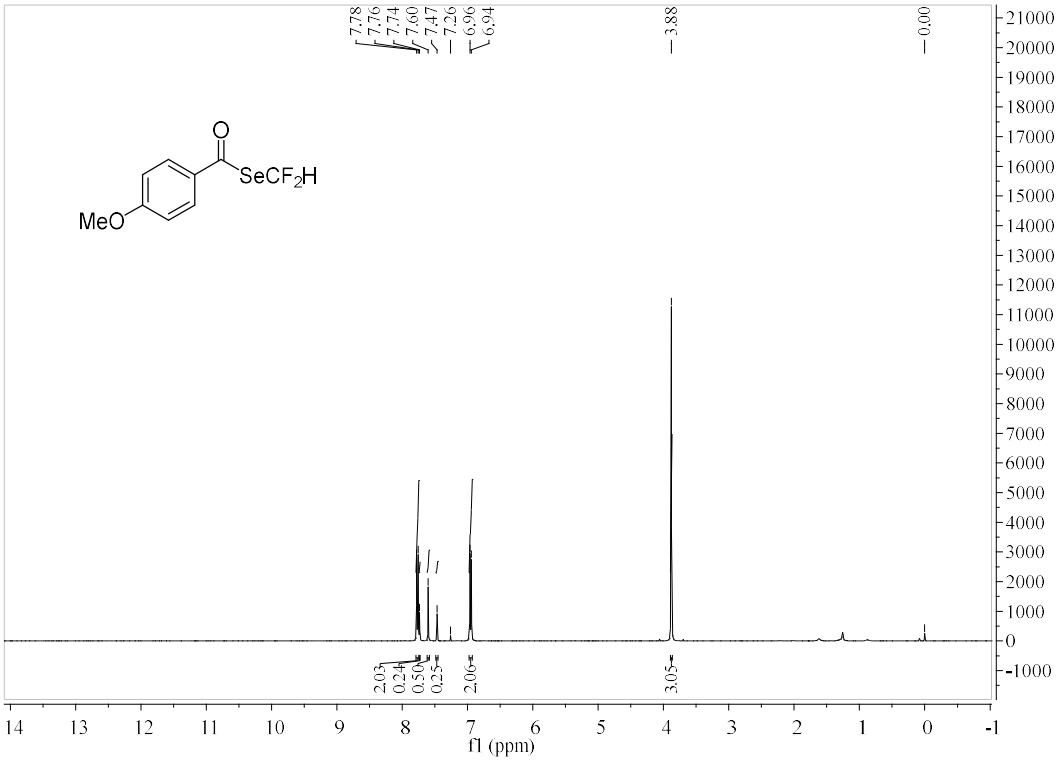
^{19}F NMR spectra of compound **3i**



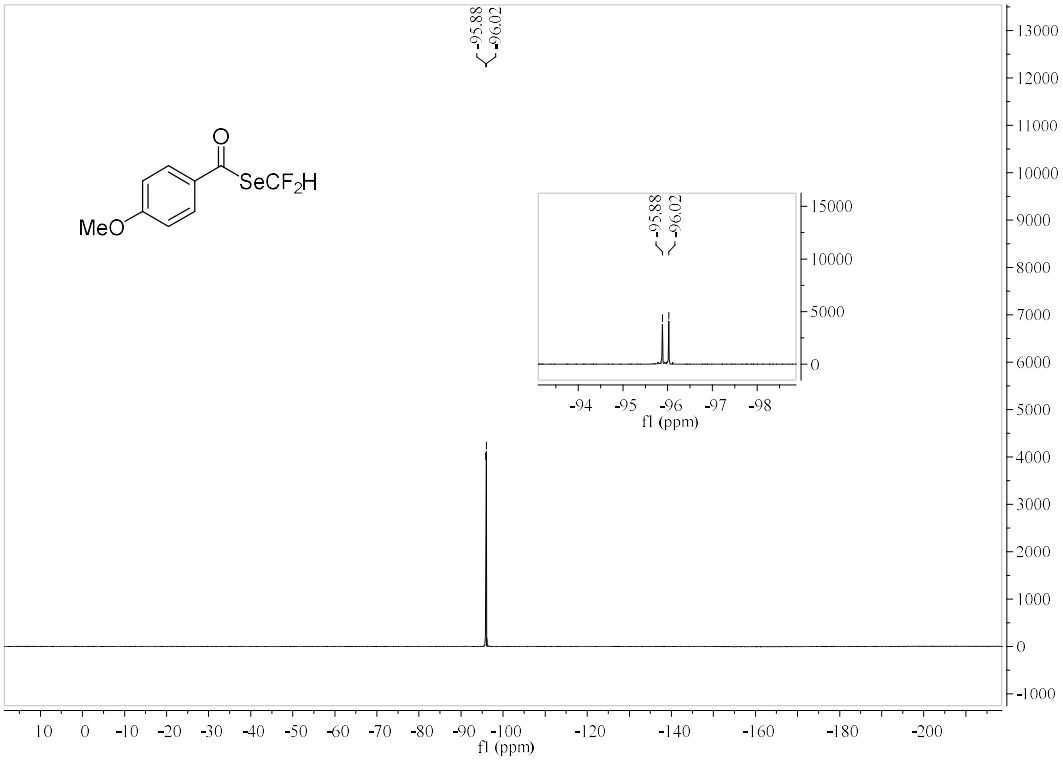
^{13}C NMR spectra of compound **3i**



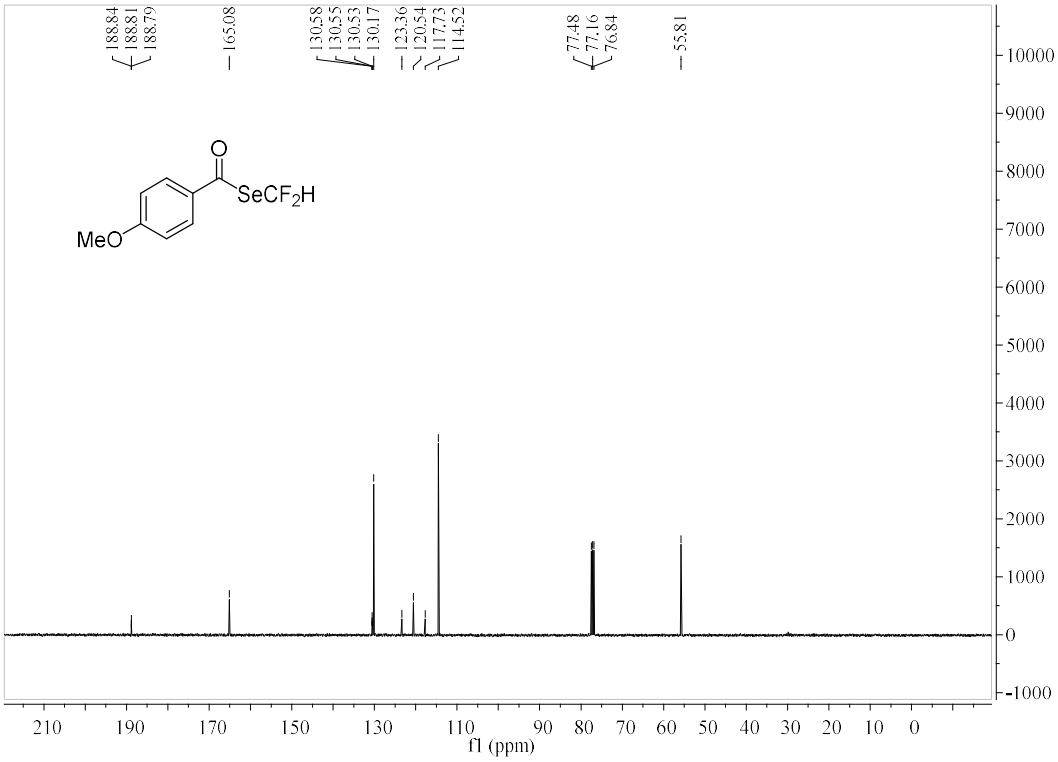
^{1}H NMR spectra of compound **3j**



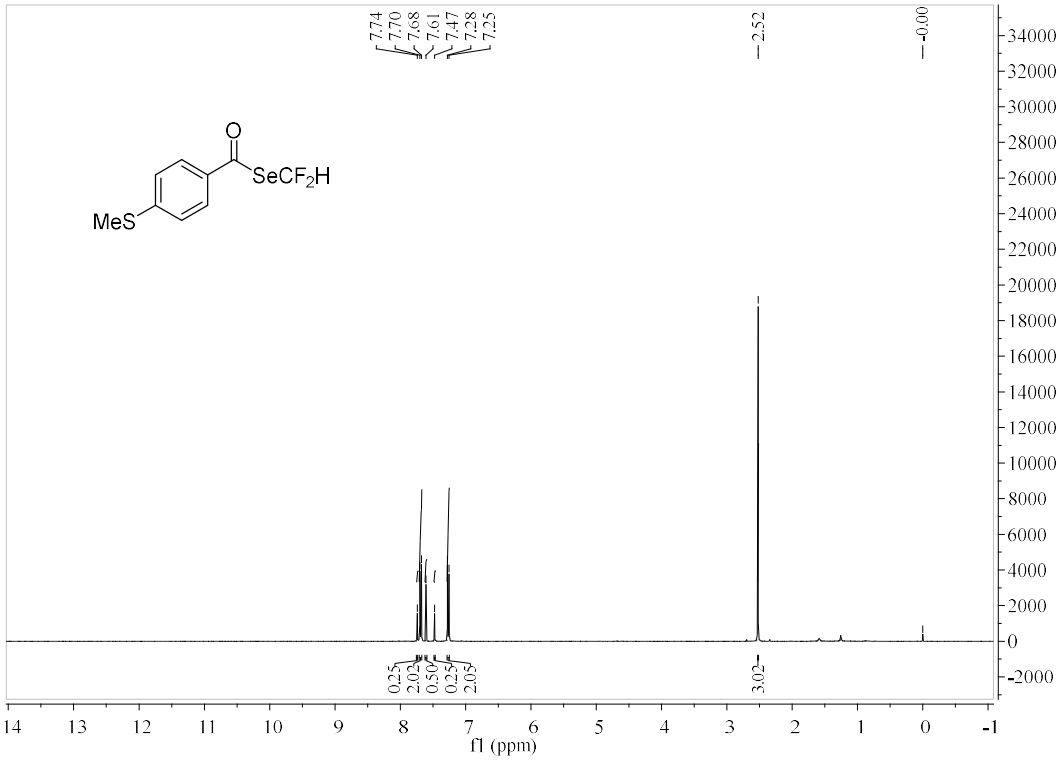
^{19}F NMR spectra of compound **3j**



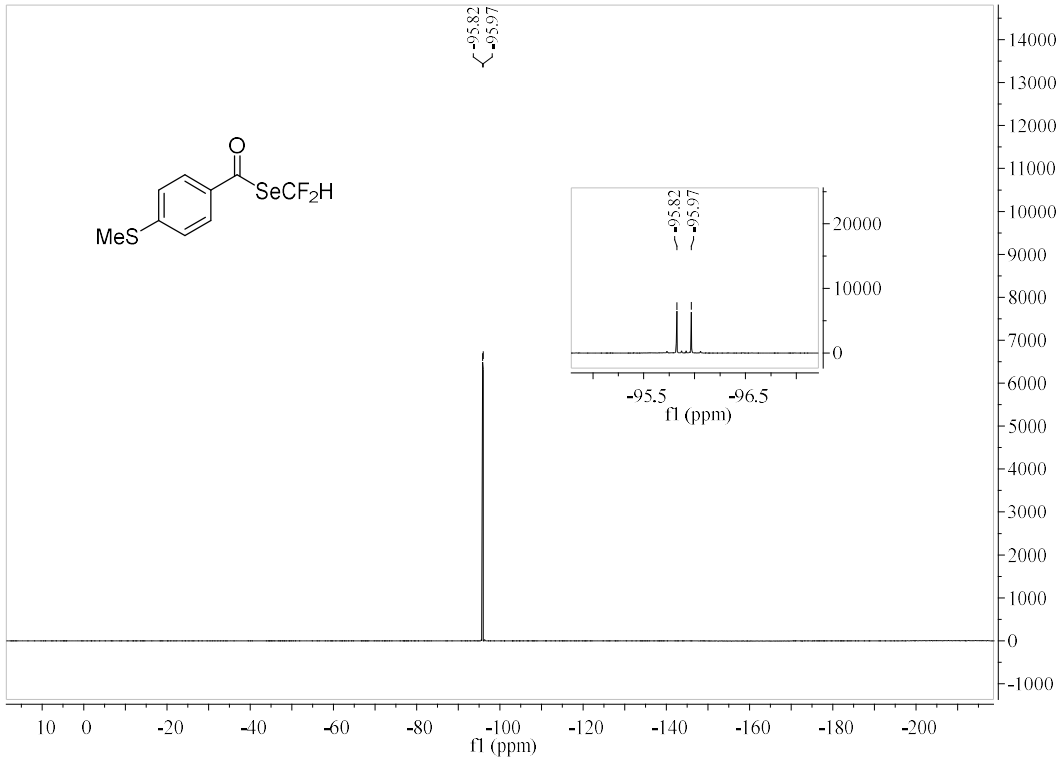
^{13}C NMR spectra of compound **3j**



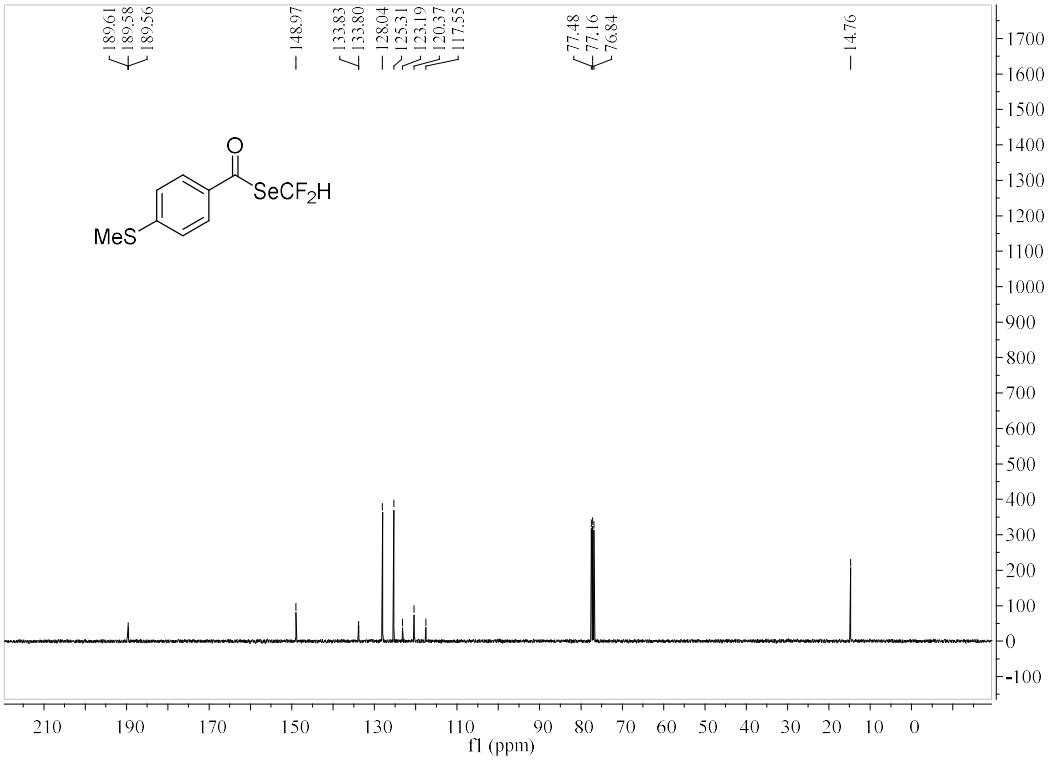
^{1}H NMR spectra of compound **3k**



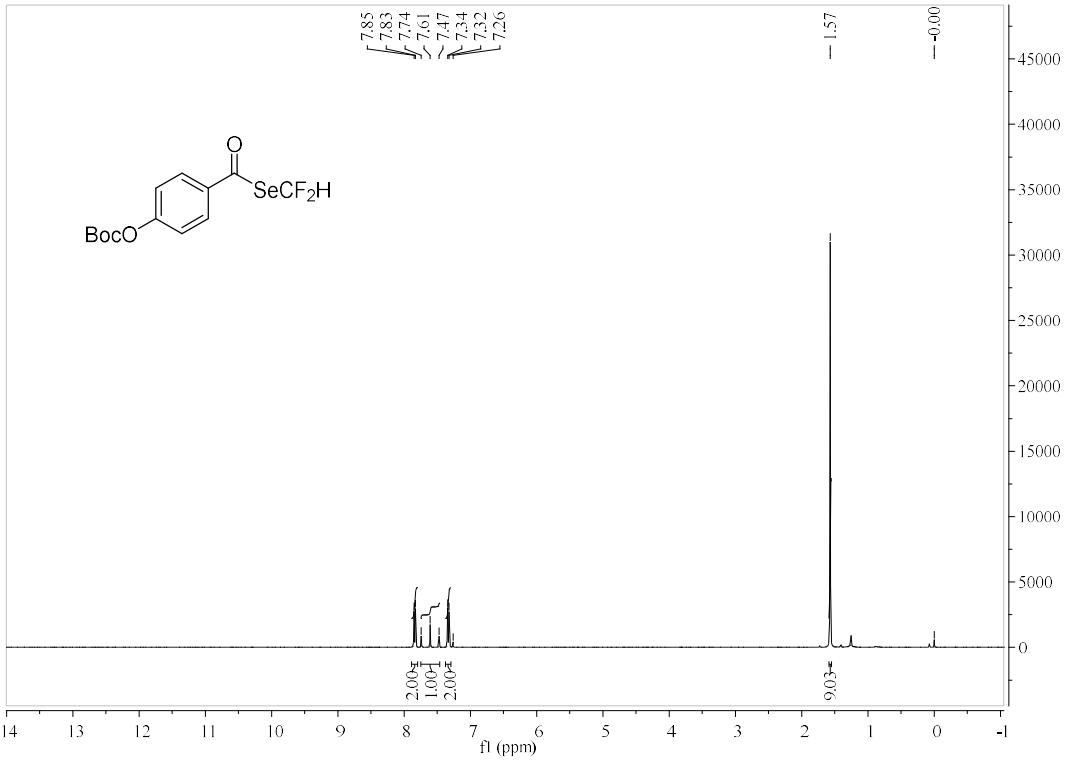
^{19}F NMR spectra of compound **3k**



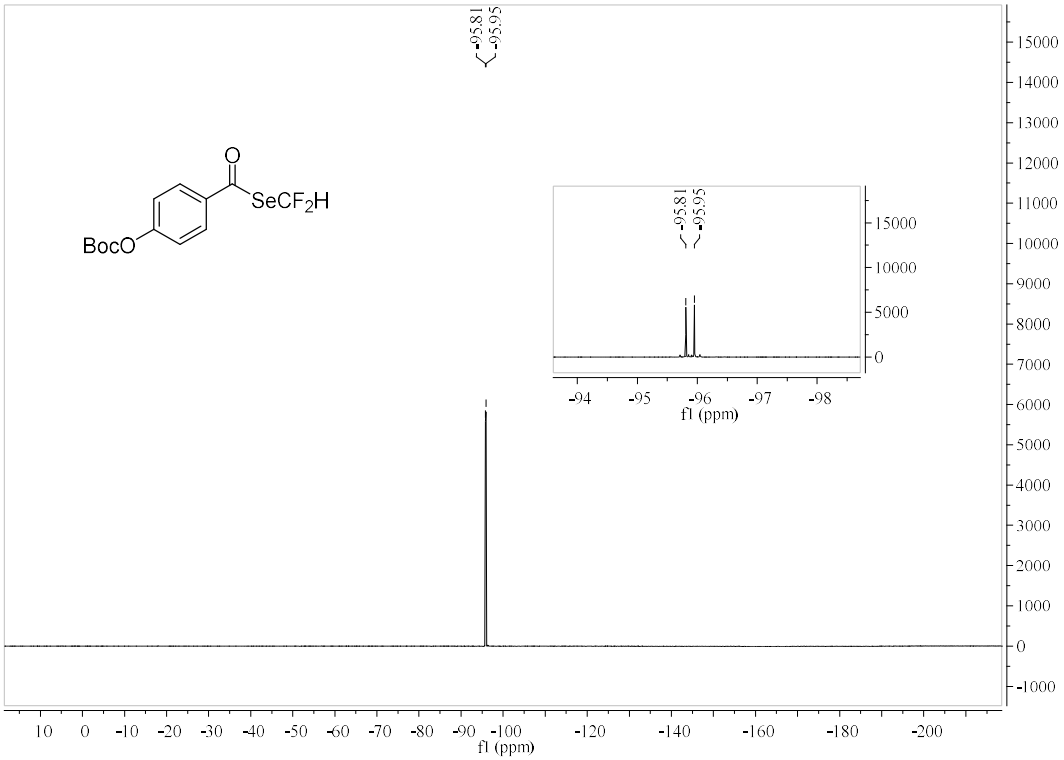
^{13}C NMR spectra of compound **3k**



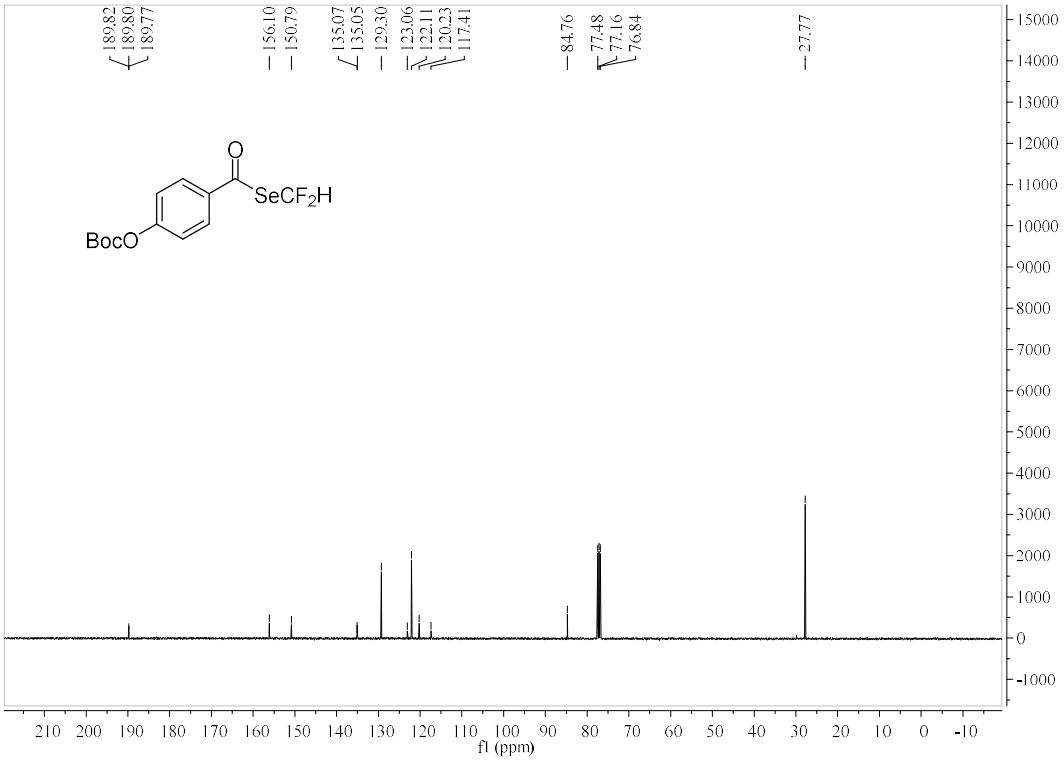
^{1}H NMR spectra of compound **3l**



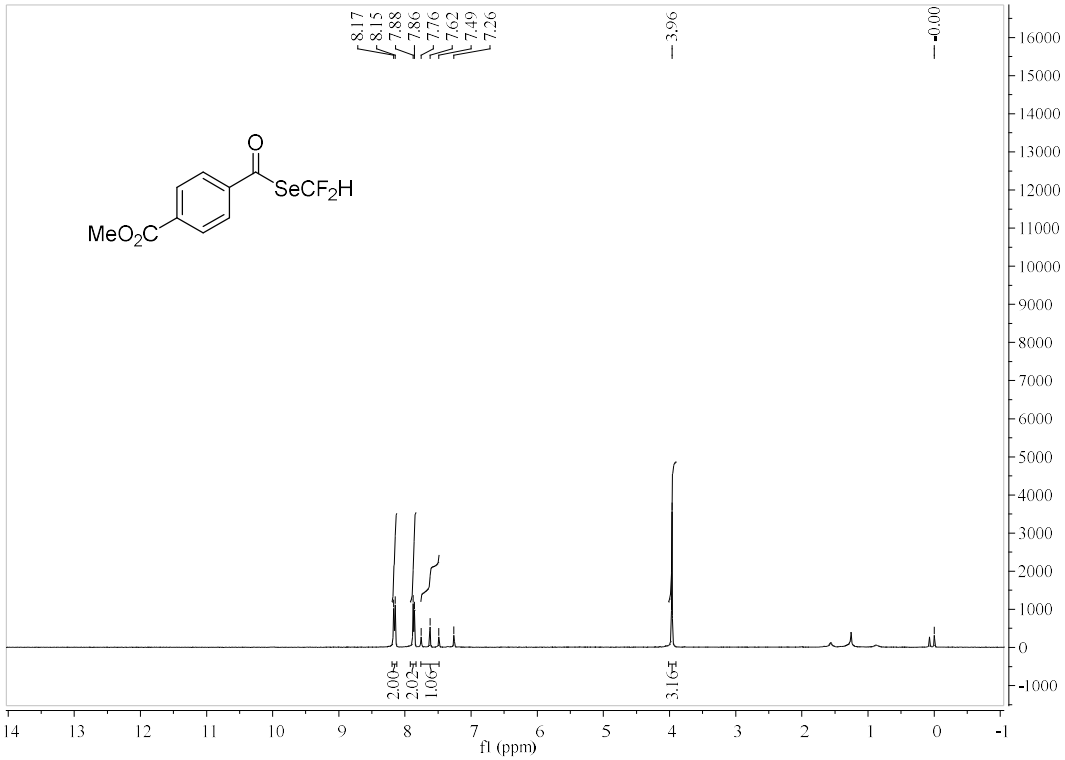
^{19}F NMR spectra of compound **3l**



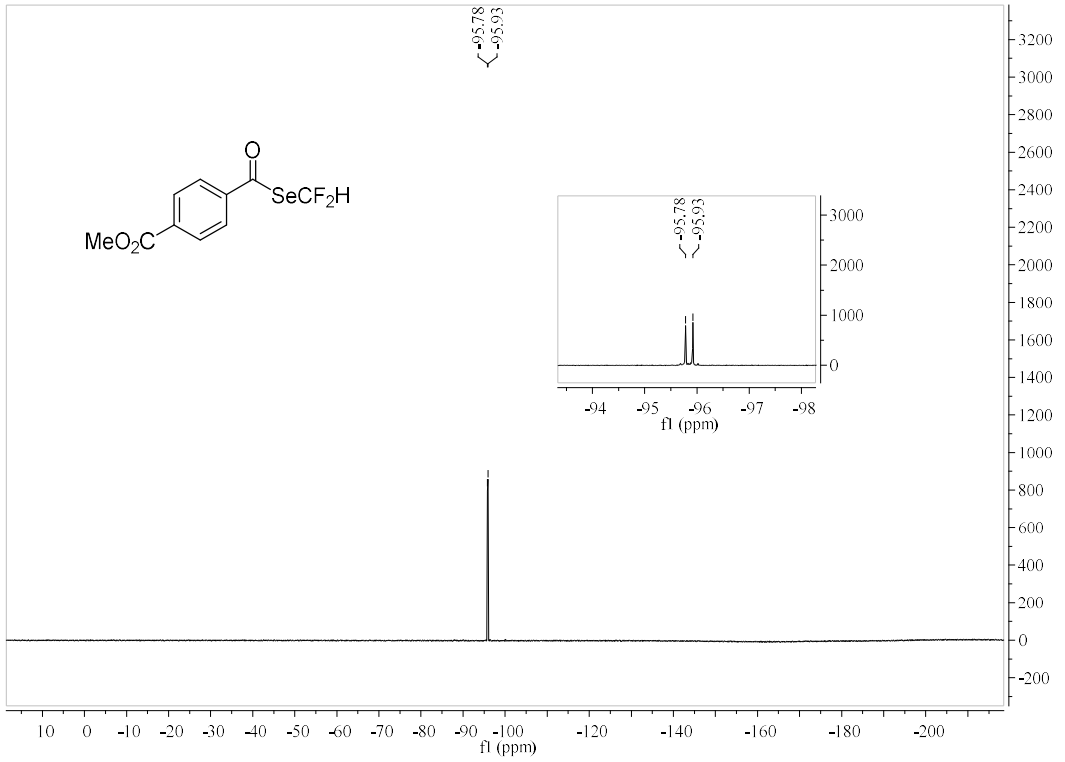
^{13}C NMR spectra of compound **3l**



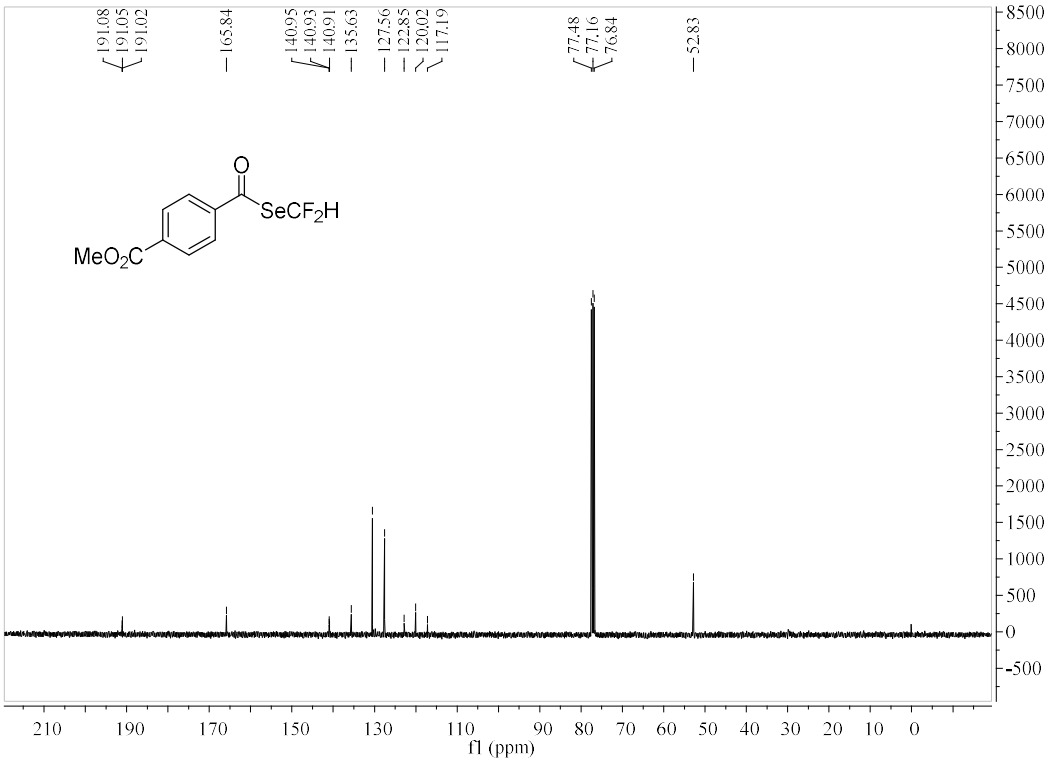
^{1}H NMR spectra of compound **3m**



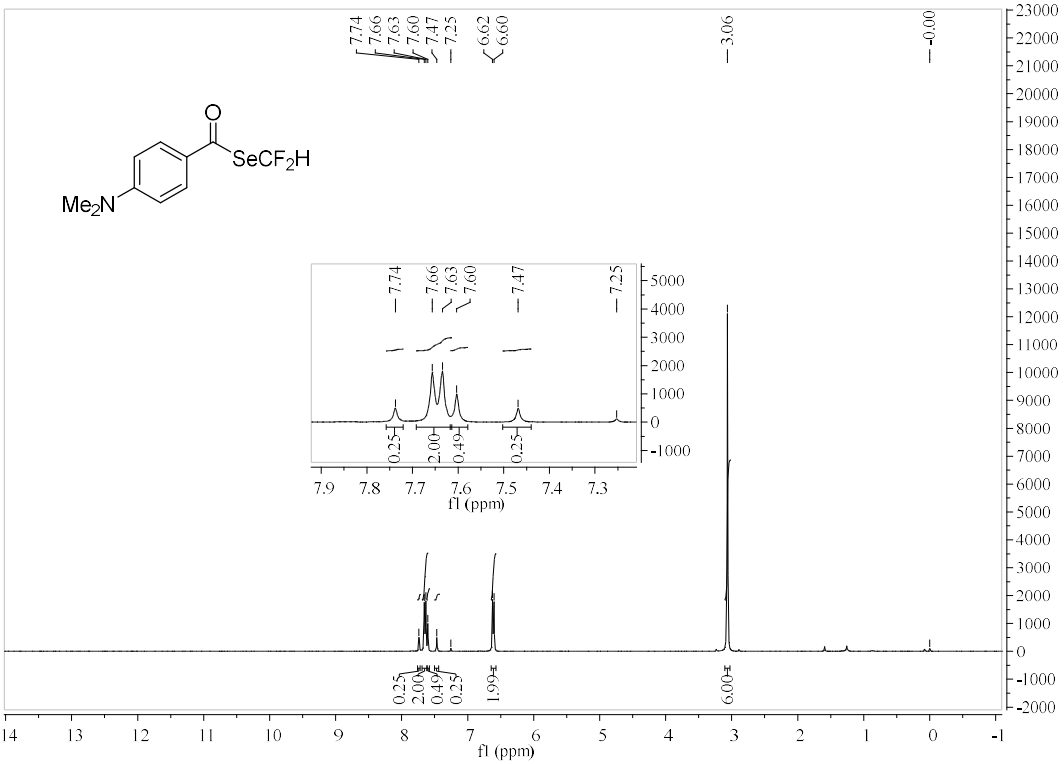
^{19}F NMR spectra of compound **3m**



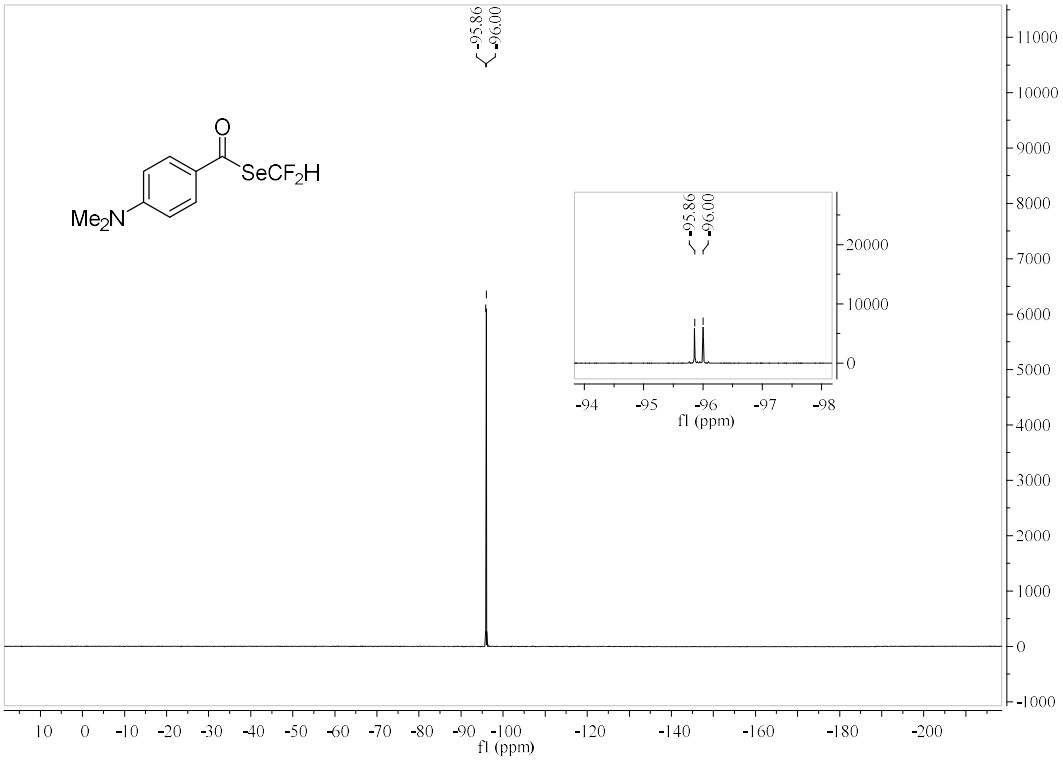
^{13}C NMR spectra of compound **3m**



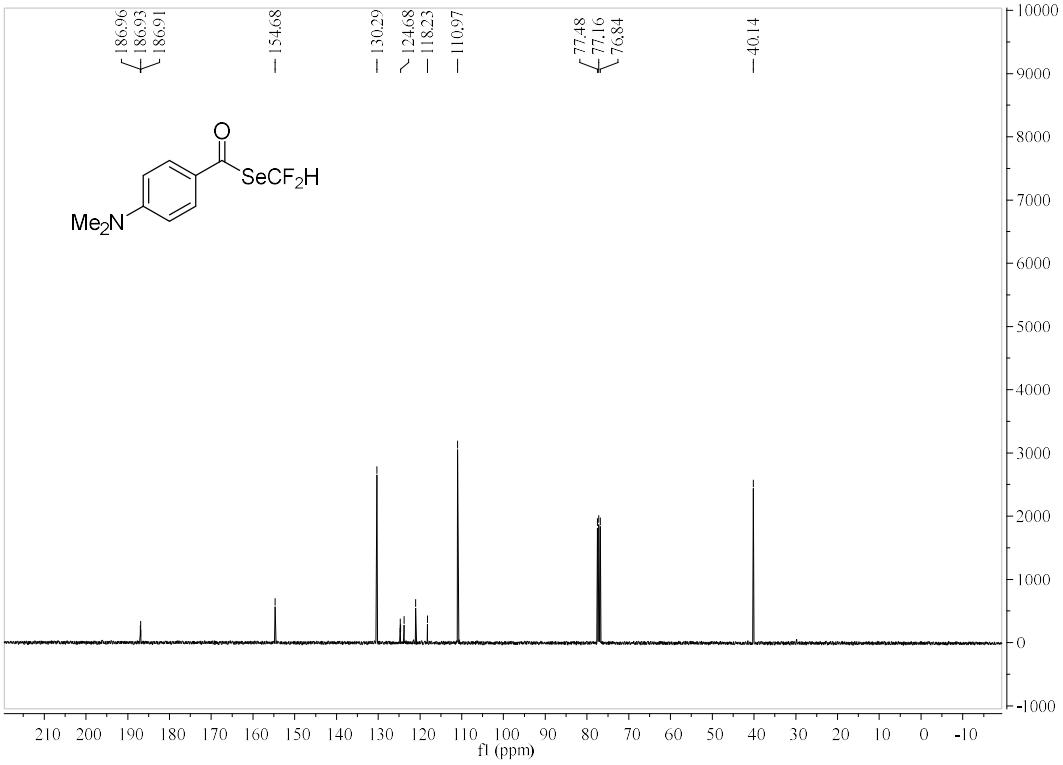
^{1}H NMR spectra of compound **3n**



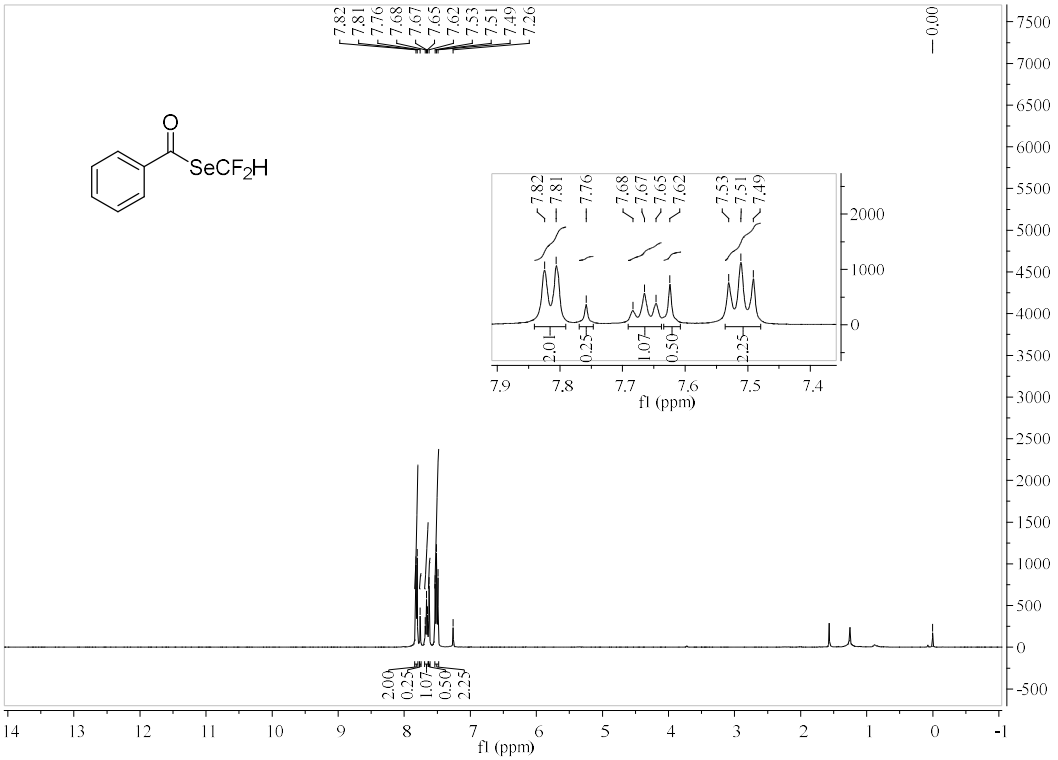
^{19}F NMR spectra of compound **3n**



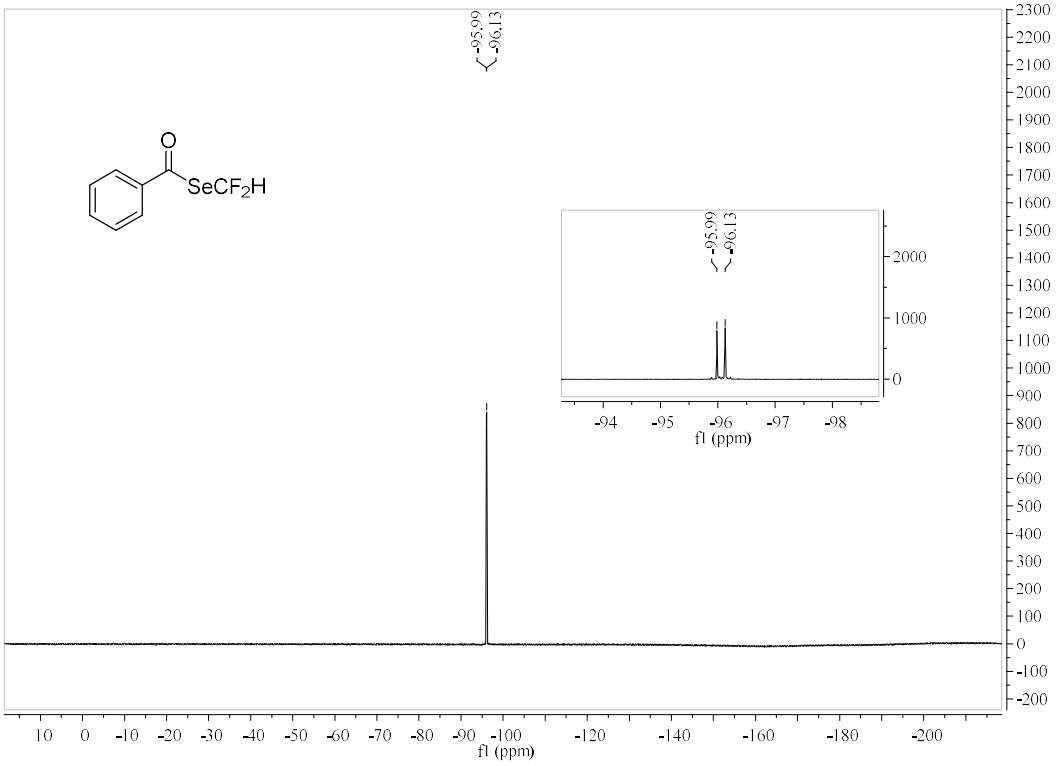
^{13}C NMR spectra of compound **3n**



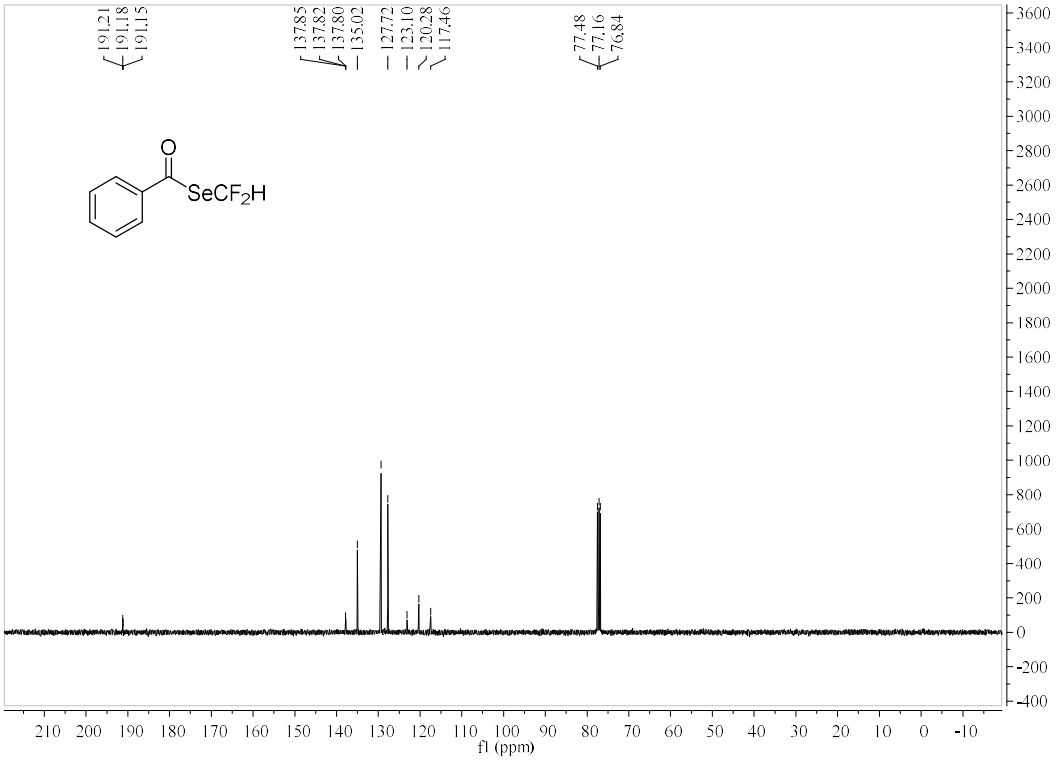
^{1}H NMR spectra of compound **3o**



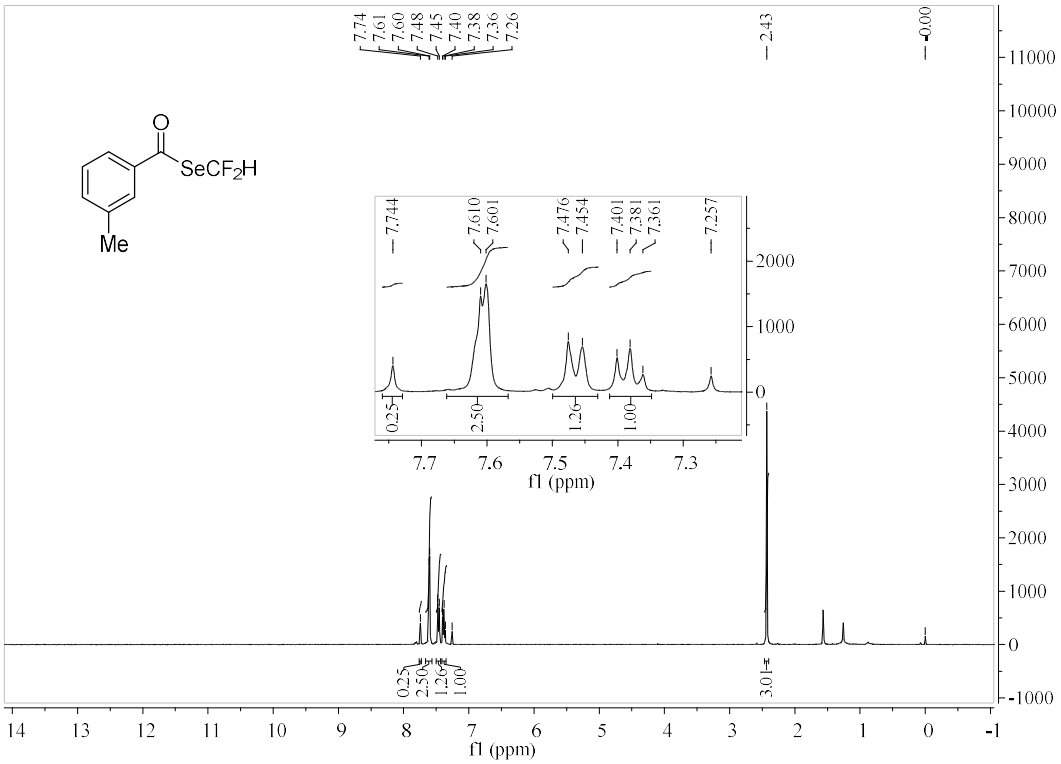
^{19}F NMR spectra of compound **3o**



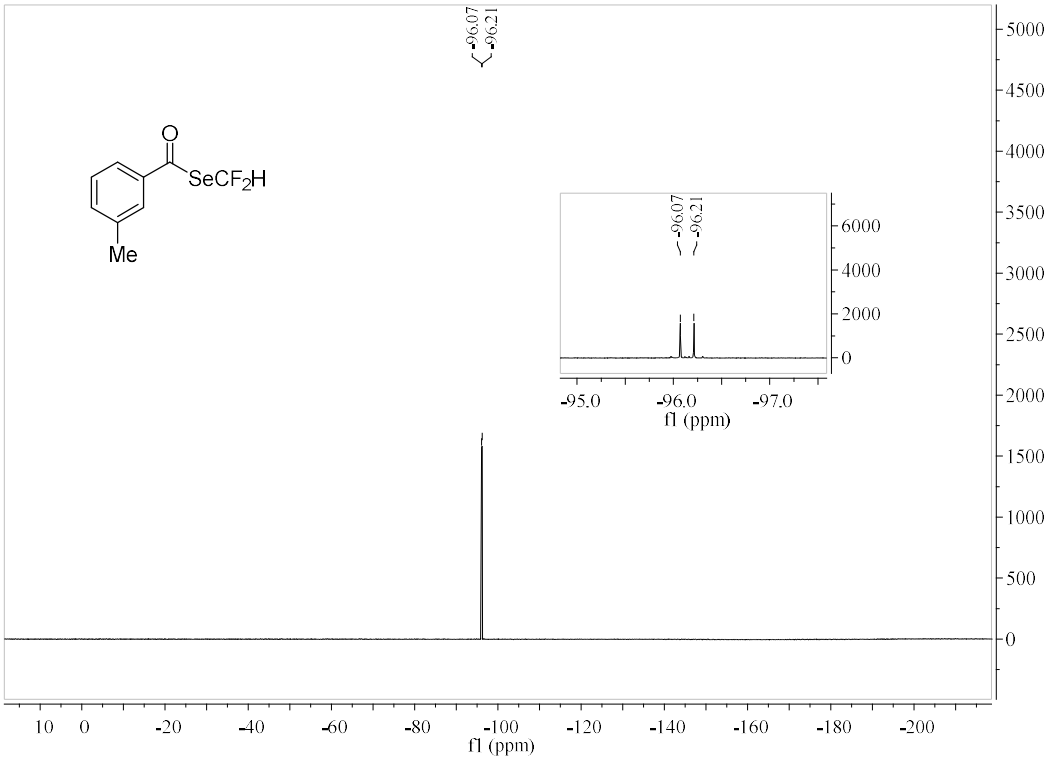
^{13}C NMR spectra of compound **3o**



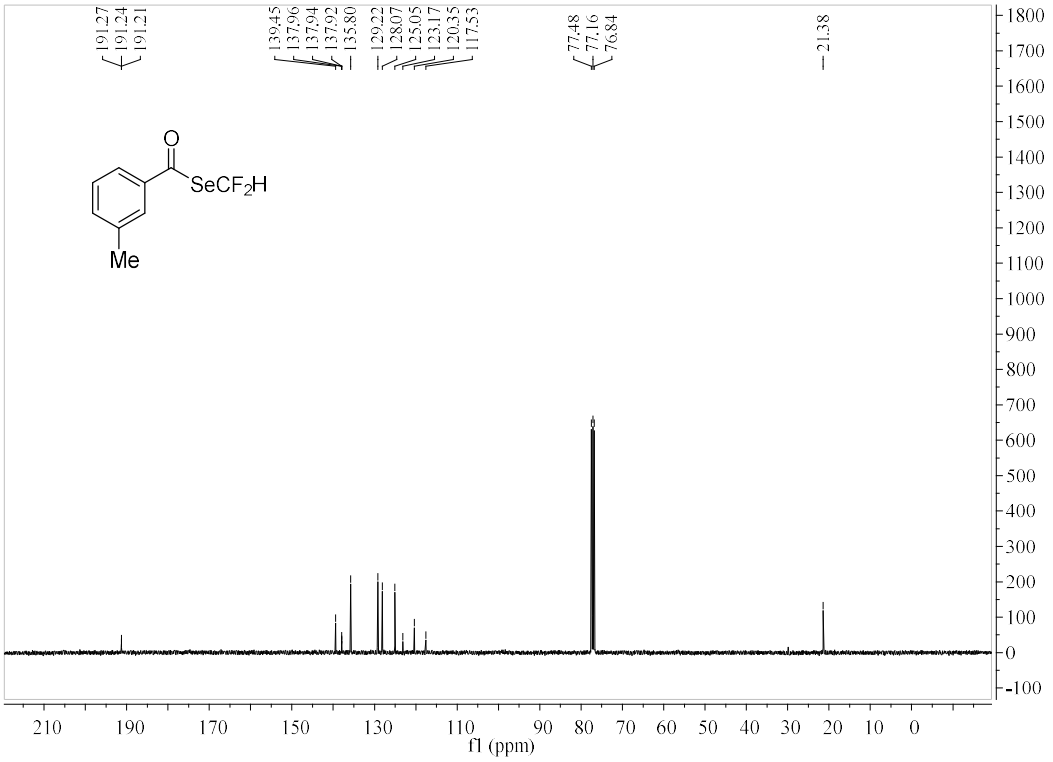
^{1}H NMR spectra of compound **3p**



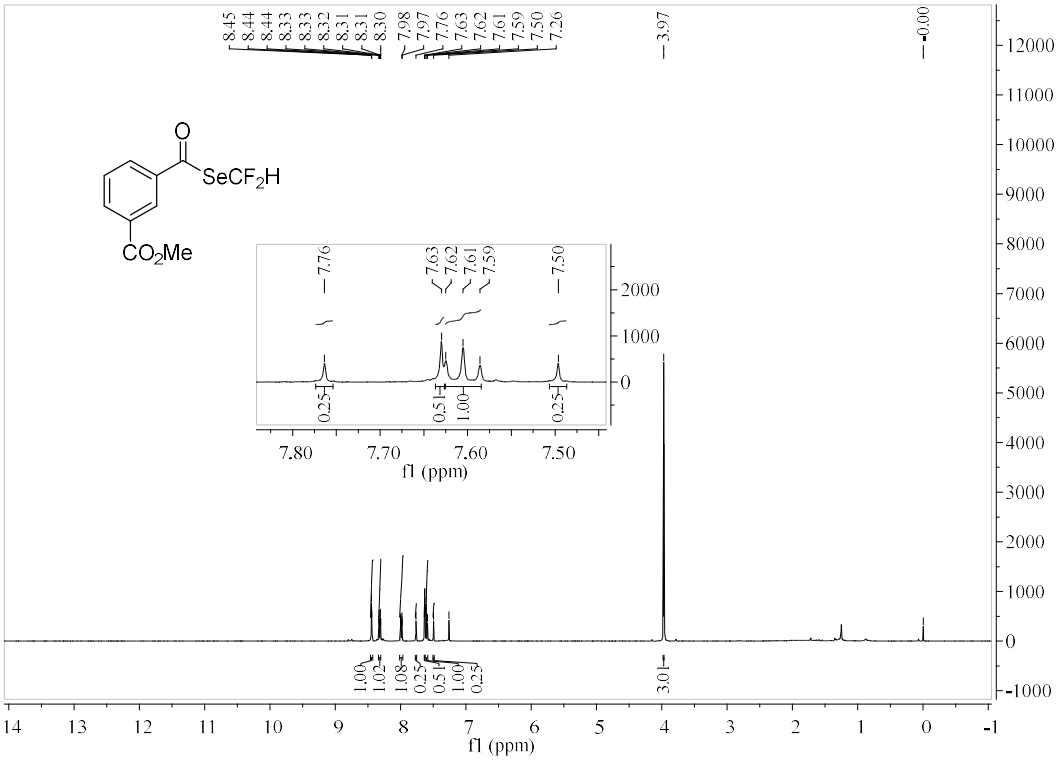
^{19}F NMR spectra of compound **3p**



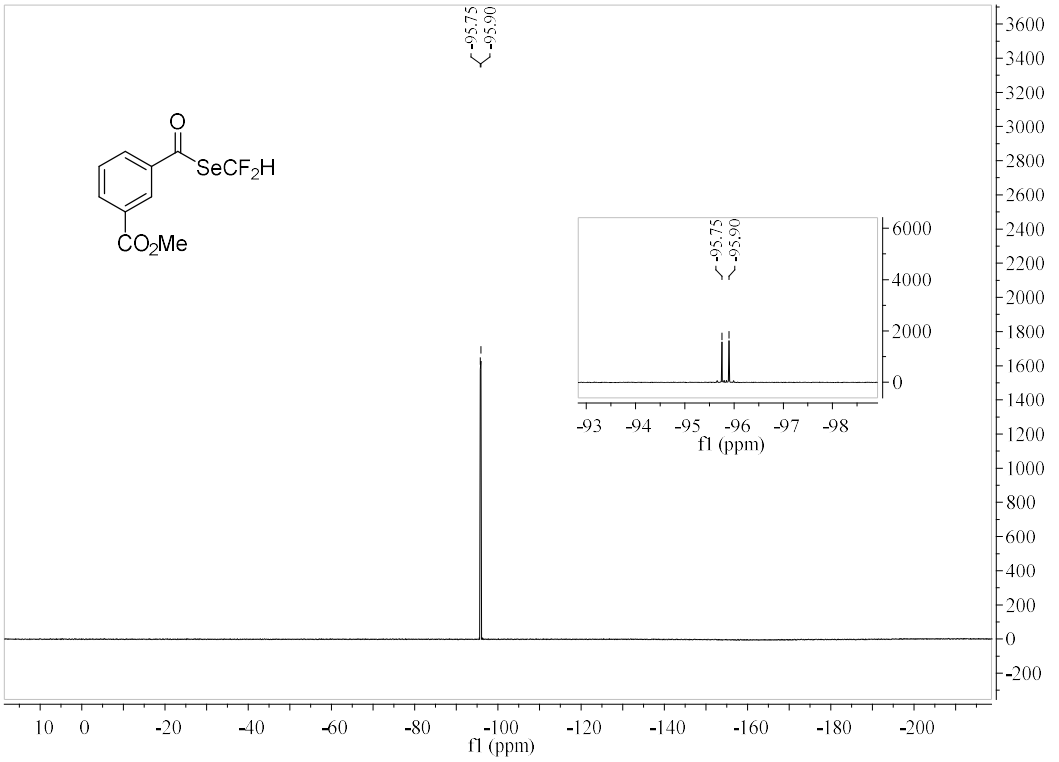
^{13}C NMR spectra of compound **3p**



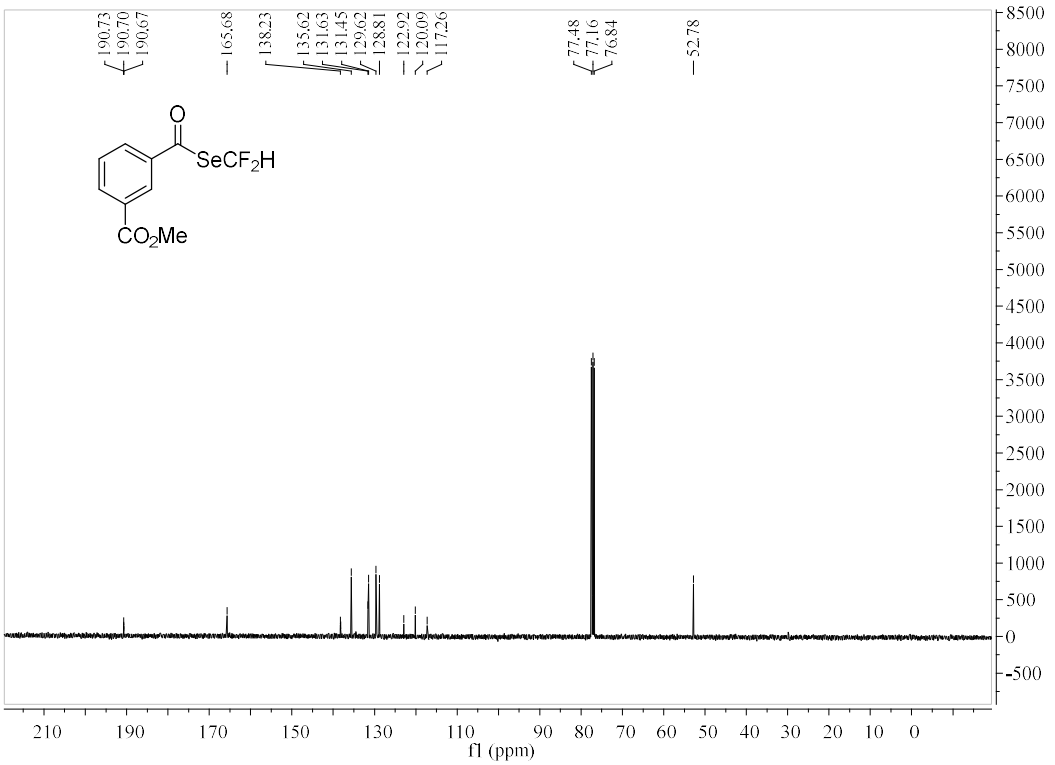
^{1}H NMR spectra of compound **3q**



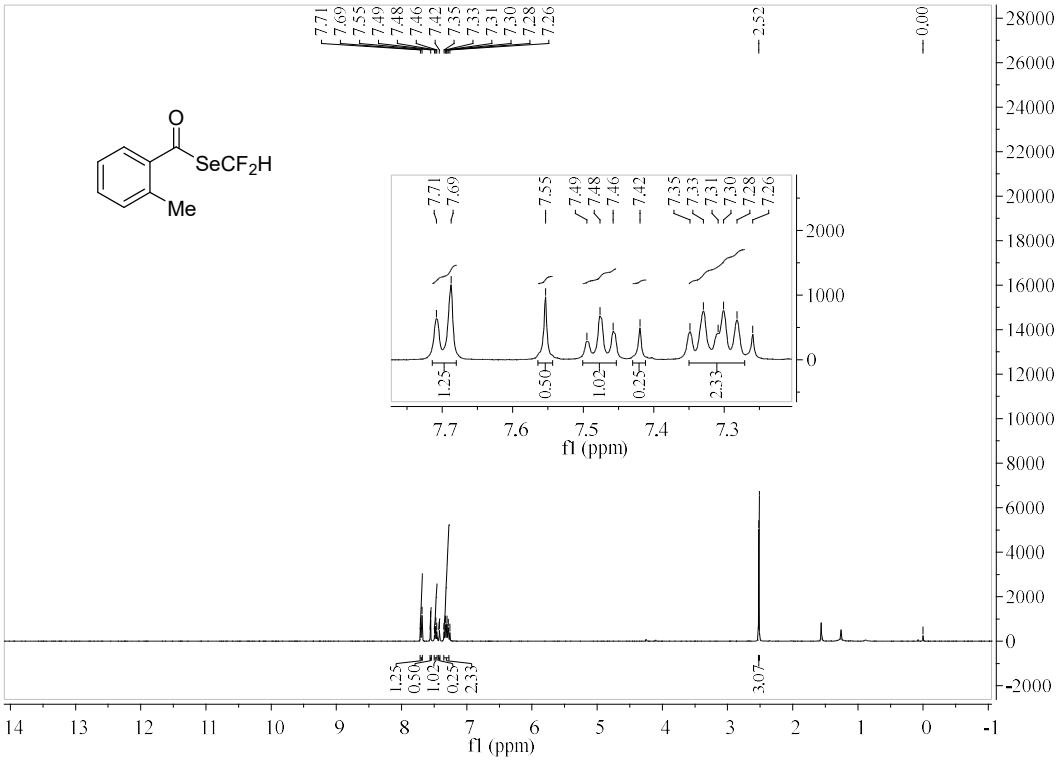
^{19}F NMR spectra of compound **3q**



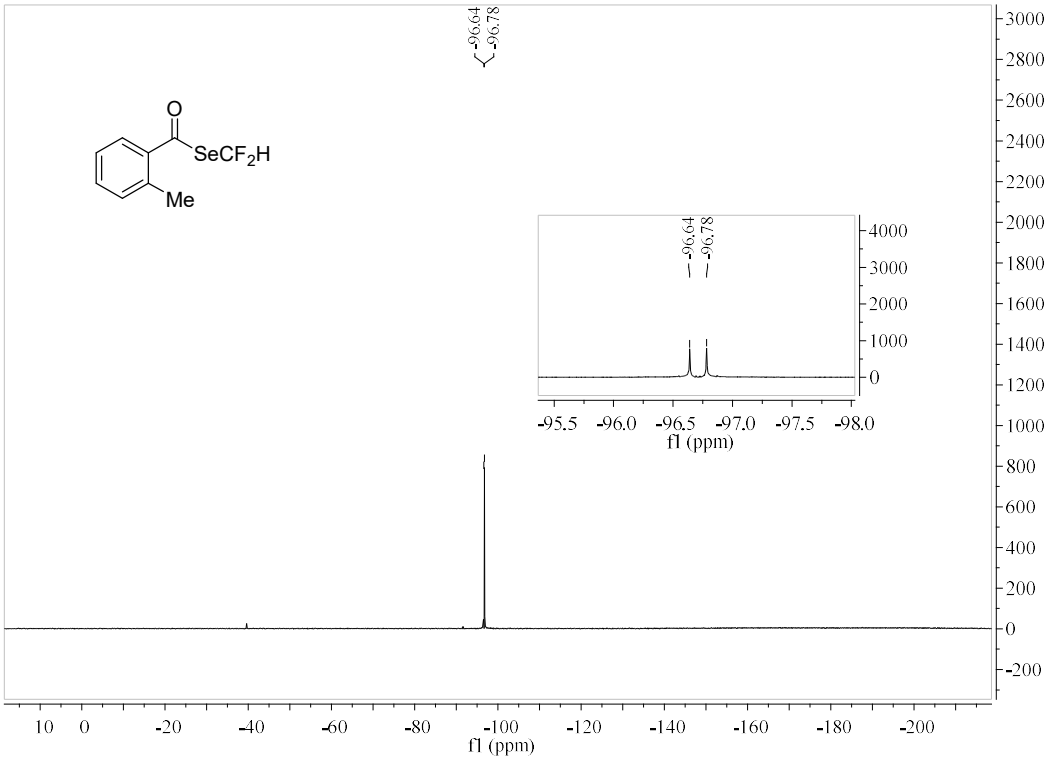
^{13}C NMR spectra of compound **3q**



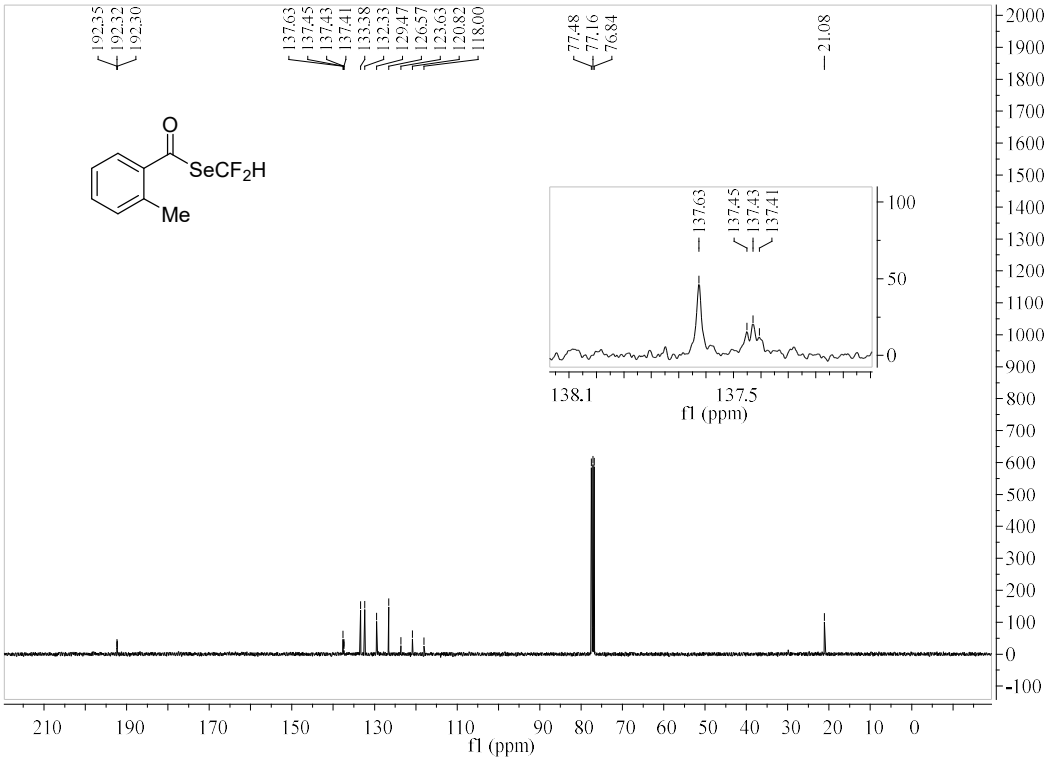
^{1}H NMR spectra of compound **3r**



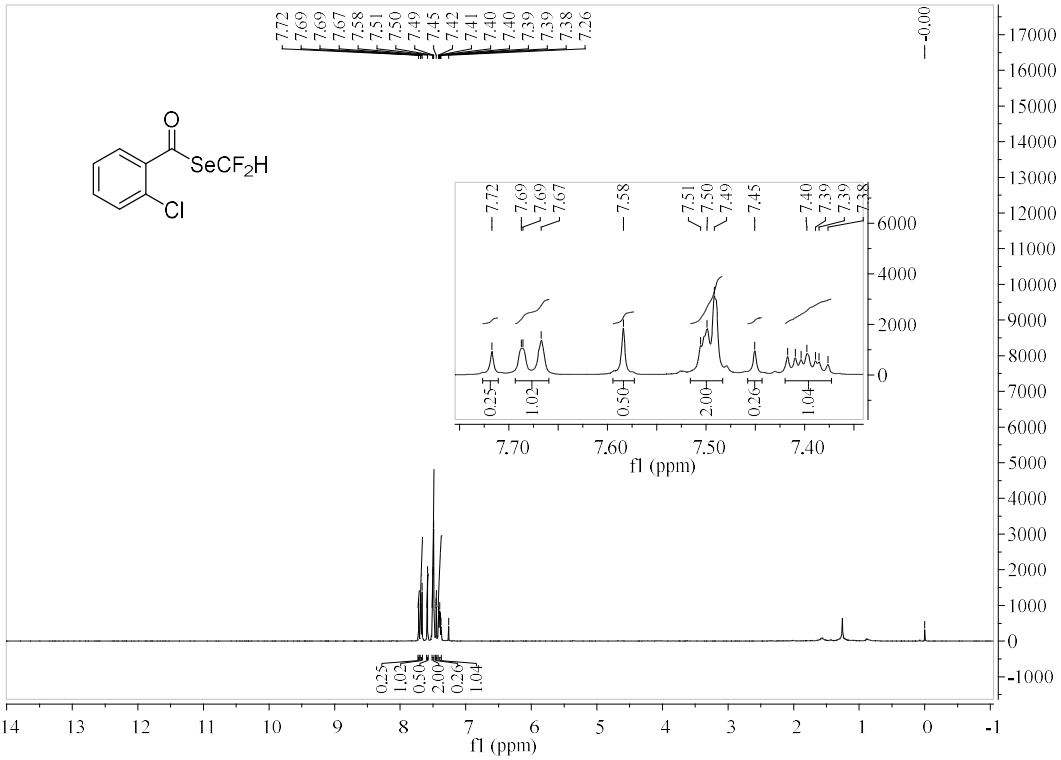
^{19}F NMR spectra of compound **3r**



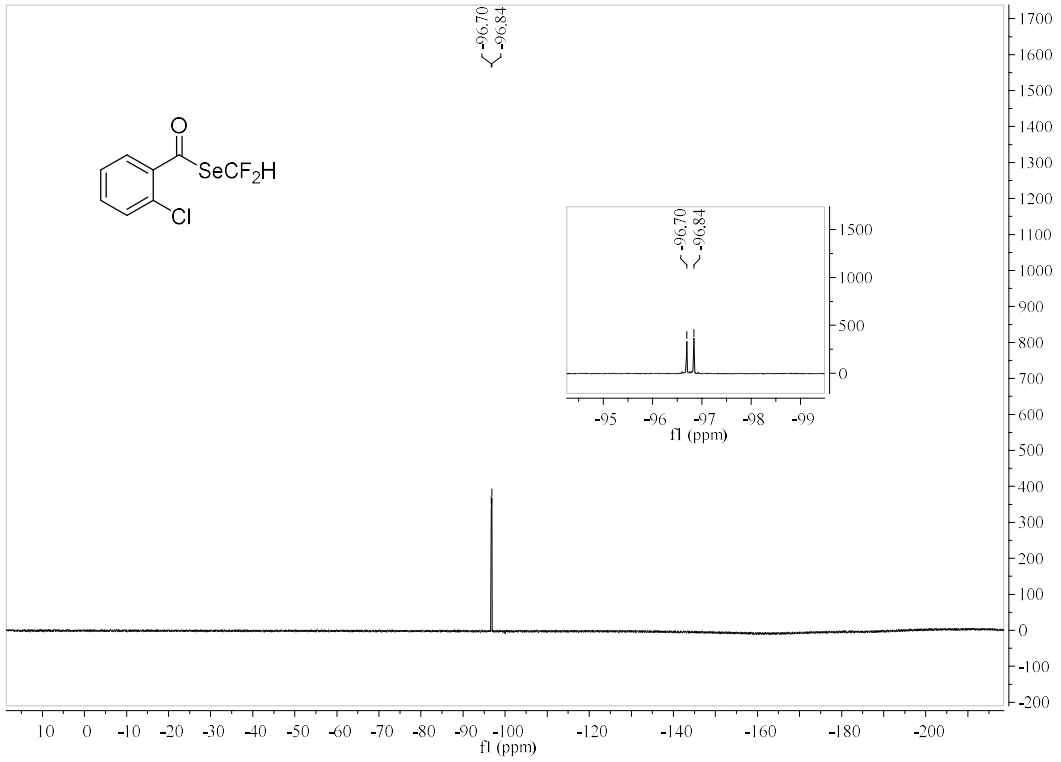
^{13}C NMR spectra of compound **3r**



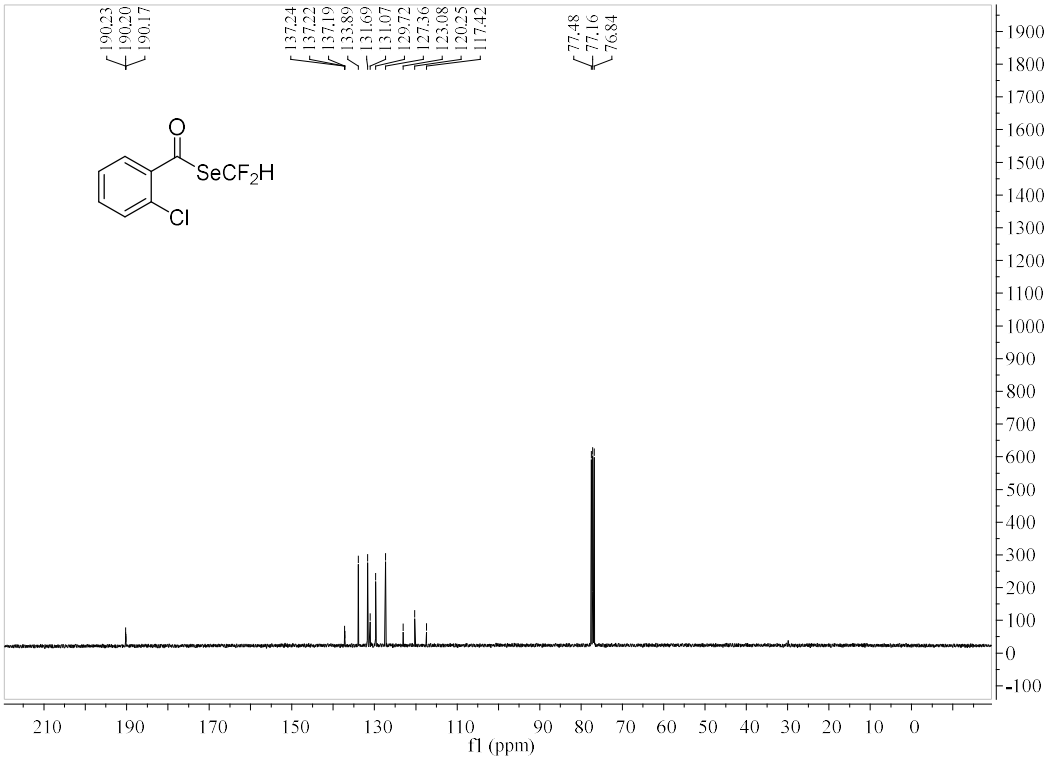
^{1}H NMR spectra of compound **3s**



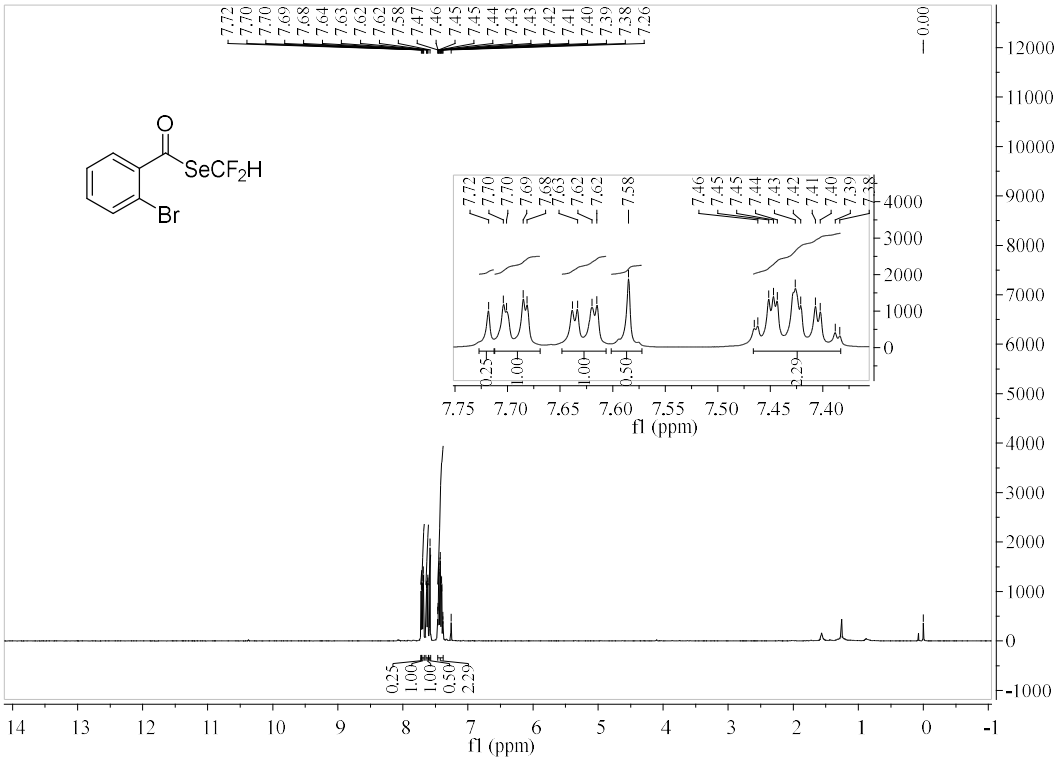
^{19}F NMR spectra of compound **3s**



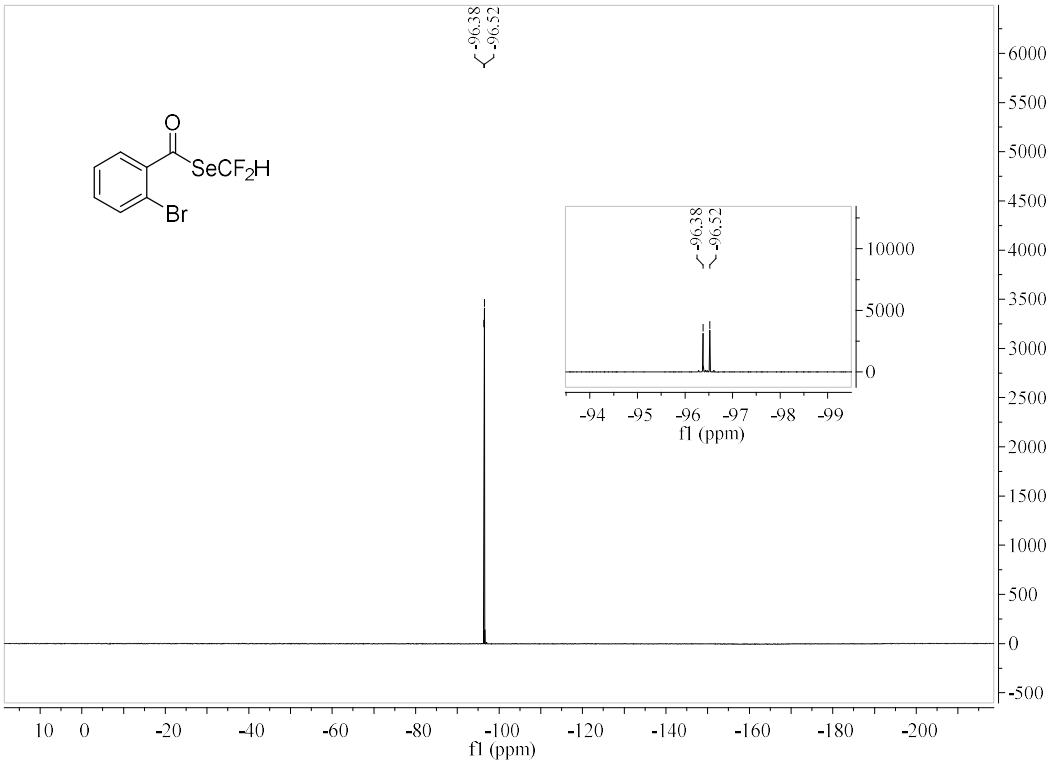
^{13}C NMR spectra of compound **3s**



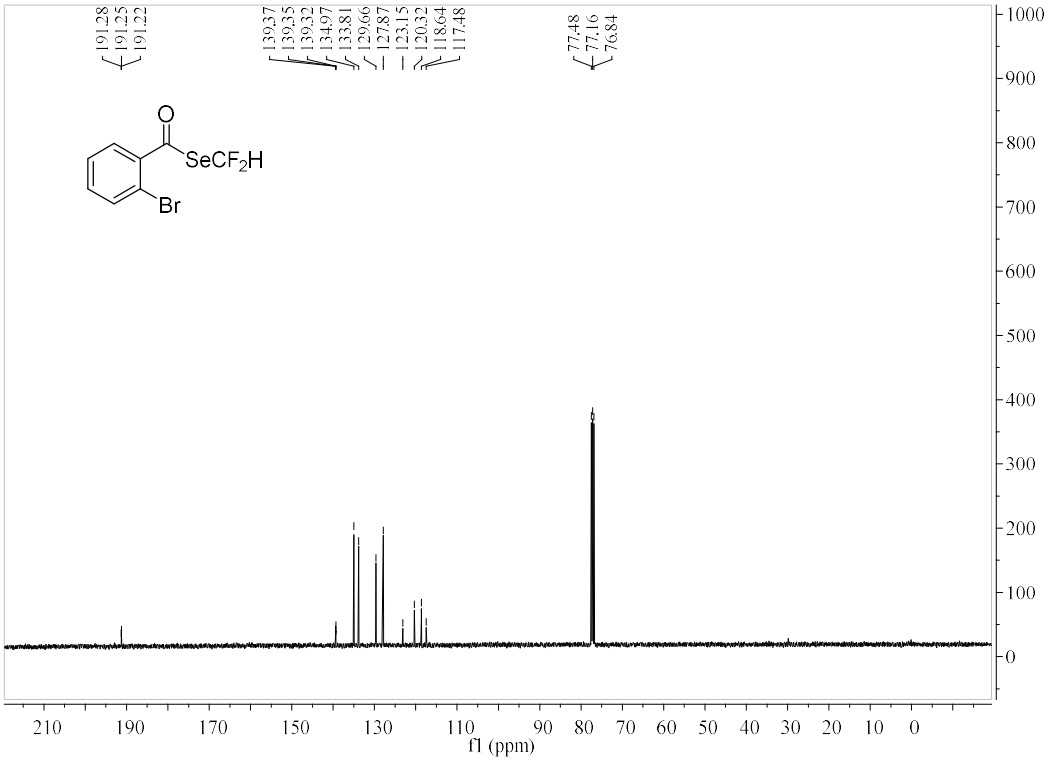
^{1}H NMR spectra of compound **3t**



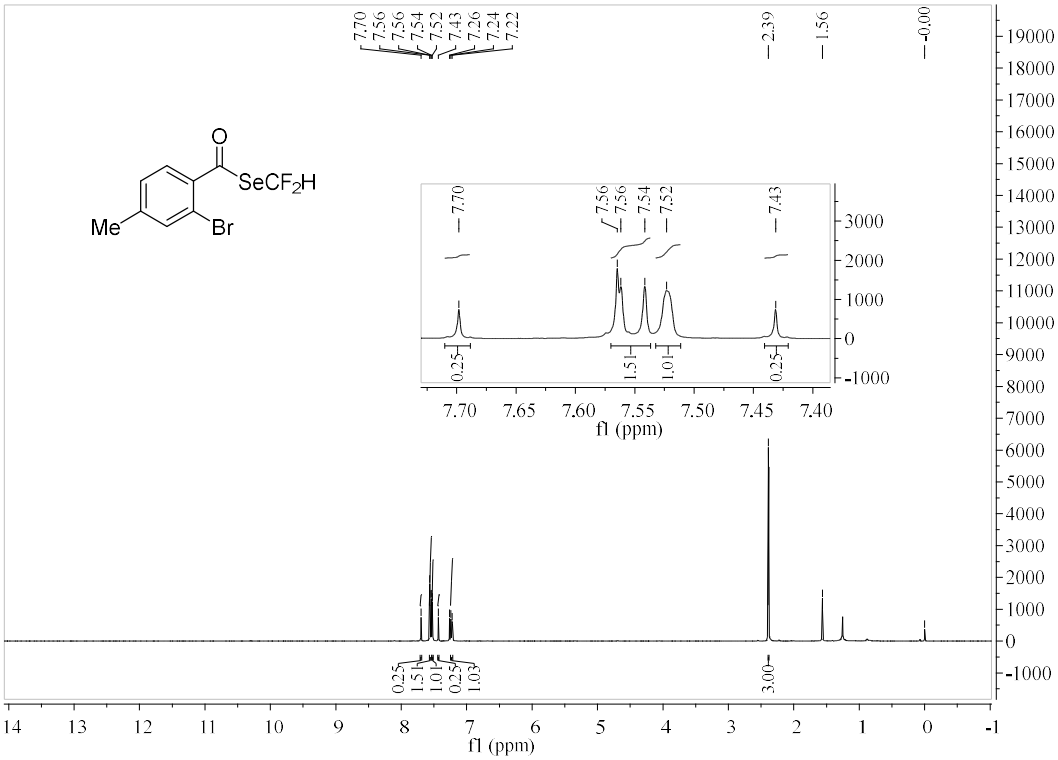
^{19}F NMR spectra of compound **3t**



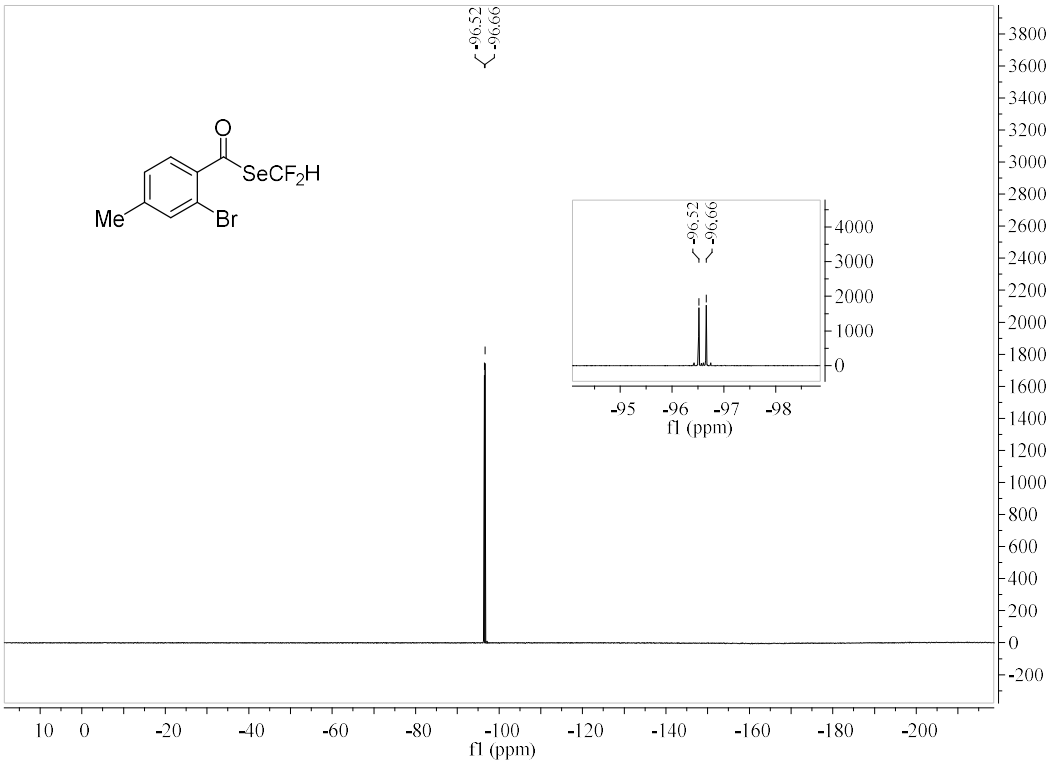
^{13}C NMR spectra of compound **3t**



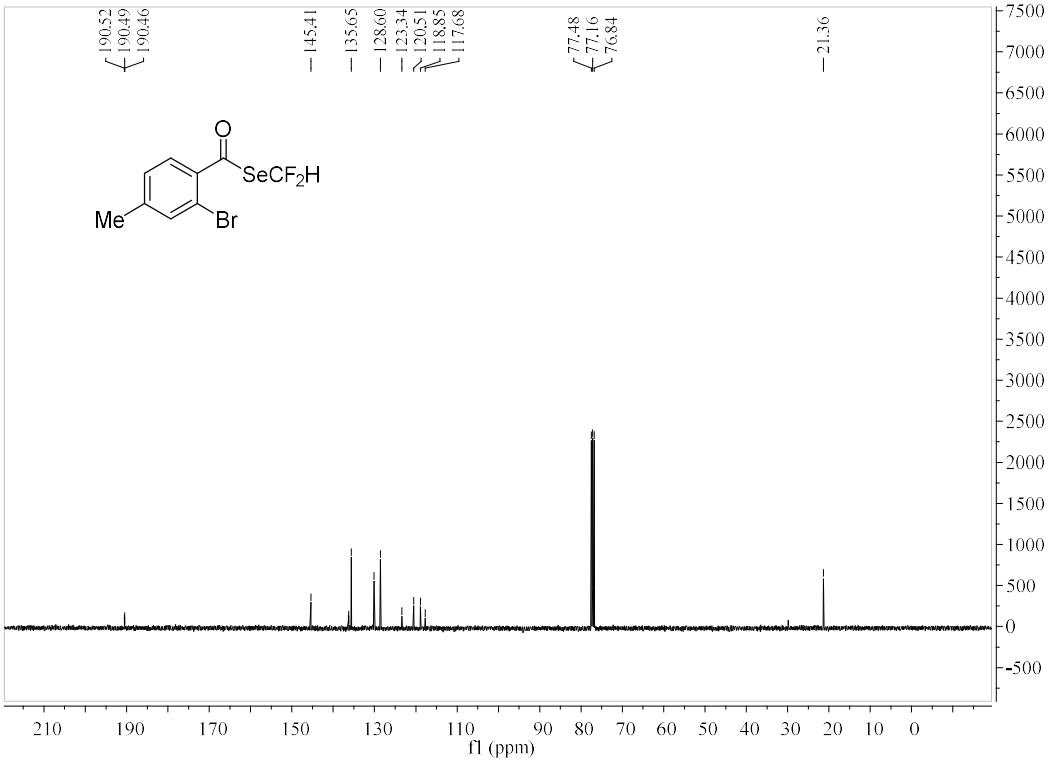
^{1}H NMR spectra of compound **3u**



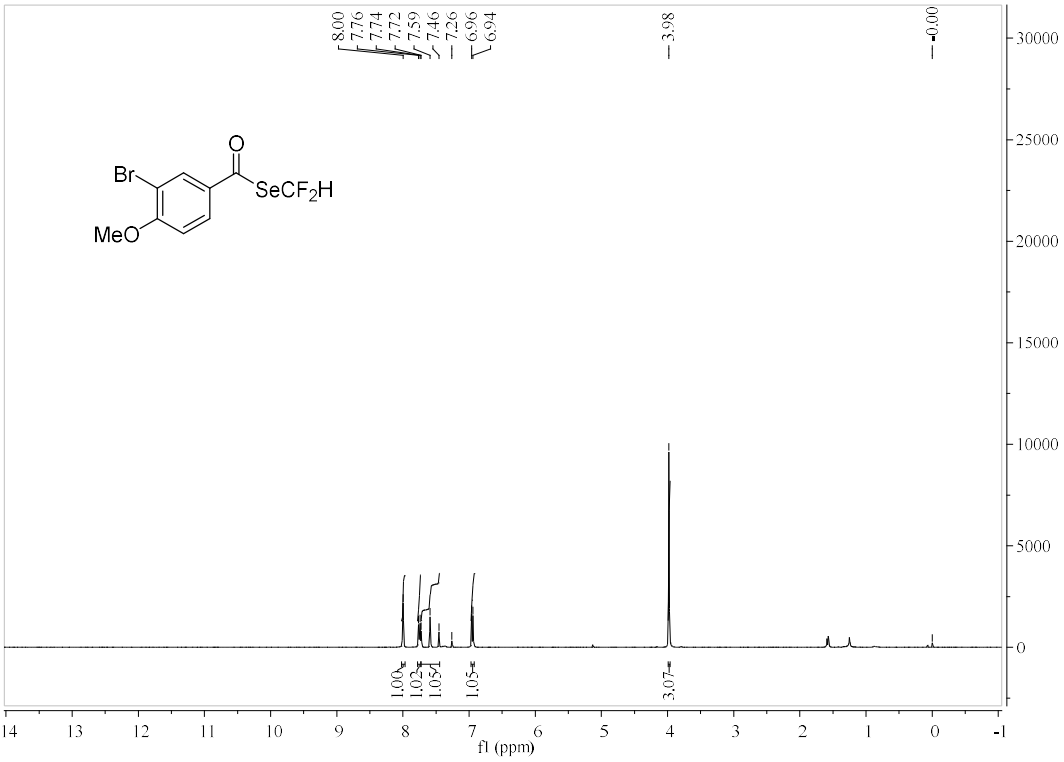
^{19}F NMR spectra of compound **3u**



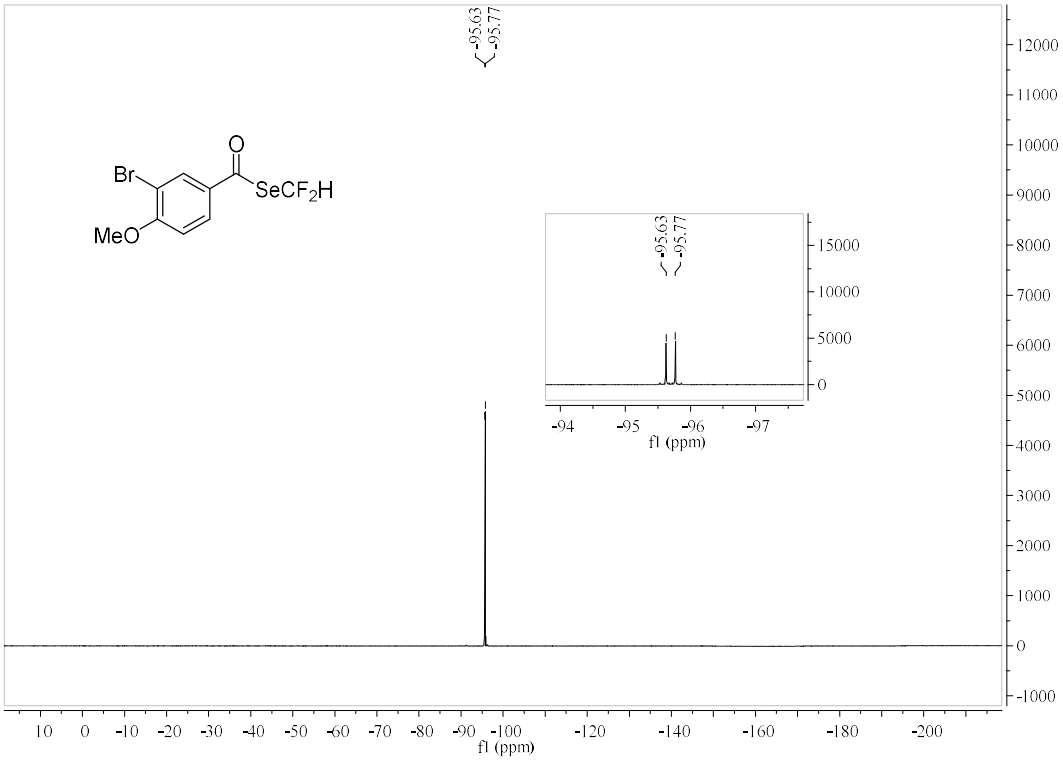
^{13}C NMR spectra of compound **3u**



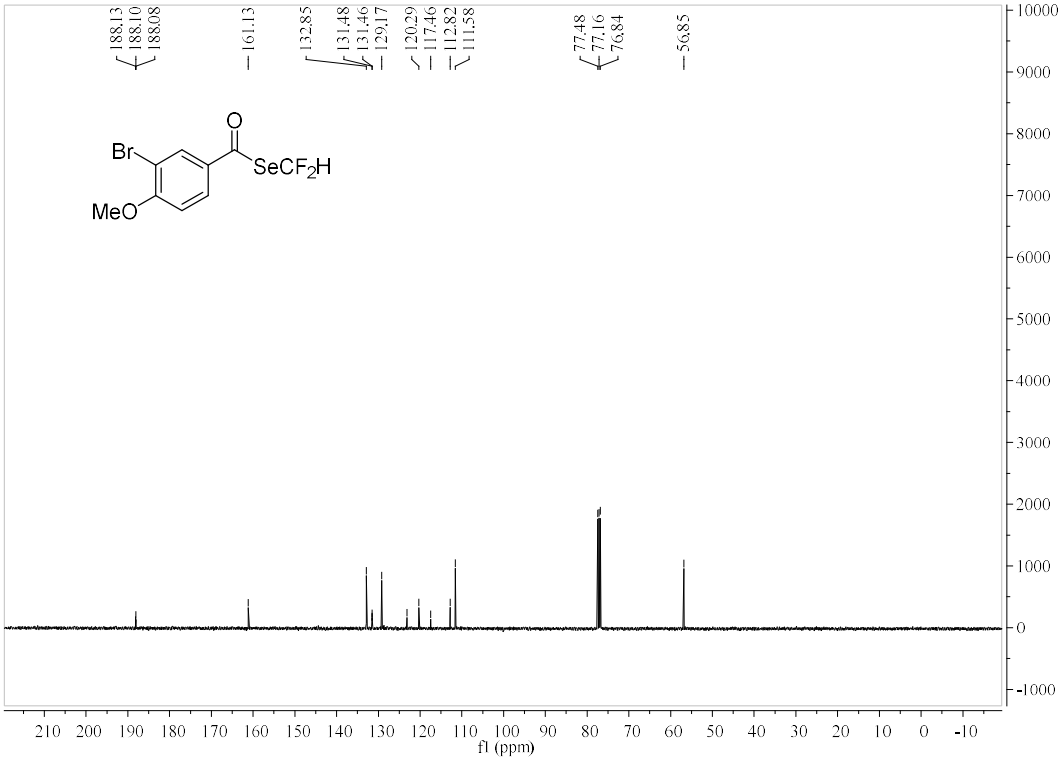
^{1}H NMR spectra of compound **3v**



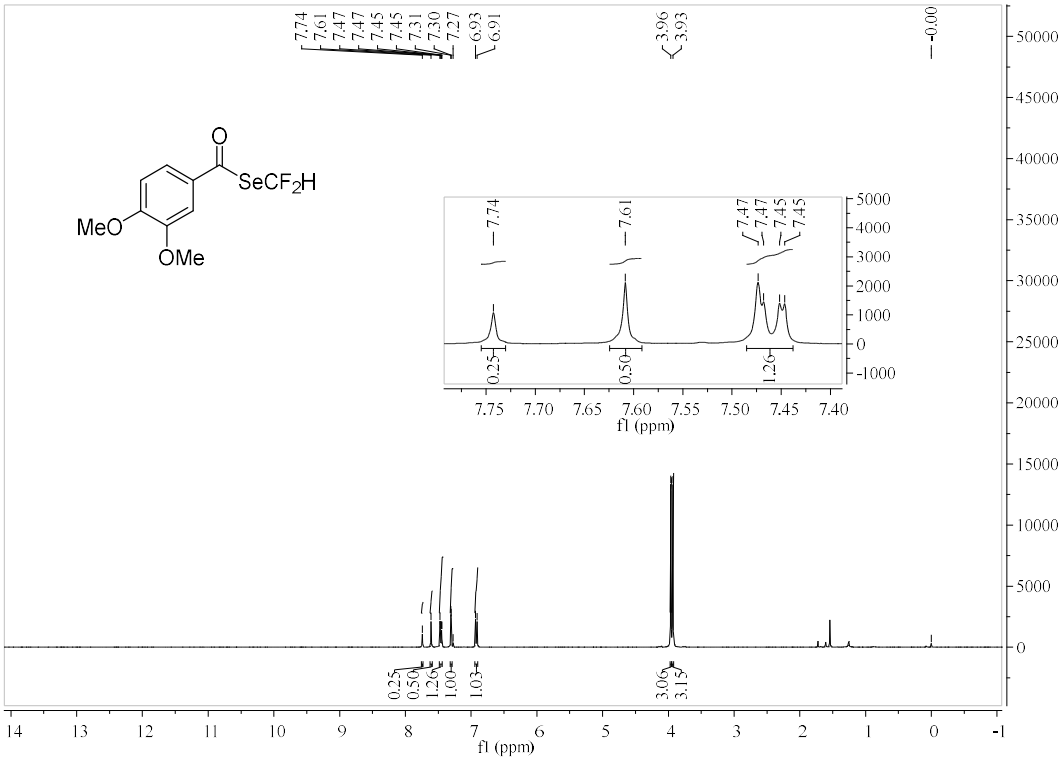
^{19}F NMR spectra of compound **3v**



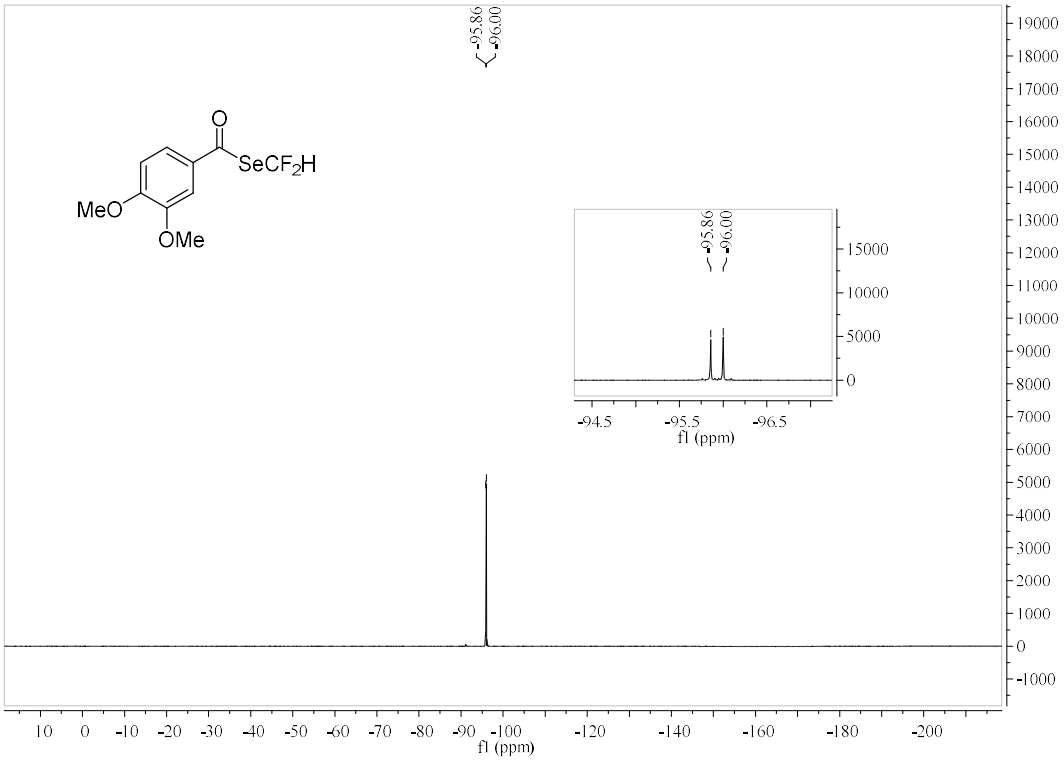
^{13}C NMR spectra of compound **3v**



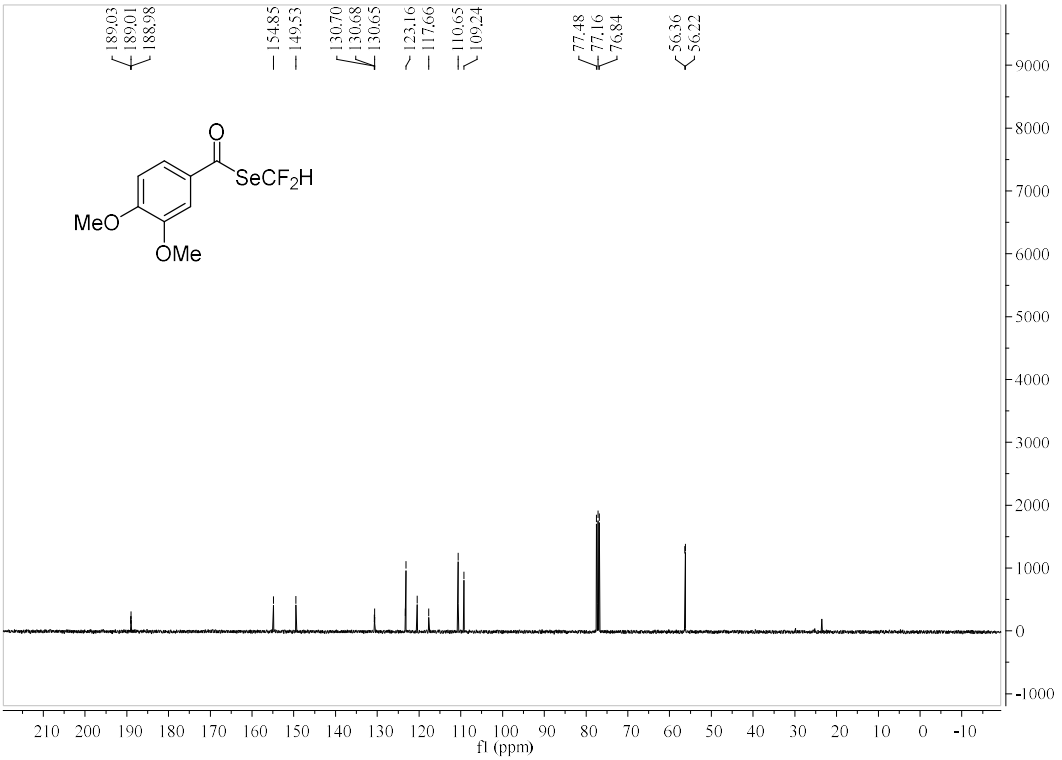
^{1}H NMR spectra of compound **3w**



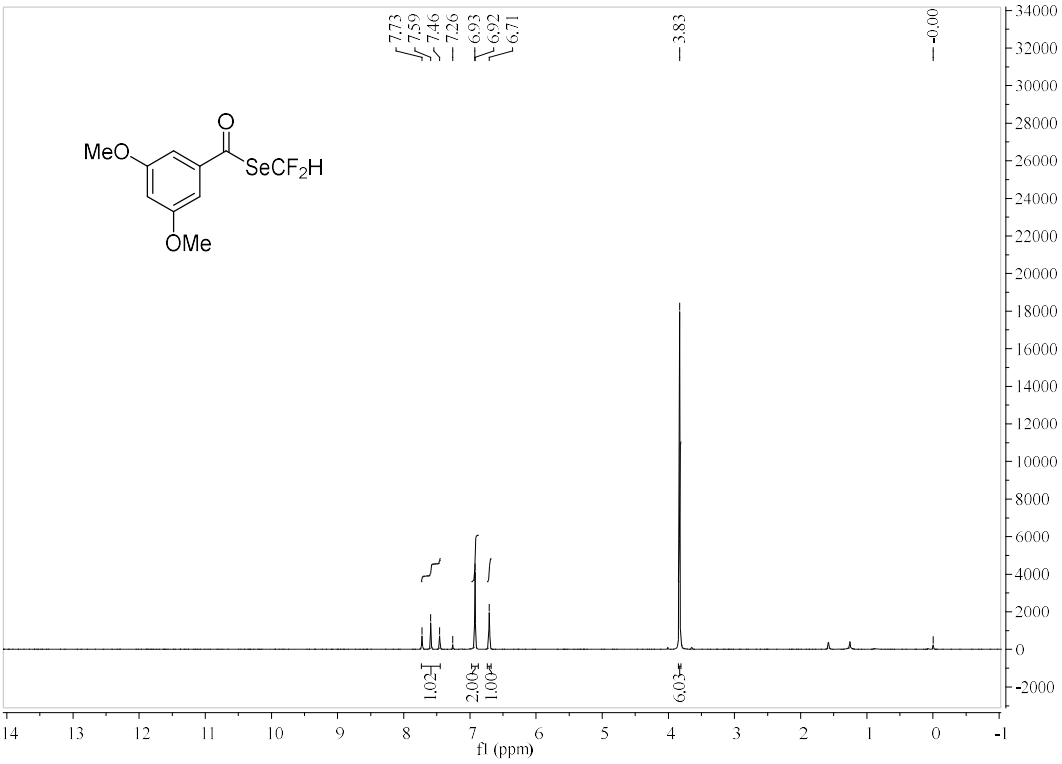
^{19}F NMR spectra of compound **3w**



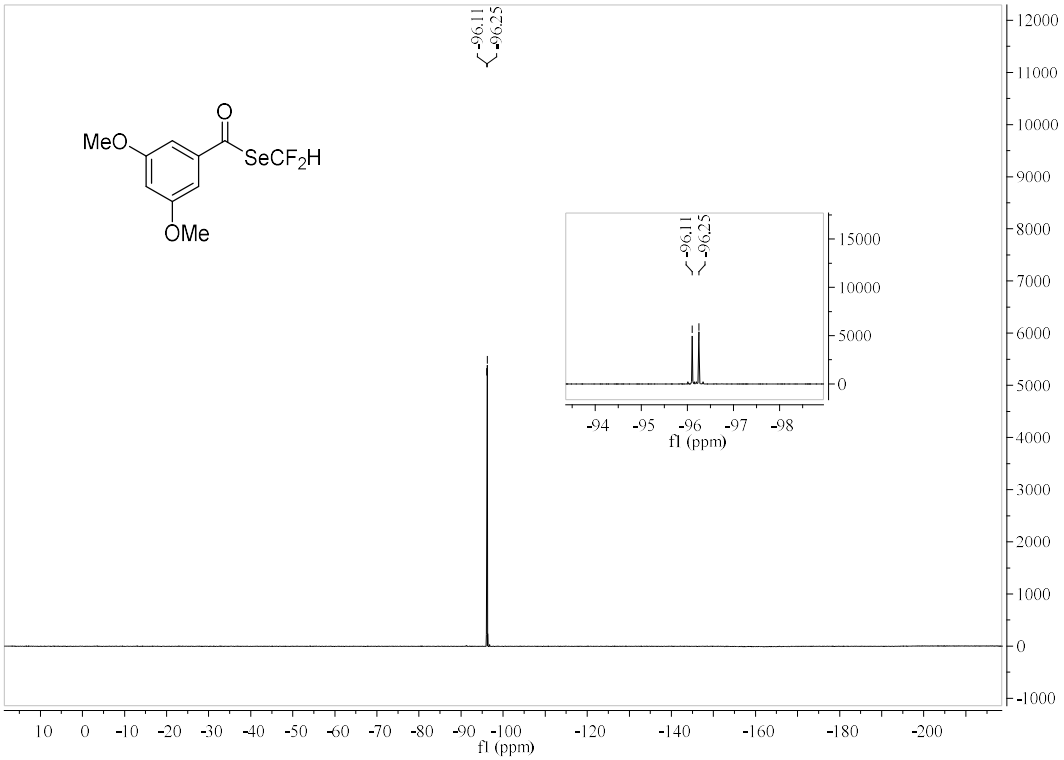
^{13}C NMR spectra of compound **3w**



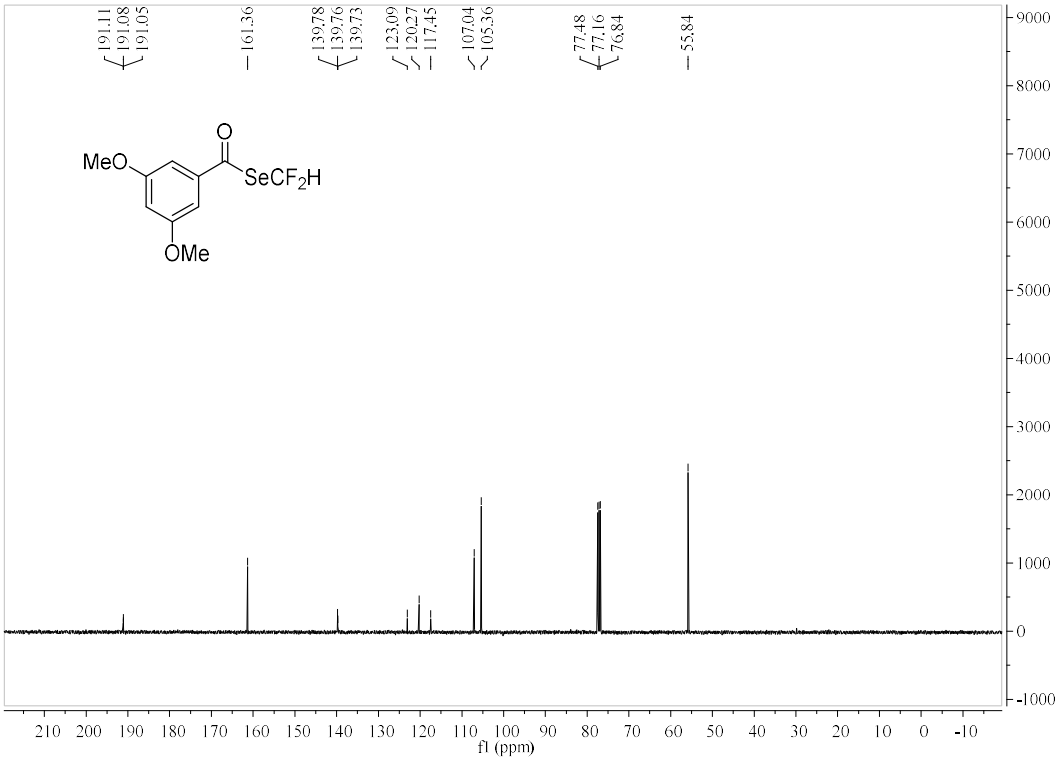
^{1}H NMR spectra of compound **3x**



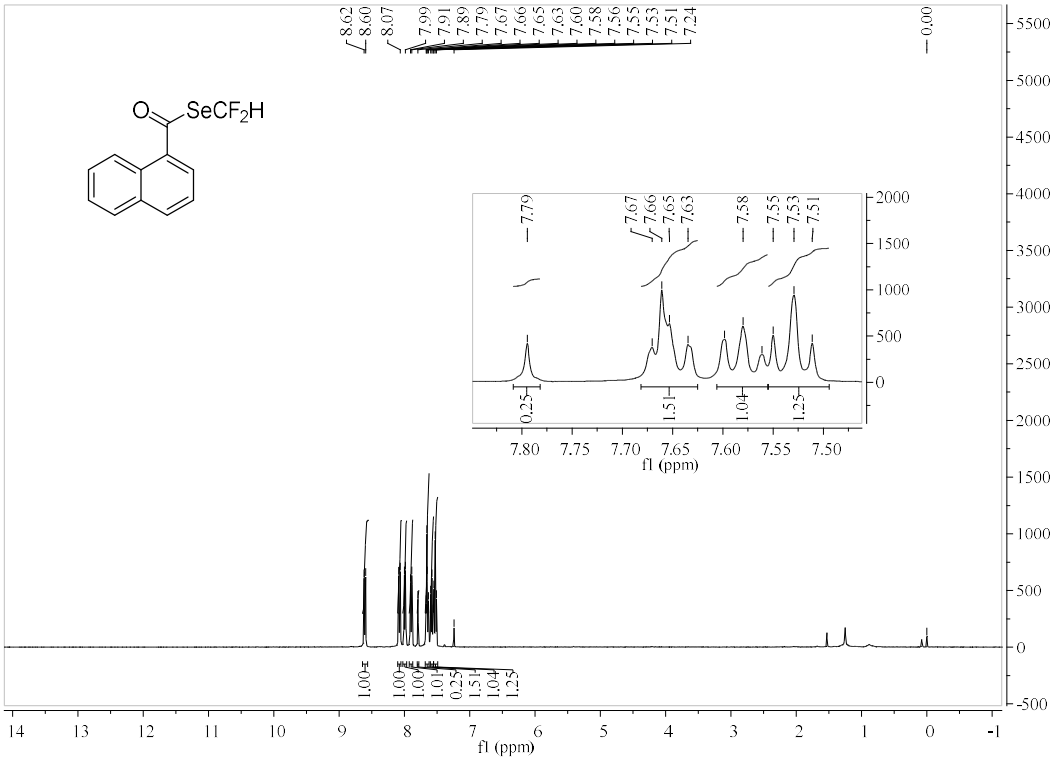
^{19}F NMR spectra of compound **3x**



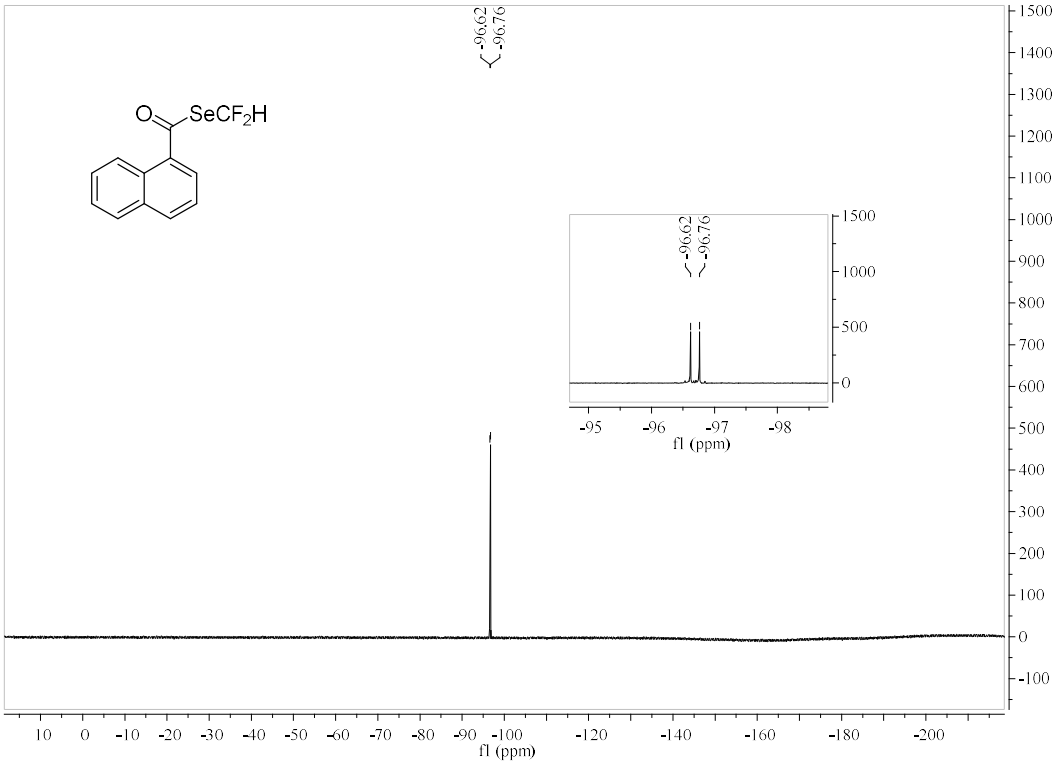
^{13}C NMR spectra of compound **3x**



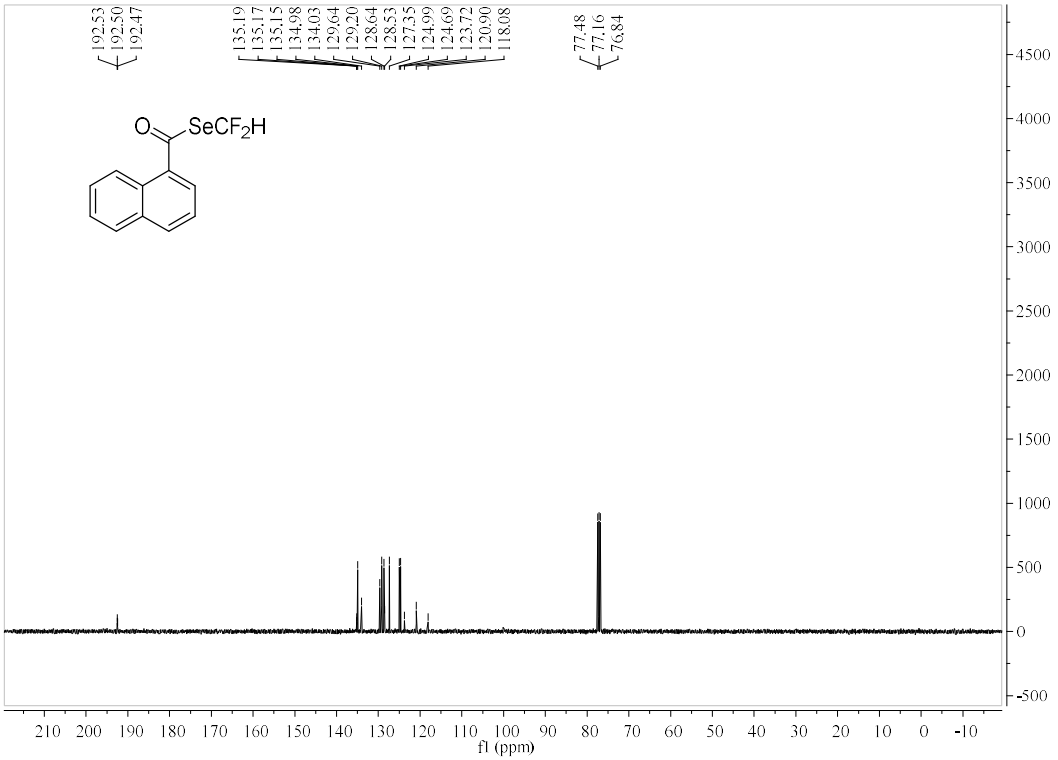
^{1}H NMR spectra of compound **3aa**



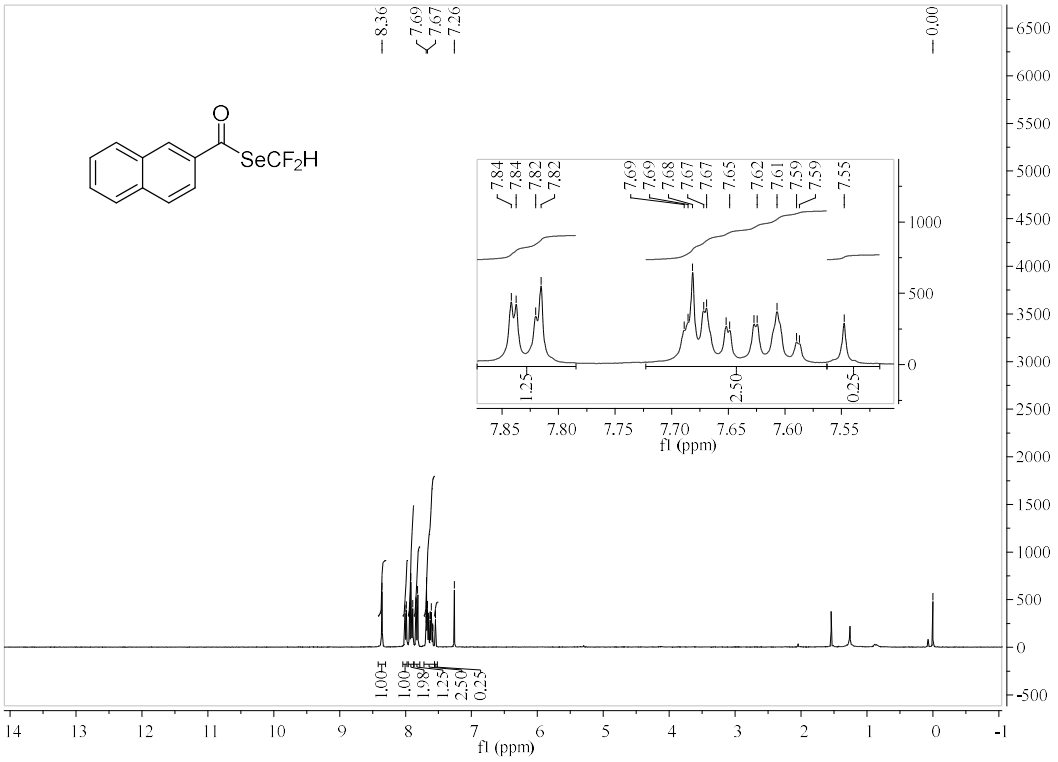
^{19}F NMR spectra of compound **3aa**



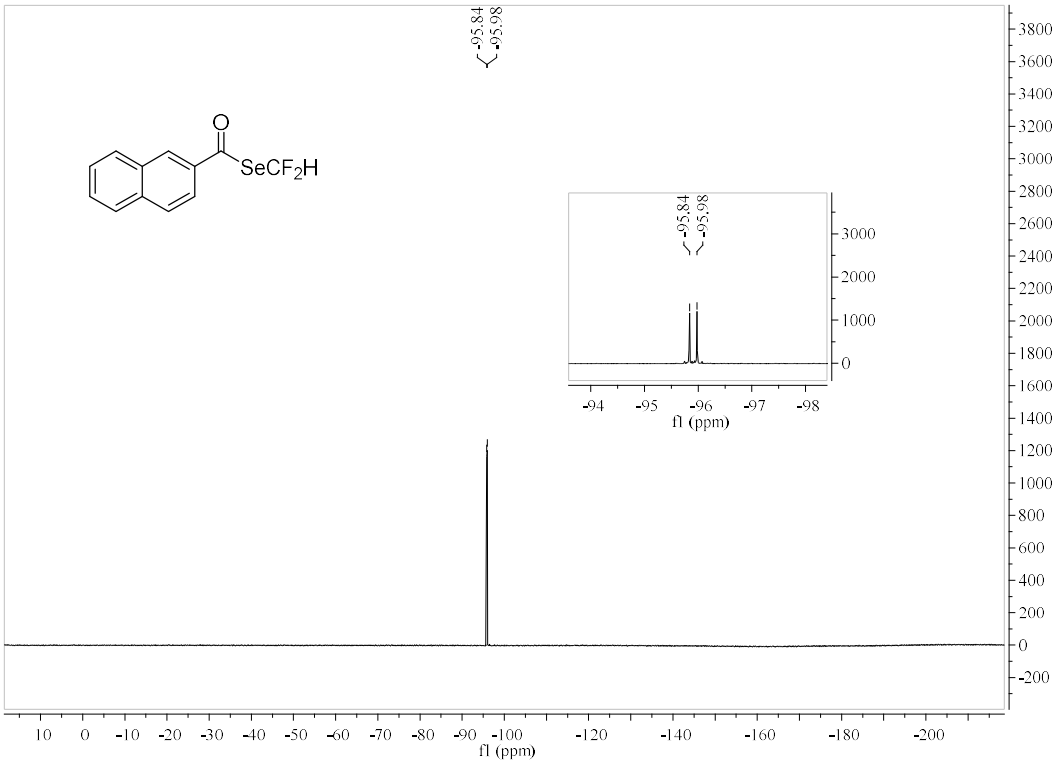
^{13}C NMR spectra of compound **3aa**



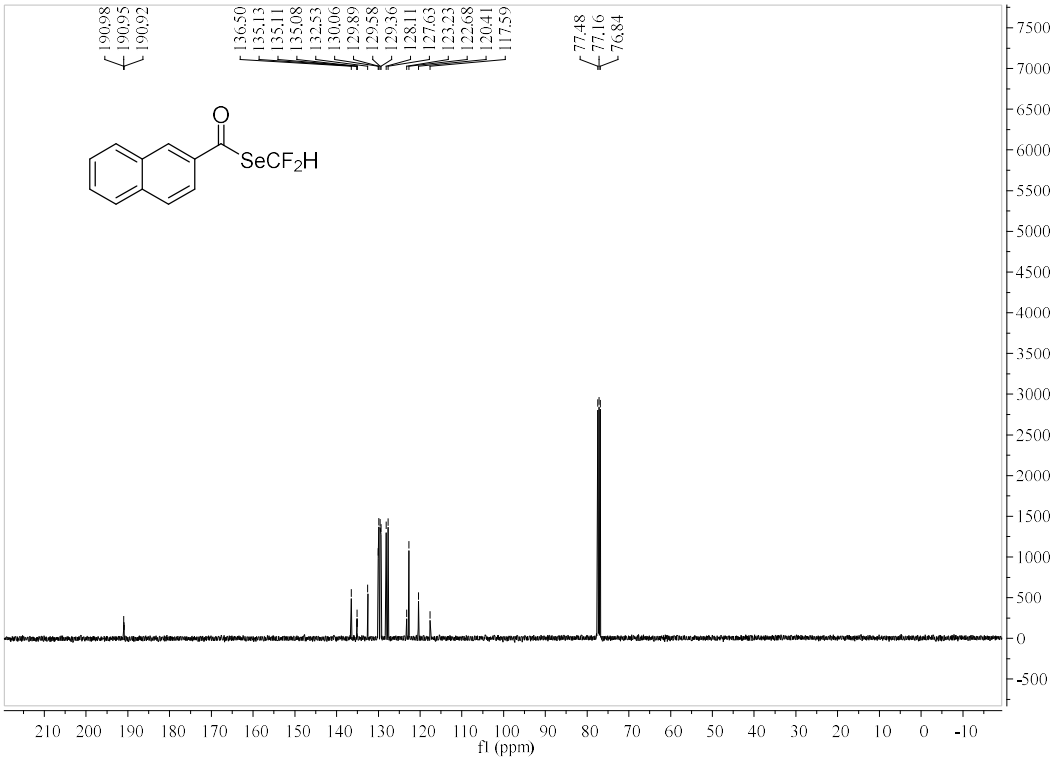
^{1}H NMR spectra of compound **3ab**



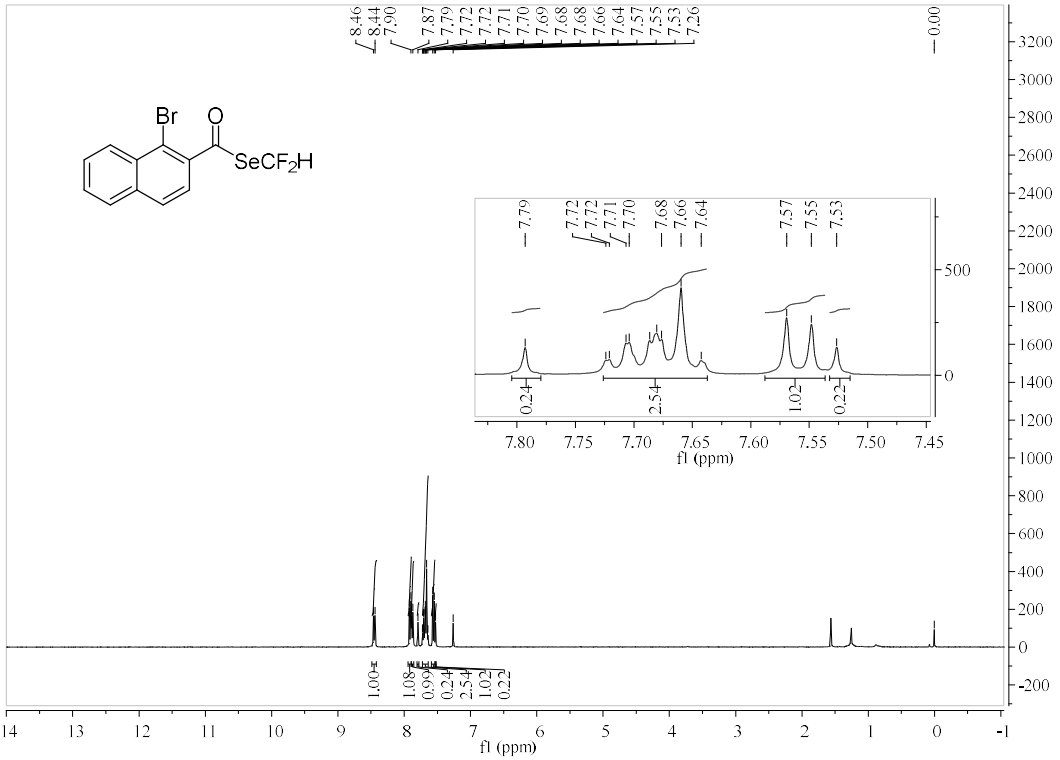
^{19}F NMR spectra of compound **3ab**



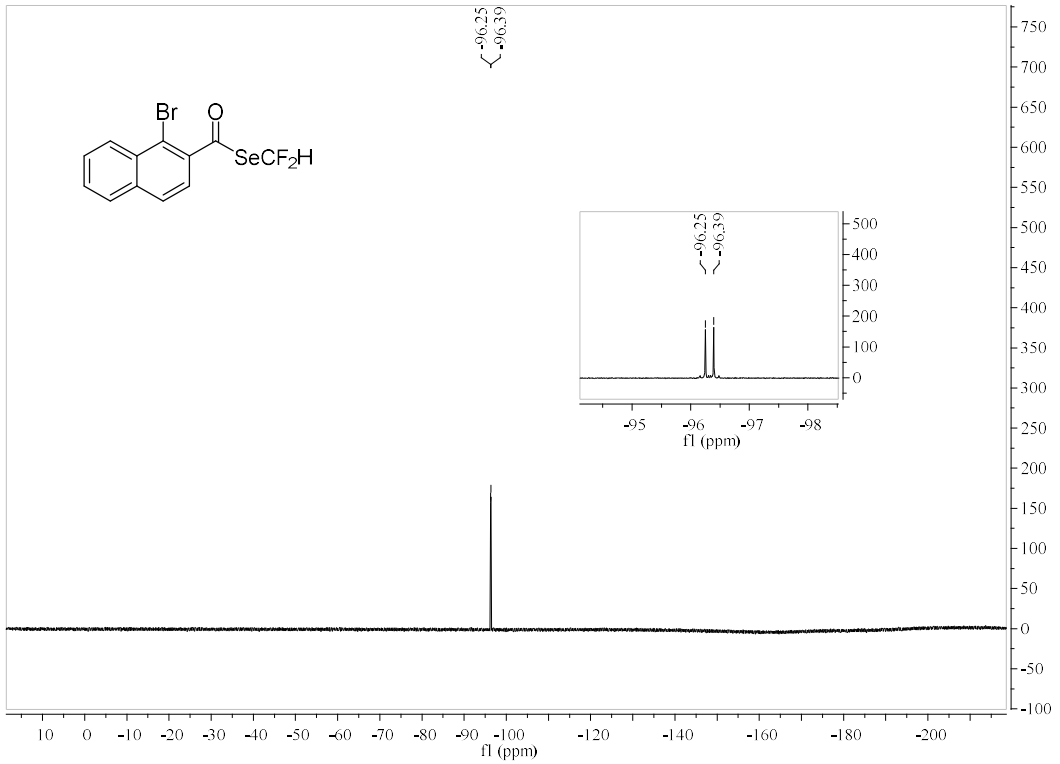
^{13}C NMR spectra of compound **3ab**



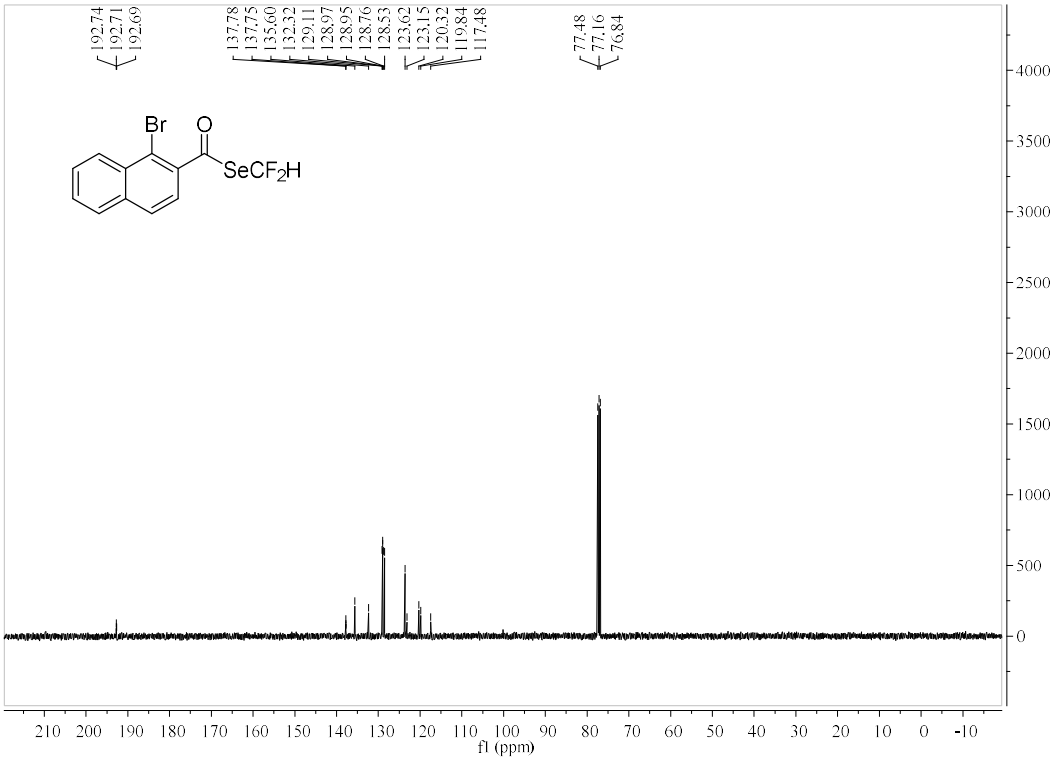
^{1}H NMR spectra of compound **3ac**



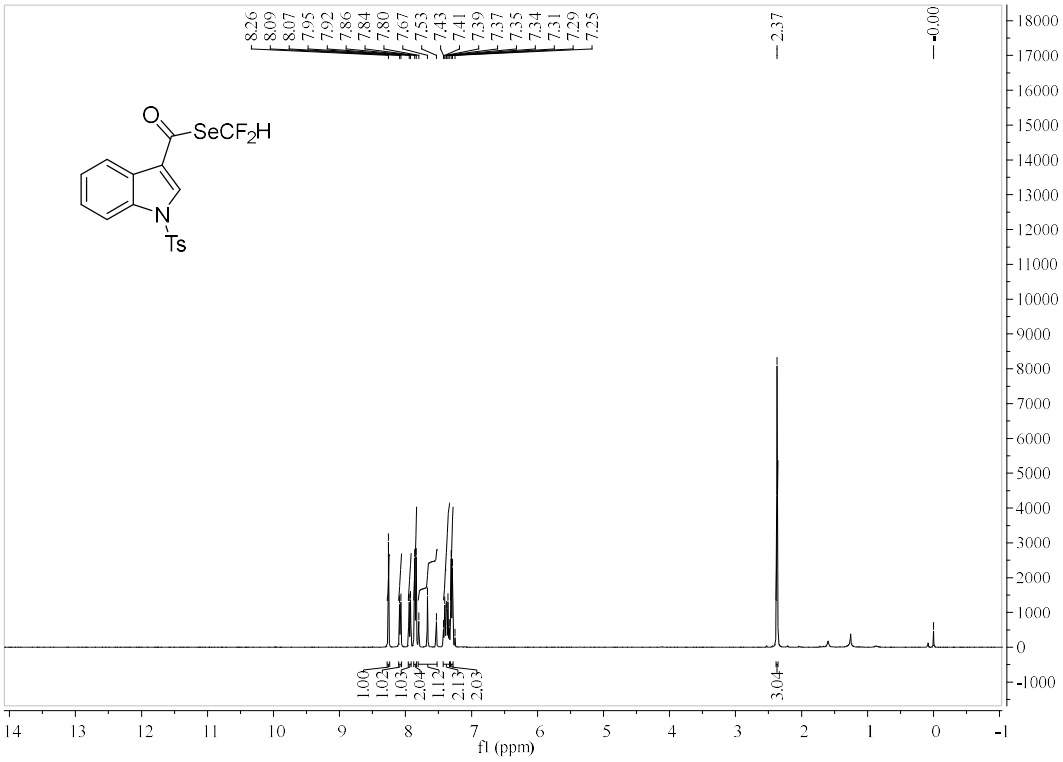
^{19}F NMR spectra of compound **3ac**



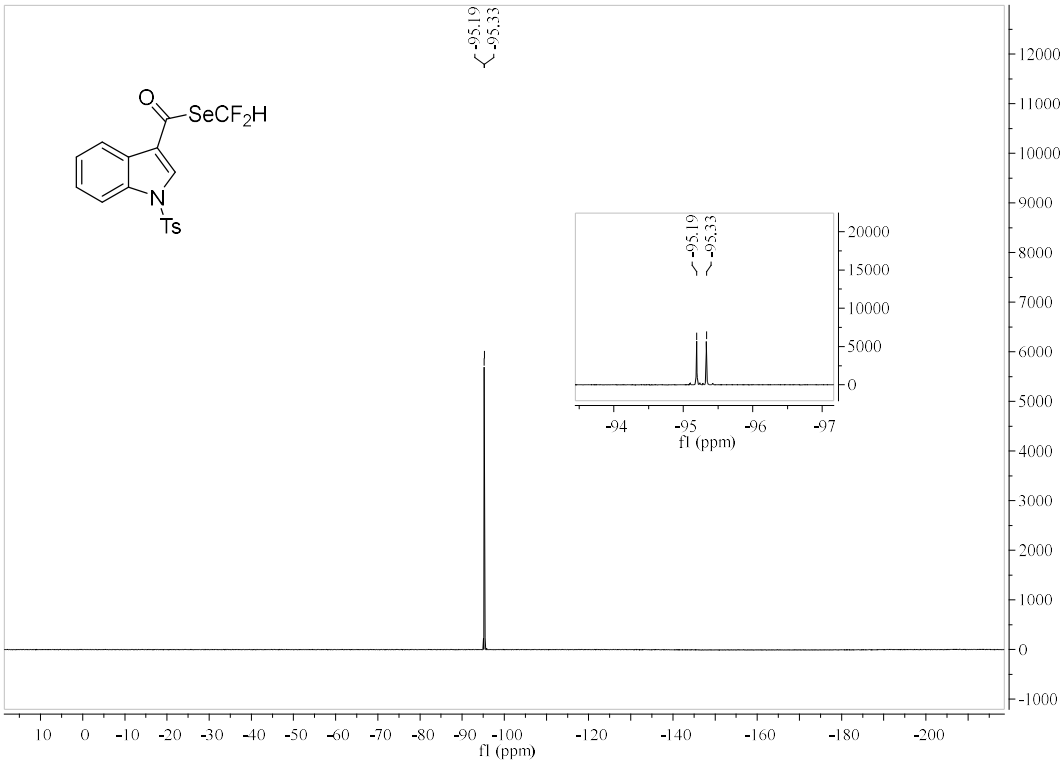
^{13}C NMR spectra of compound **3ac**



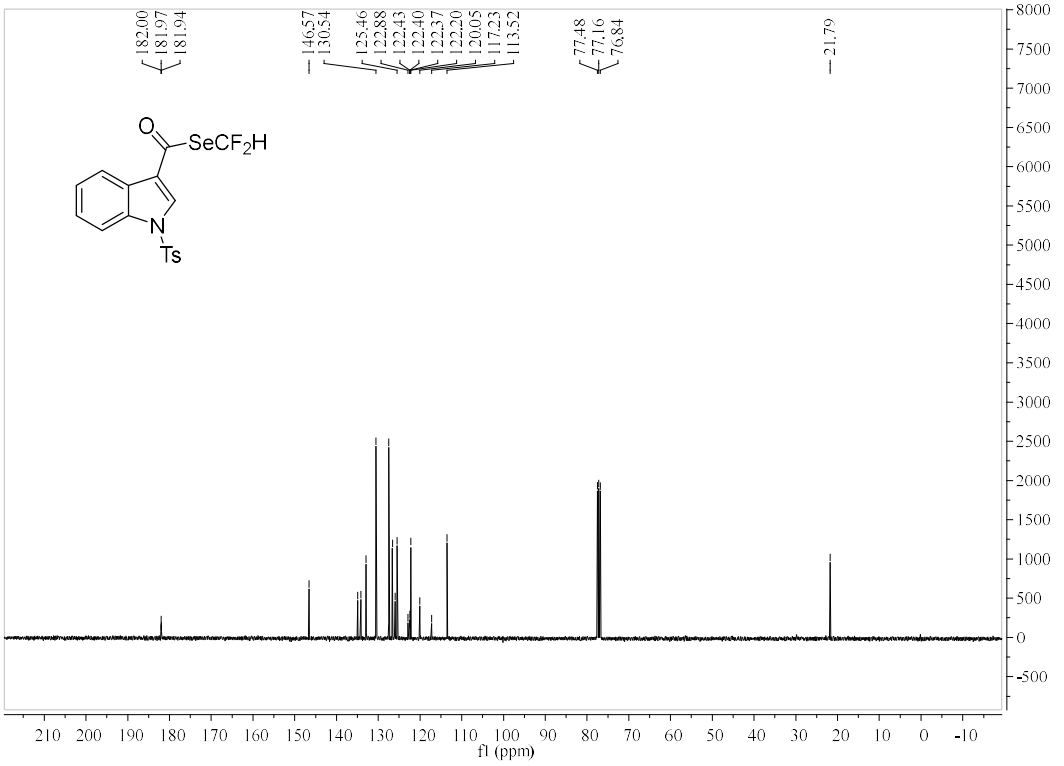
^{1}H NMR spectra of compound **3ad**



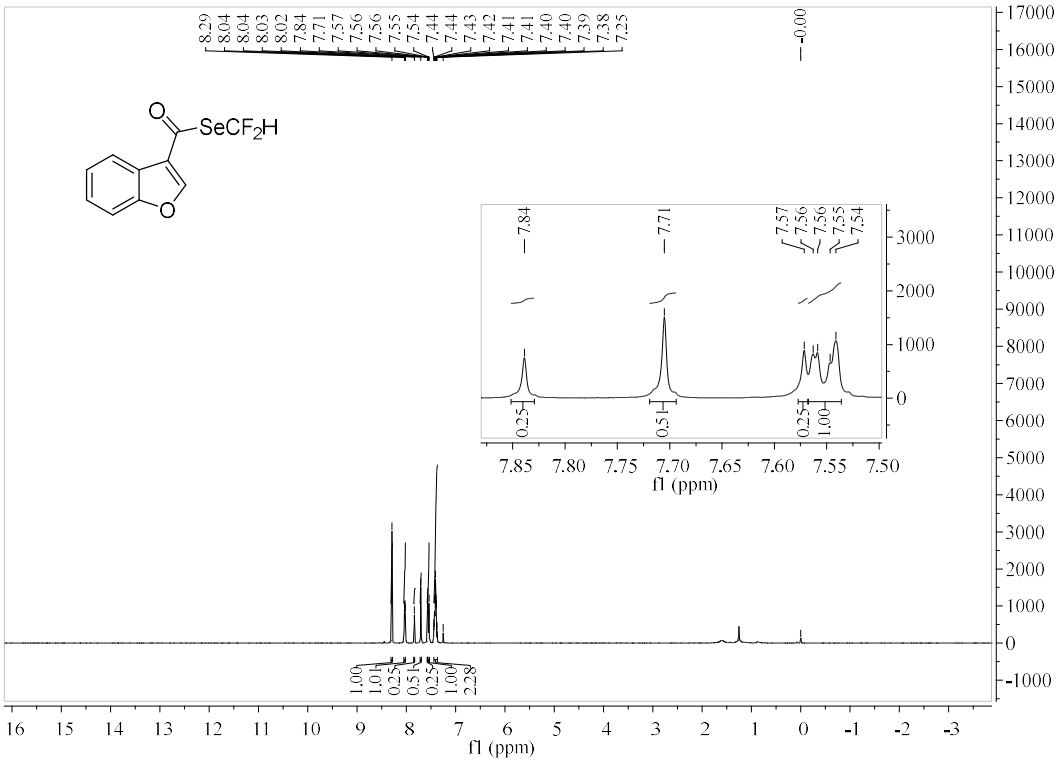
^{19}F NMR spectra of compound **3ad**



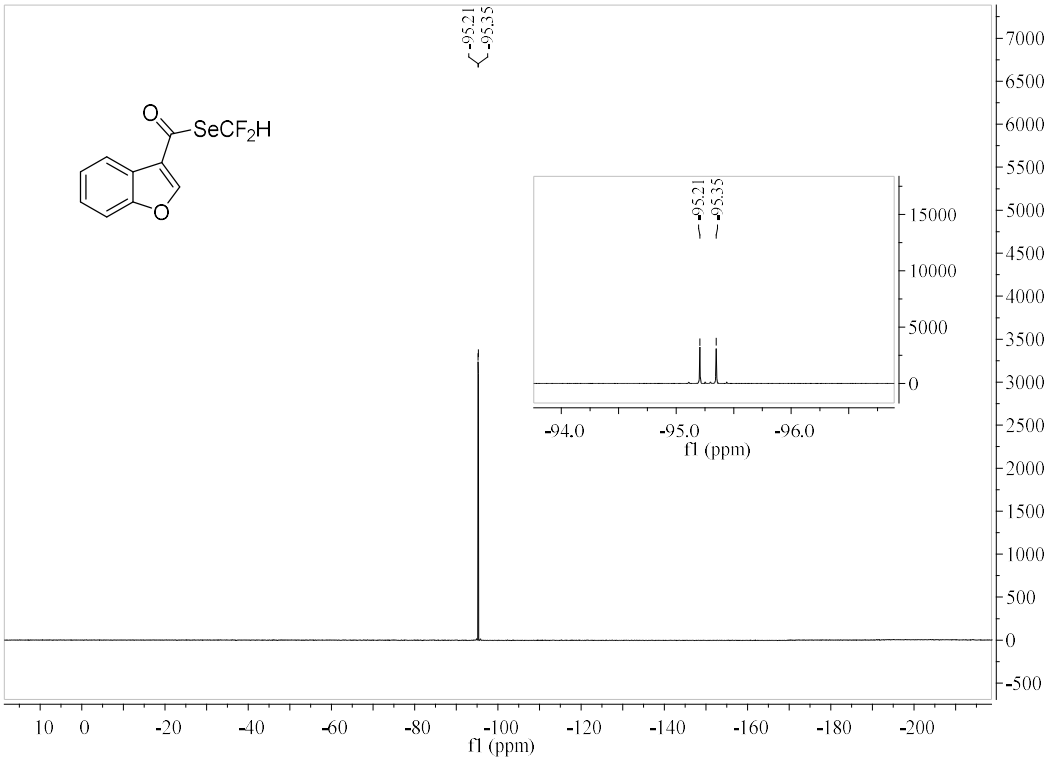
^{13}C NMR spectra of compound **3ad**



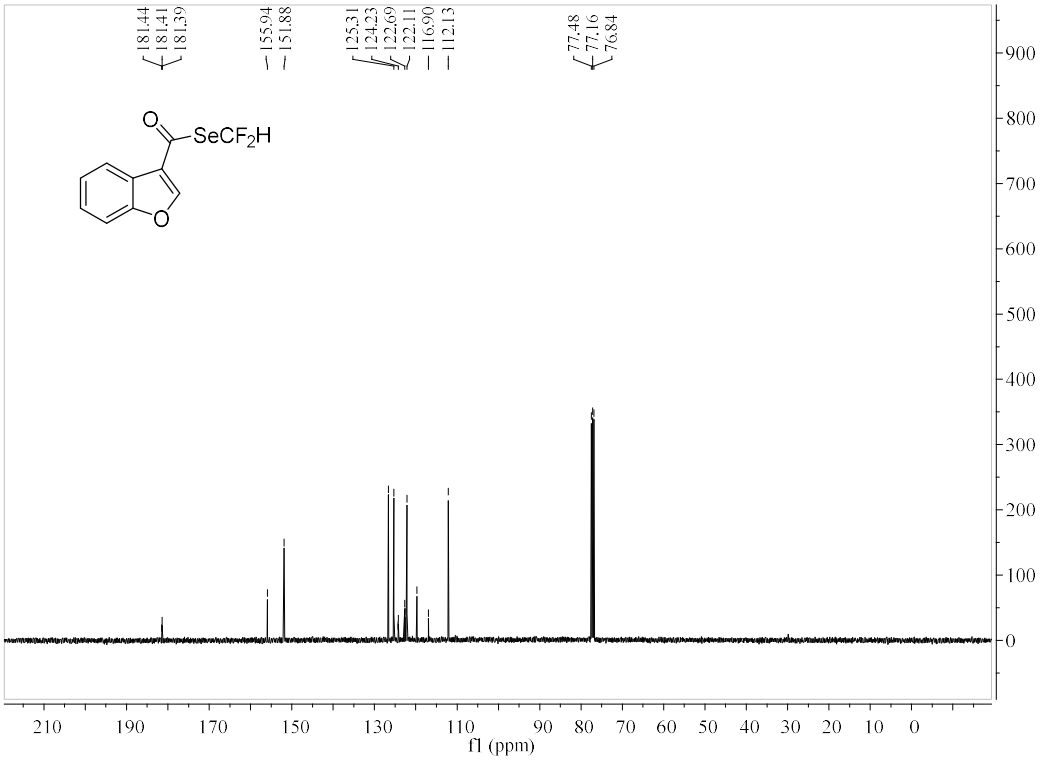
^{1}H NMR spectra of compound **3ae**



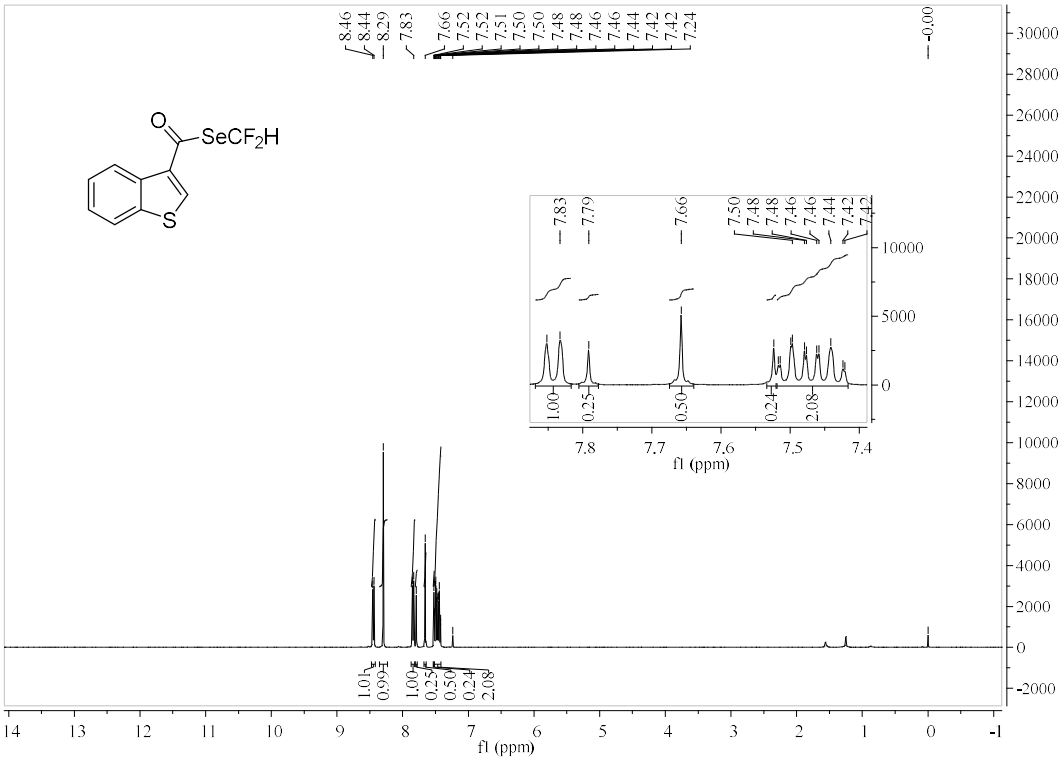
^{19}F NMR spectra of compound **3ae**



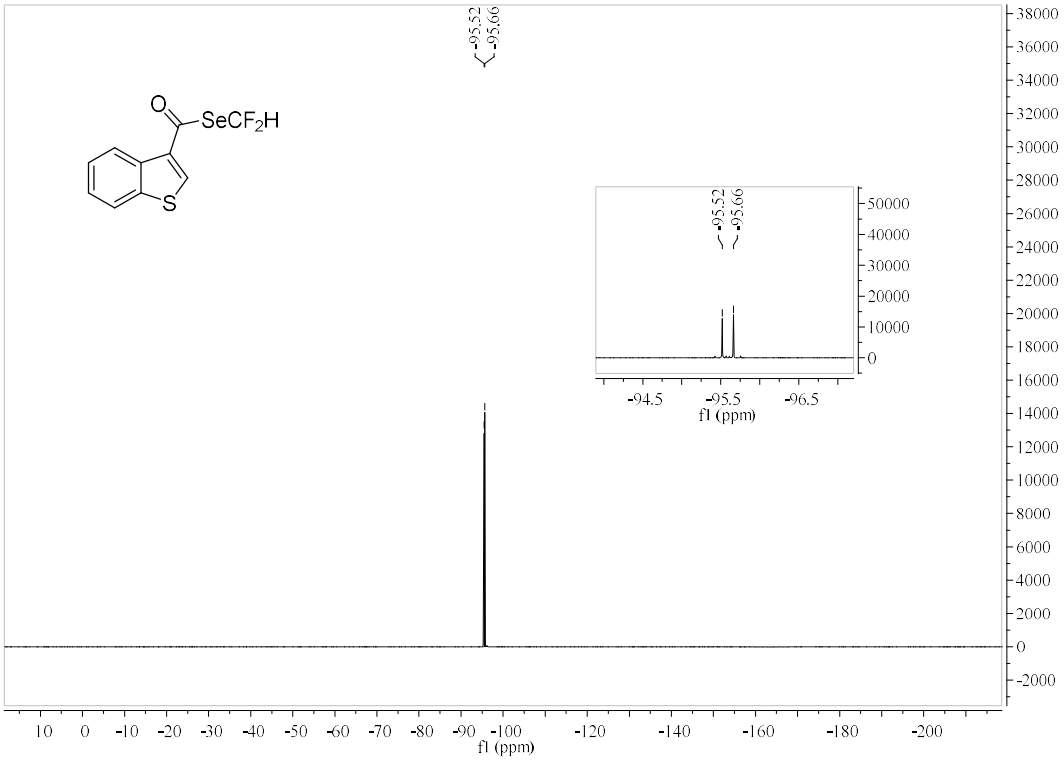
^{13}C NMR spectra of compound **3ae**



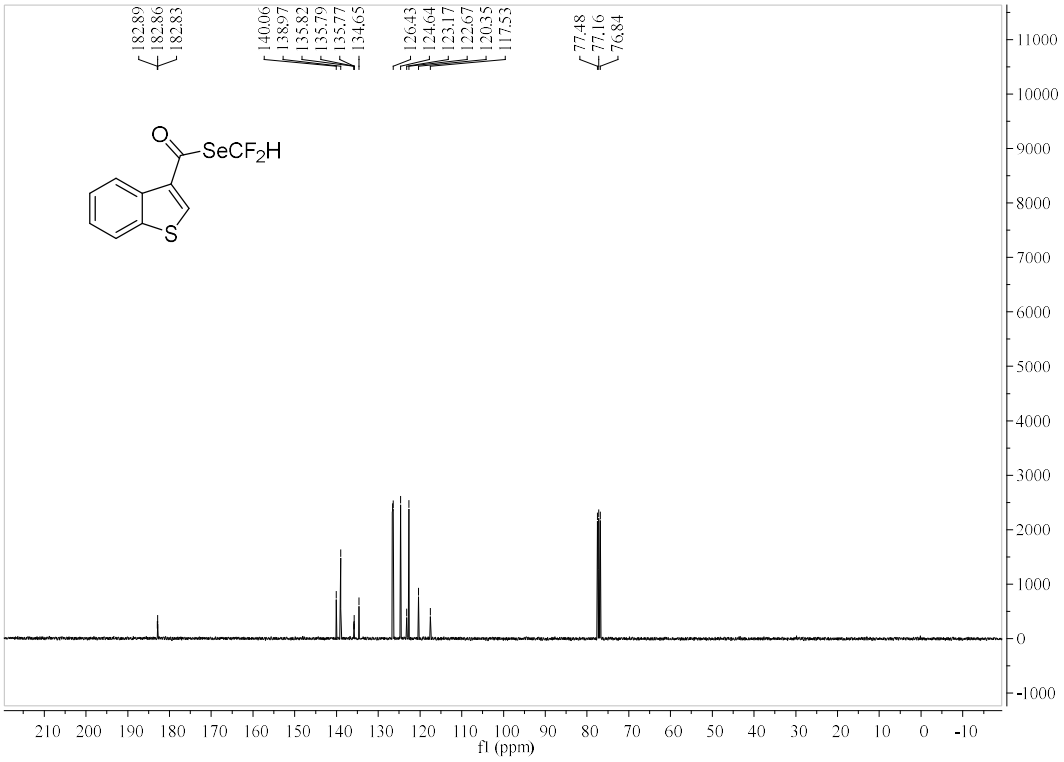
^{1}H NMR spectra of compound **3af**



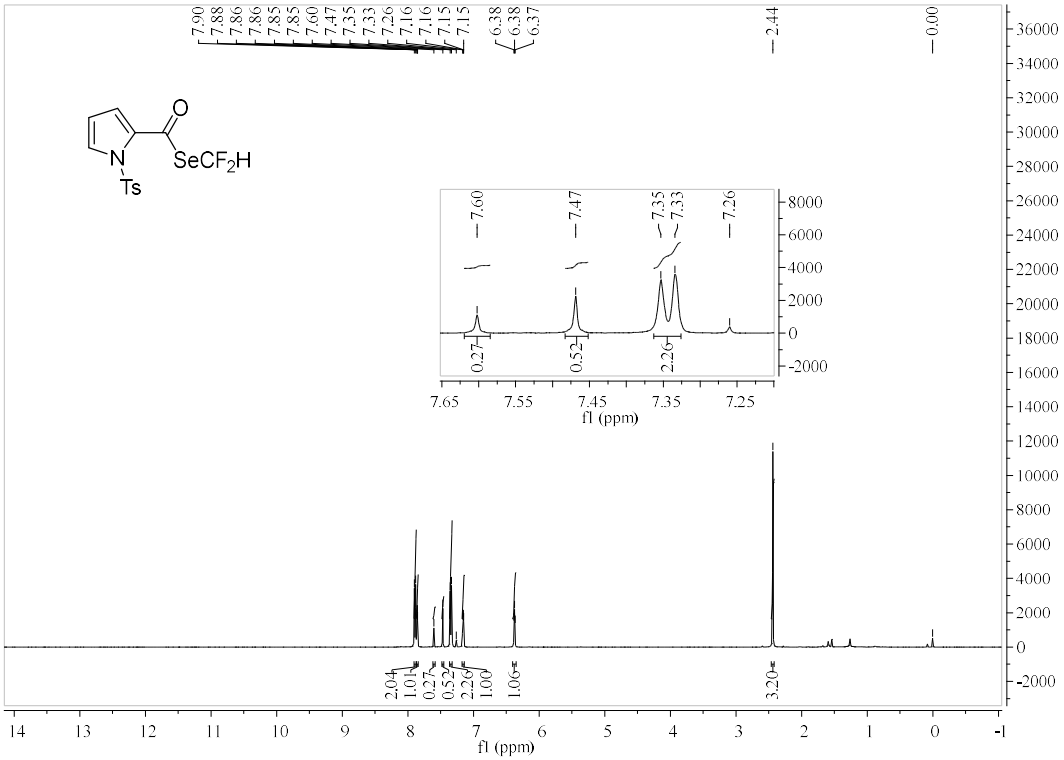
^{19}F NMR spectra of compound **3af**



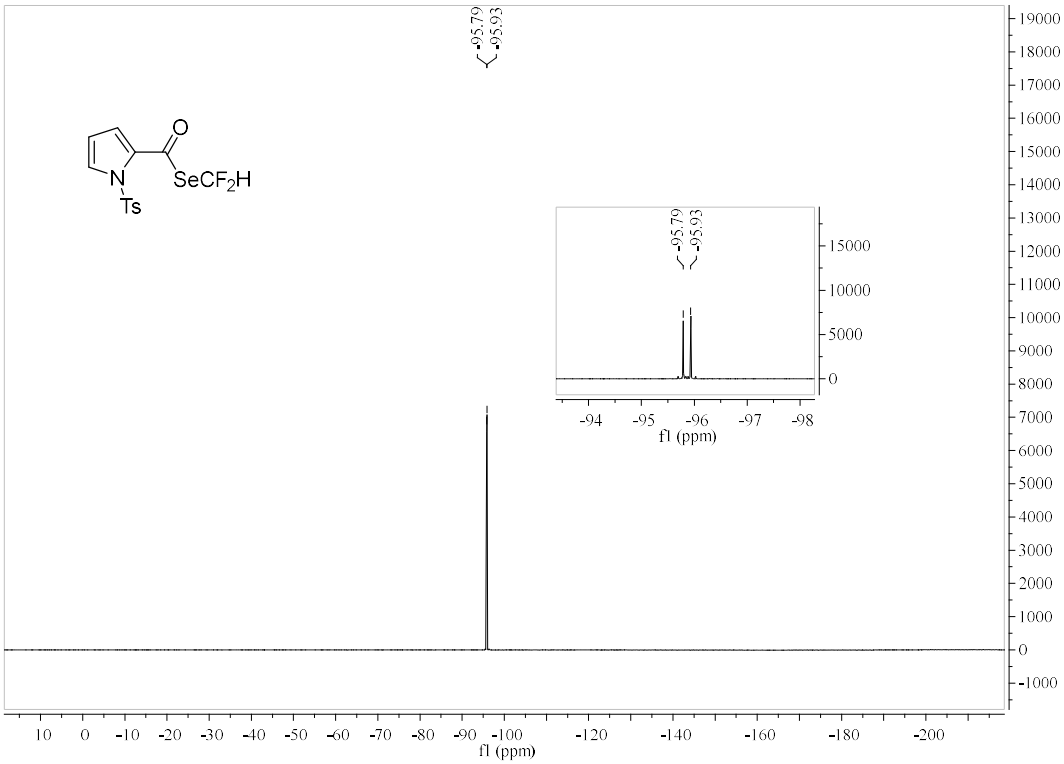
^{13}C NMR spectra of compound **3af**



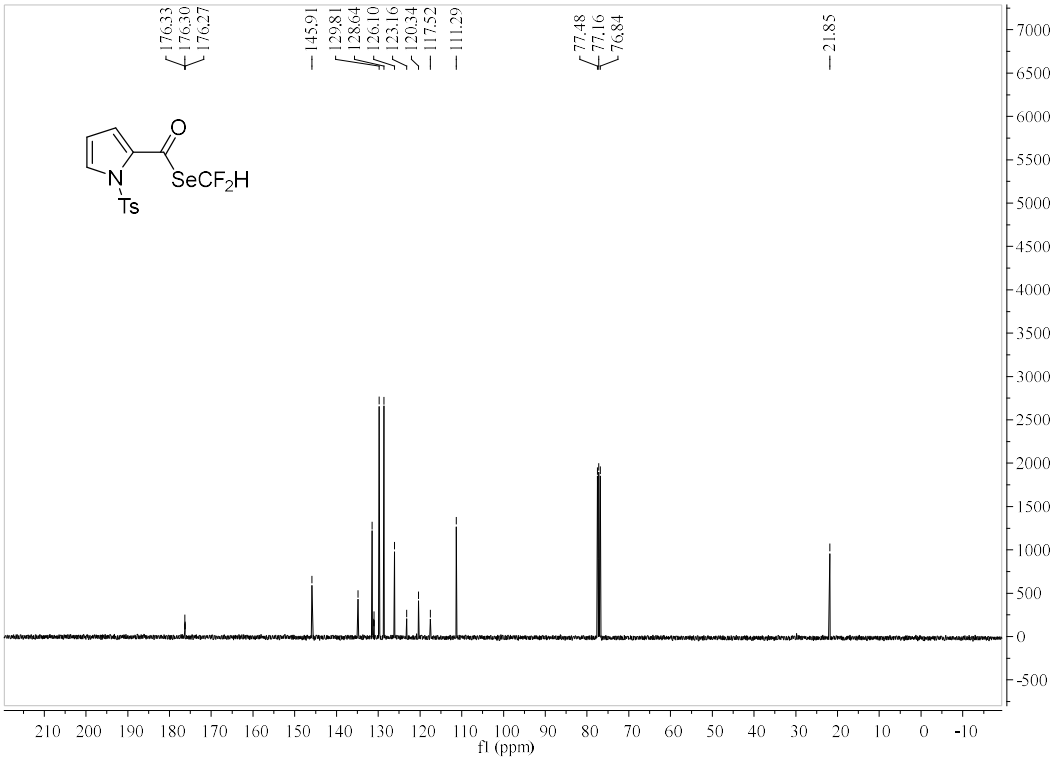
^{1}H NMR spectra of compound **3ag**



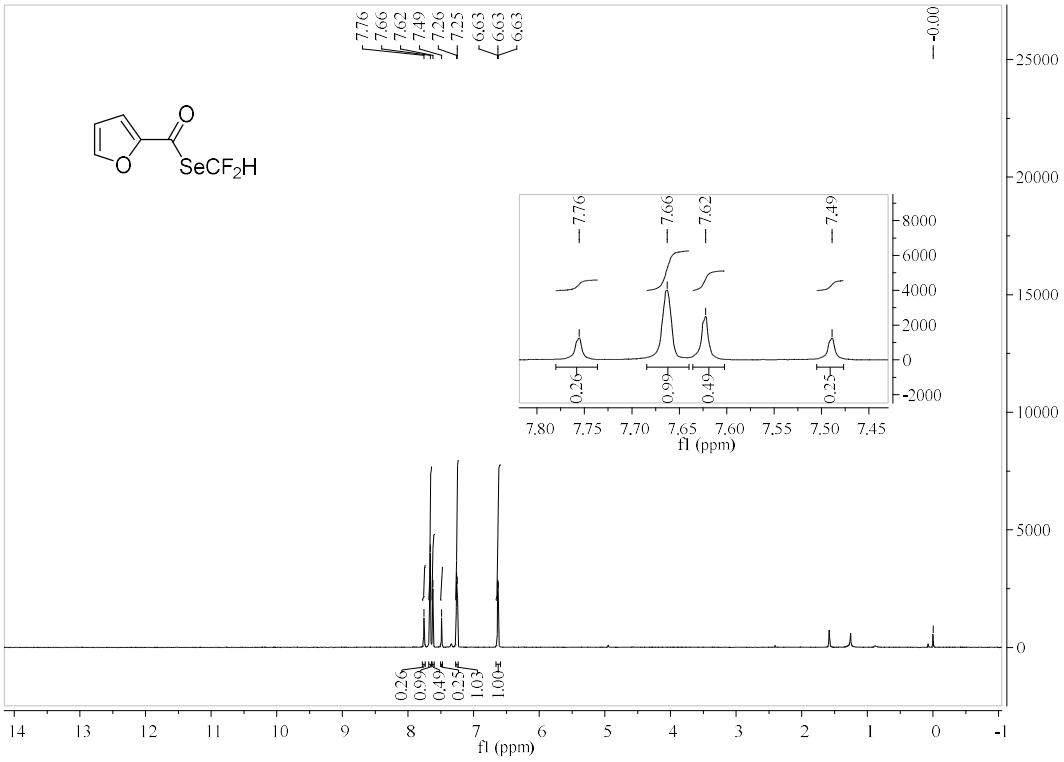
^{19}F NMR spectra of compound **3ag**



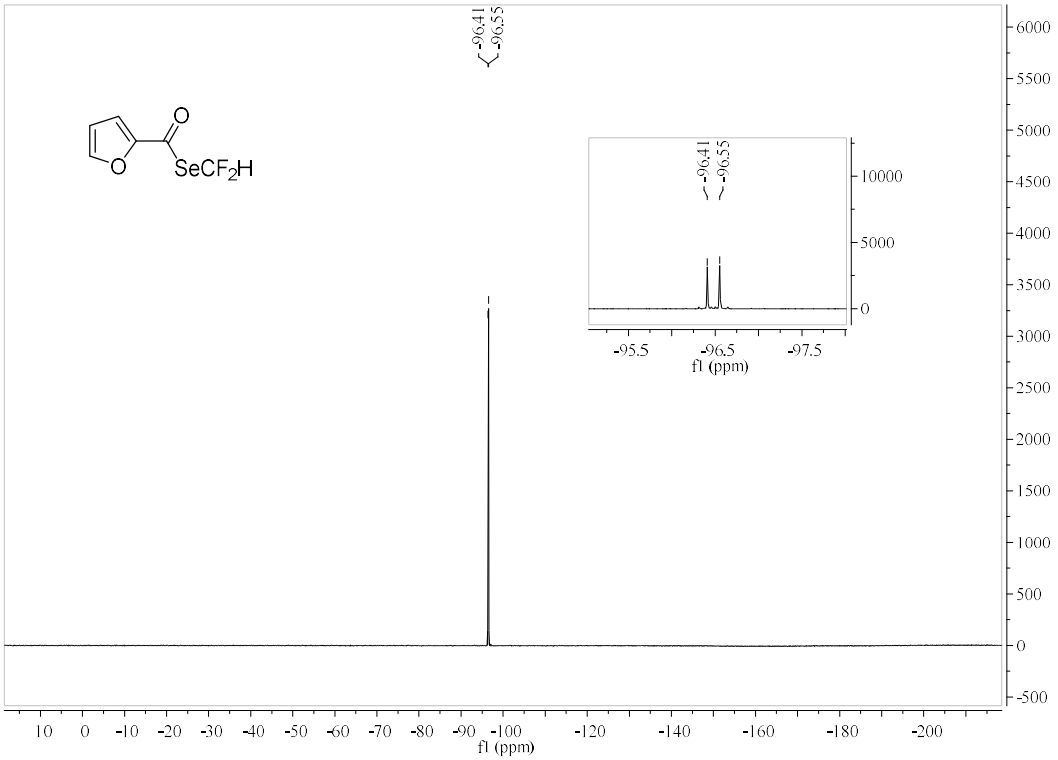
^{13}C NMR spectra of compound **3ag**



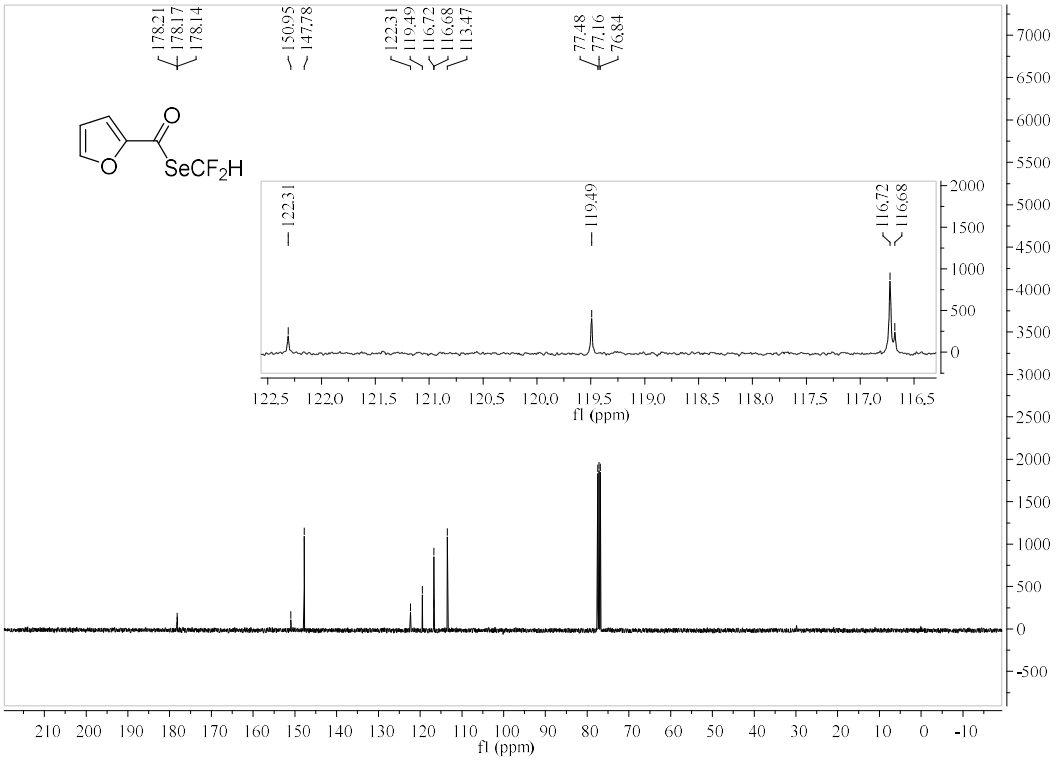
^{1}H NMR spectra of compound **3ah**



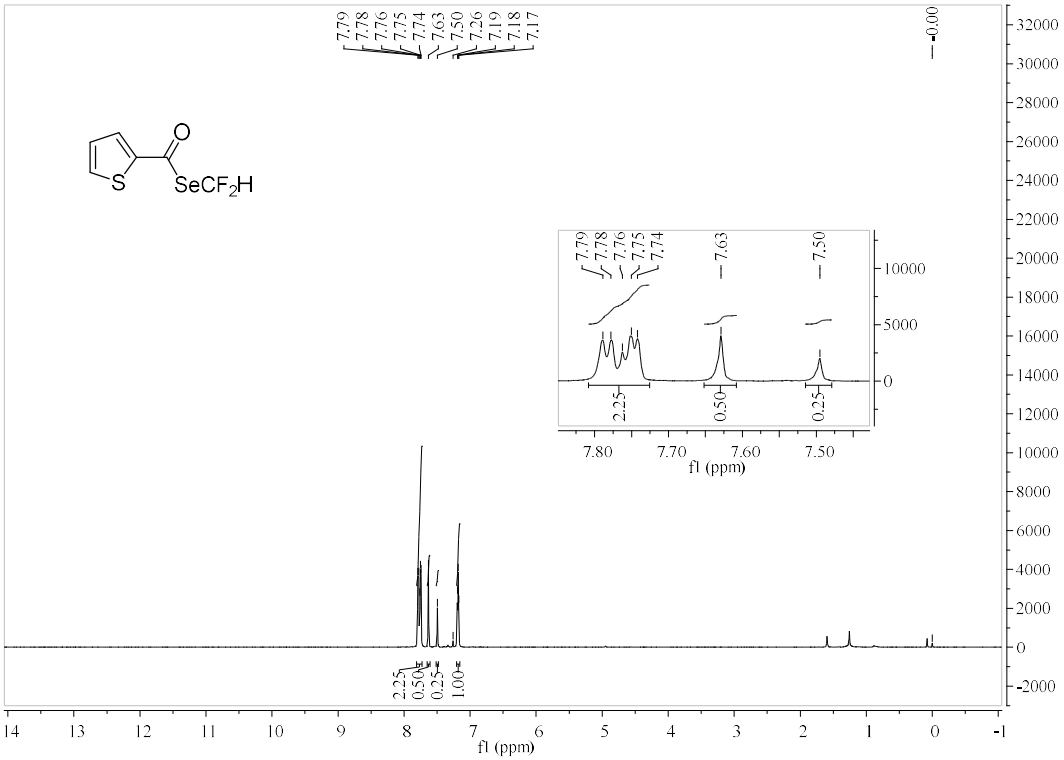
^{19}F NMR spectra of compound **3ah**



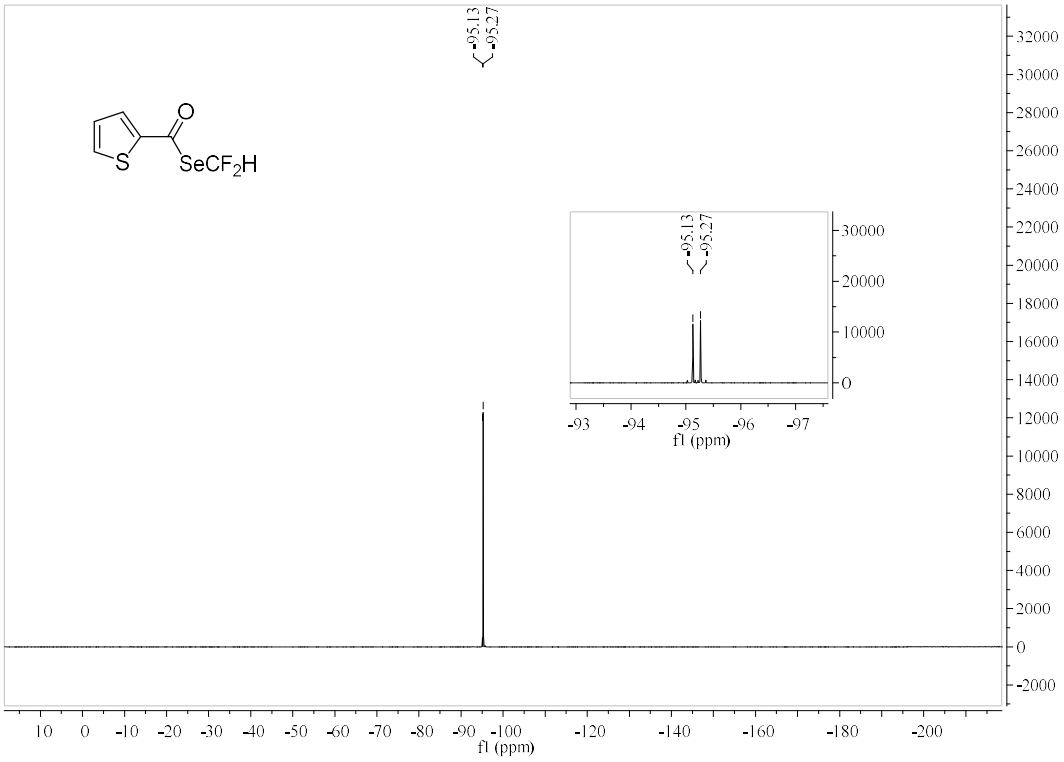
^{13}C NMR spectra of compound **3ah**



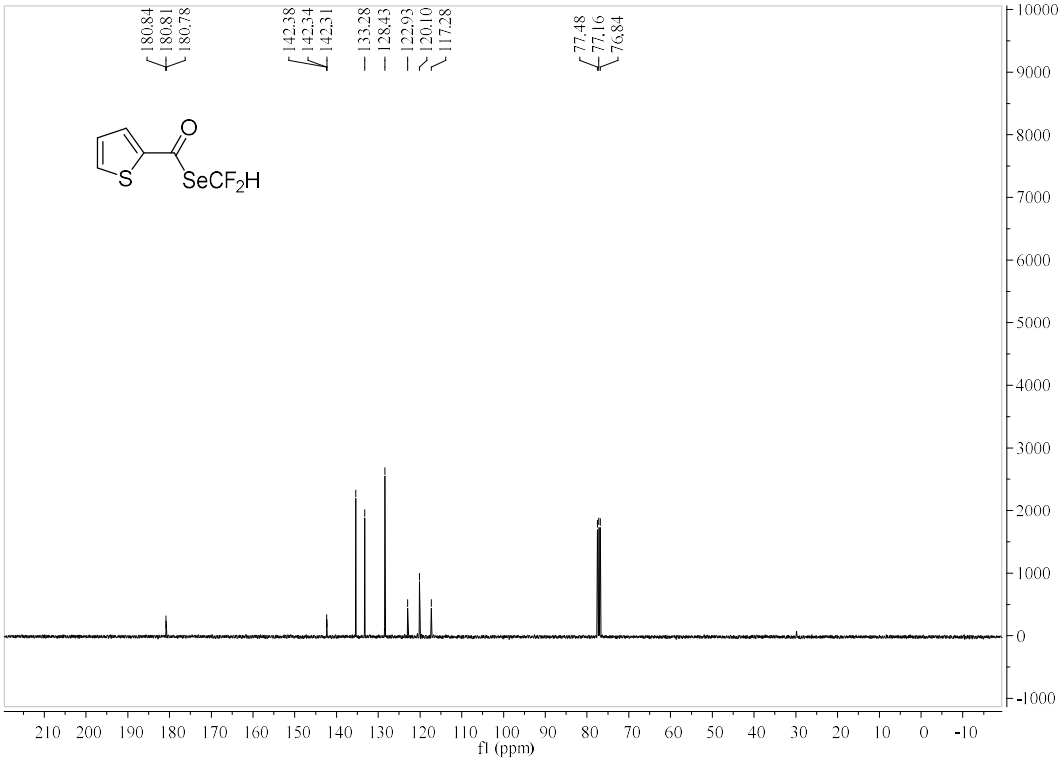
^{1}H NMR spectra of compound **3ai**



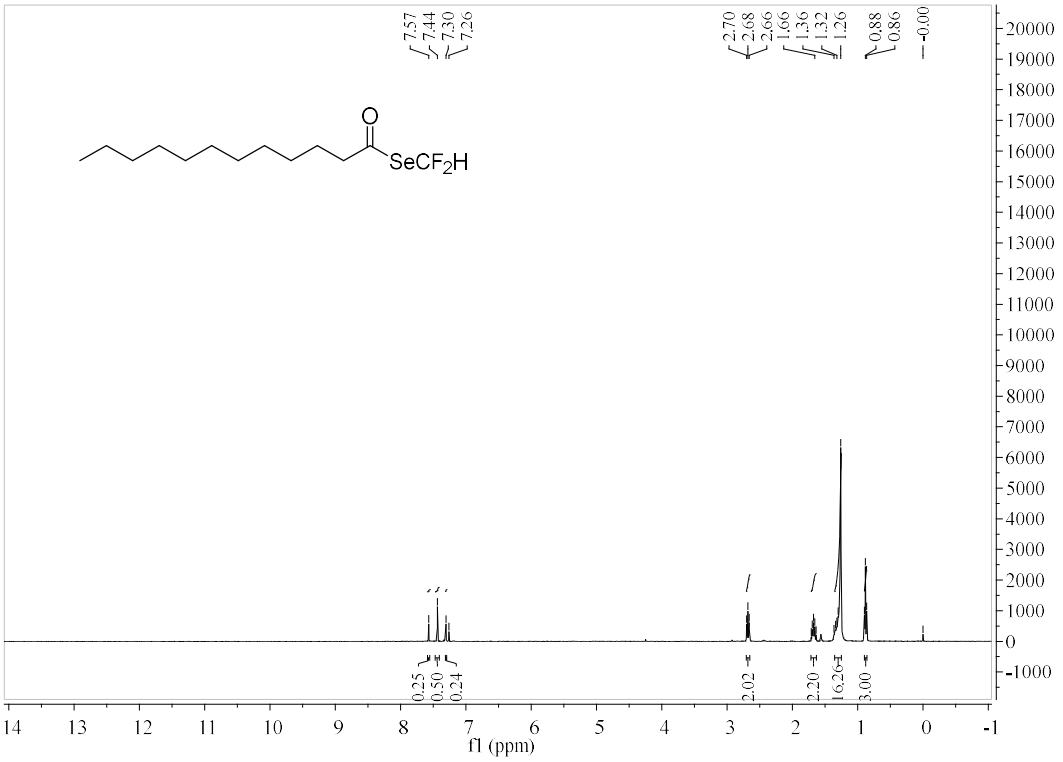
^{19}F NMR spectra of compound **3ai**



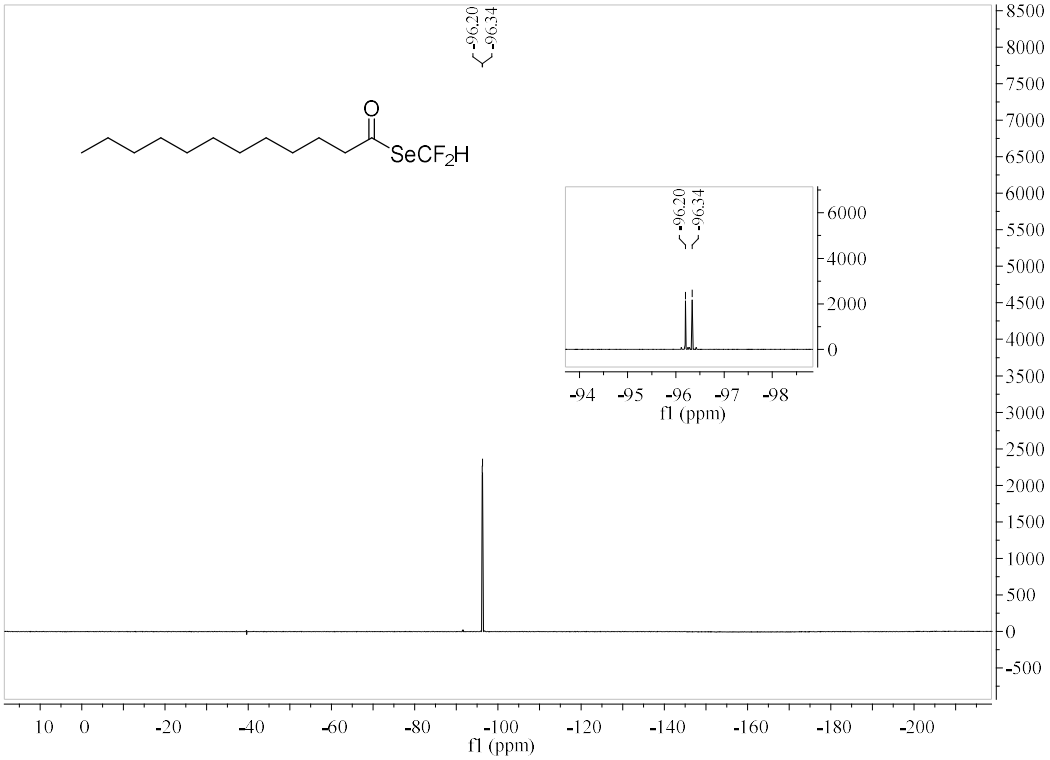
^{13}C NMR spectra of compound **3ai**



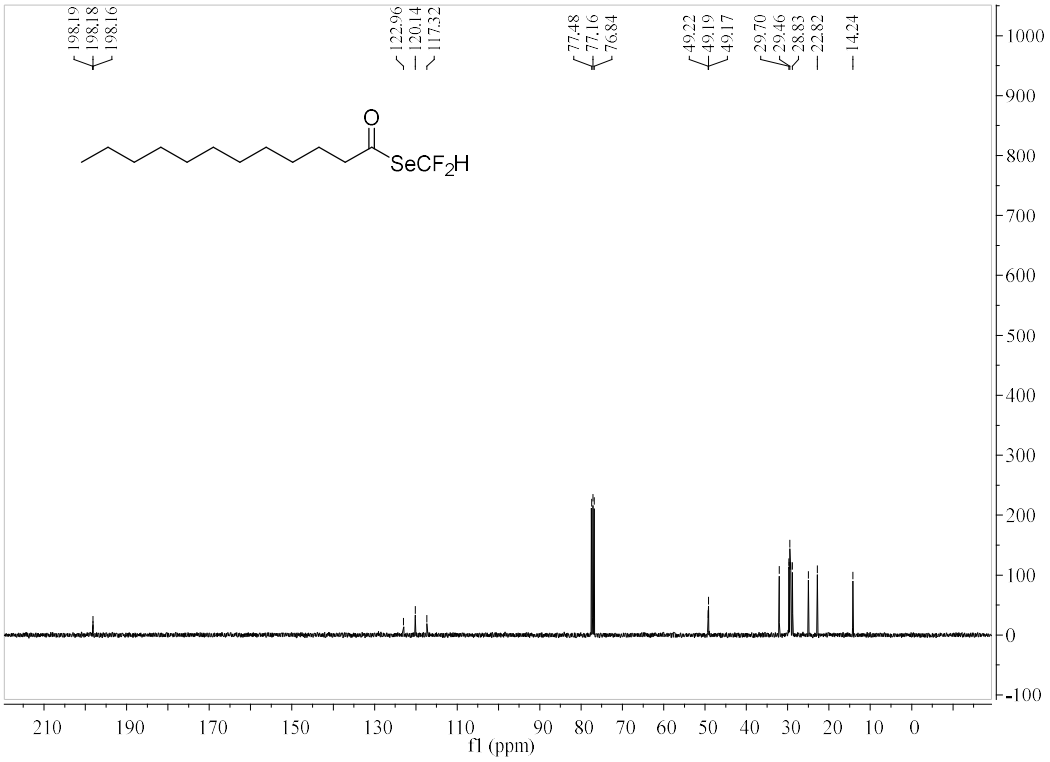
^{1}H NMR spectra of compound **3ba**



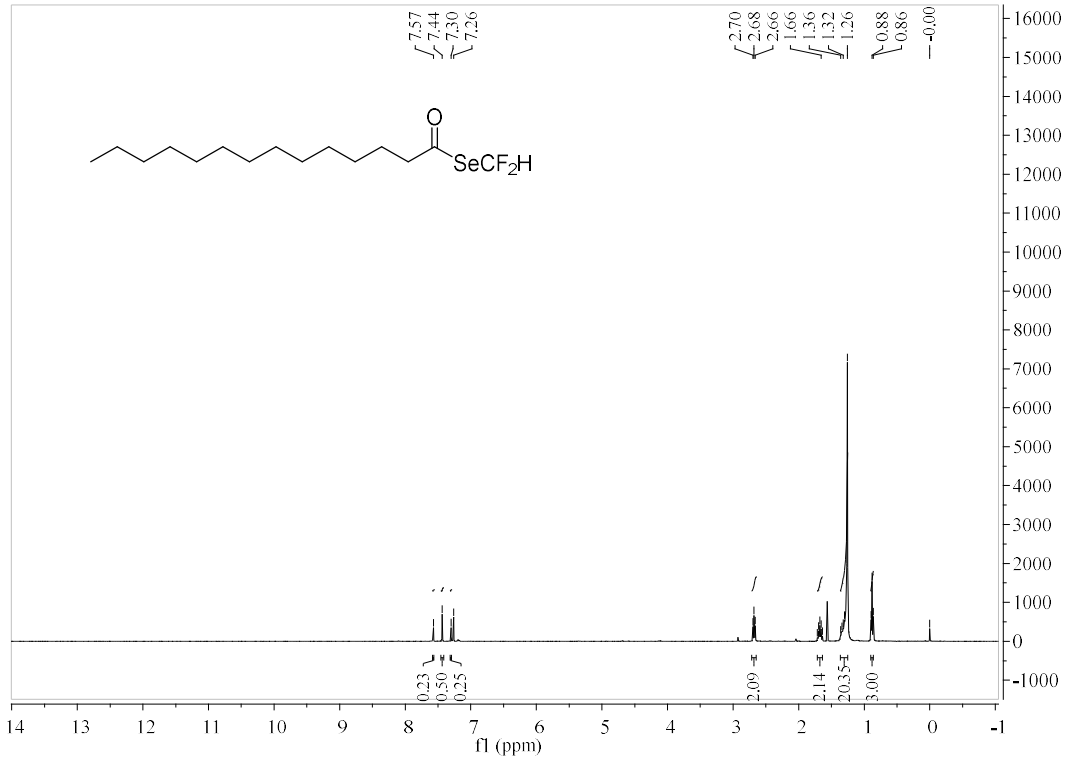
^{19}F NMR spectra of compound **3ba**



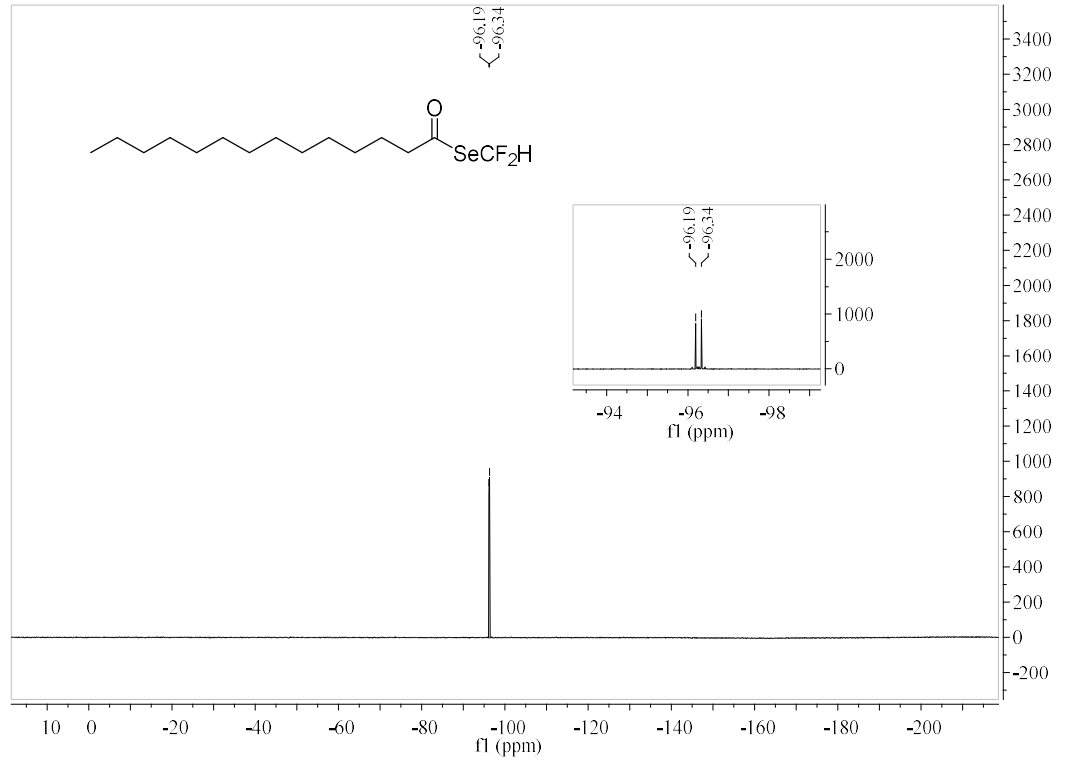
^{13}C NMR spectra of compound **3ba**



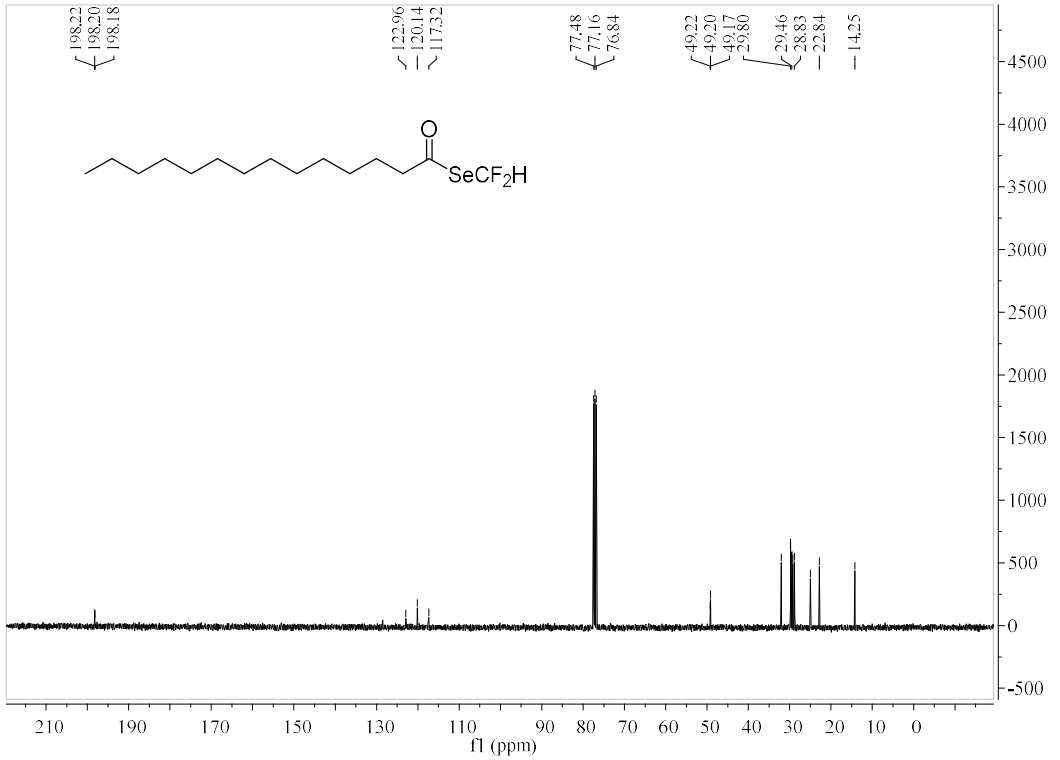
^{1}H NMR spectra of compound **3bb**



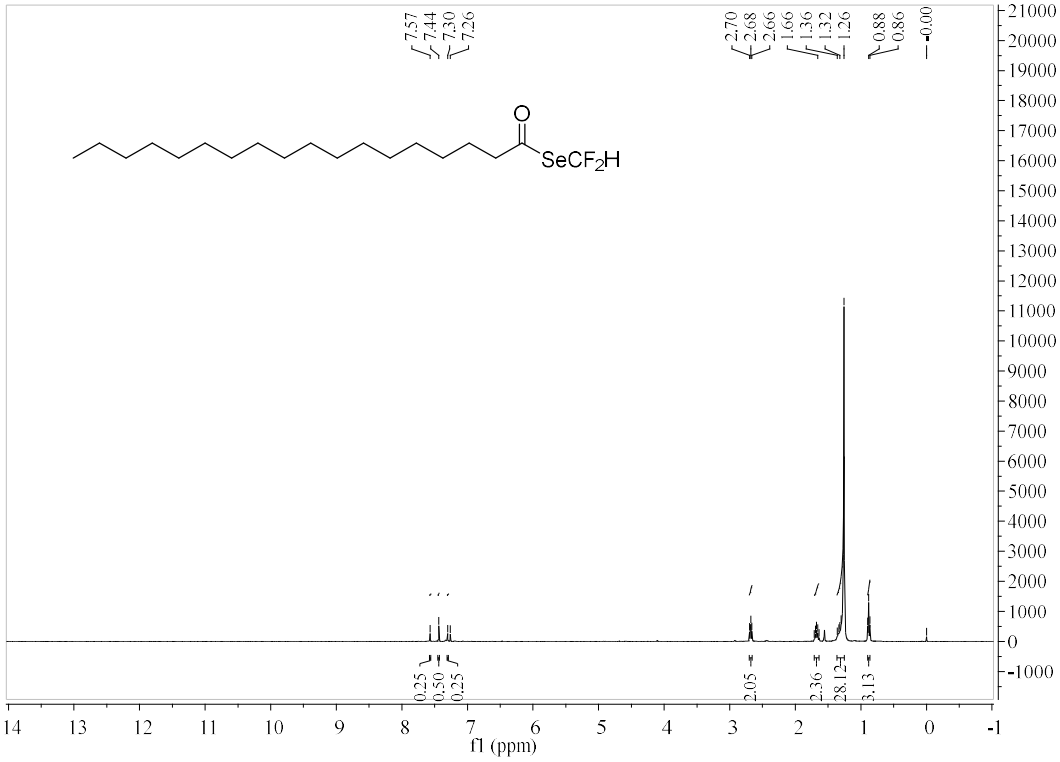
^{19}F NMR spectra of compound **3bb**



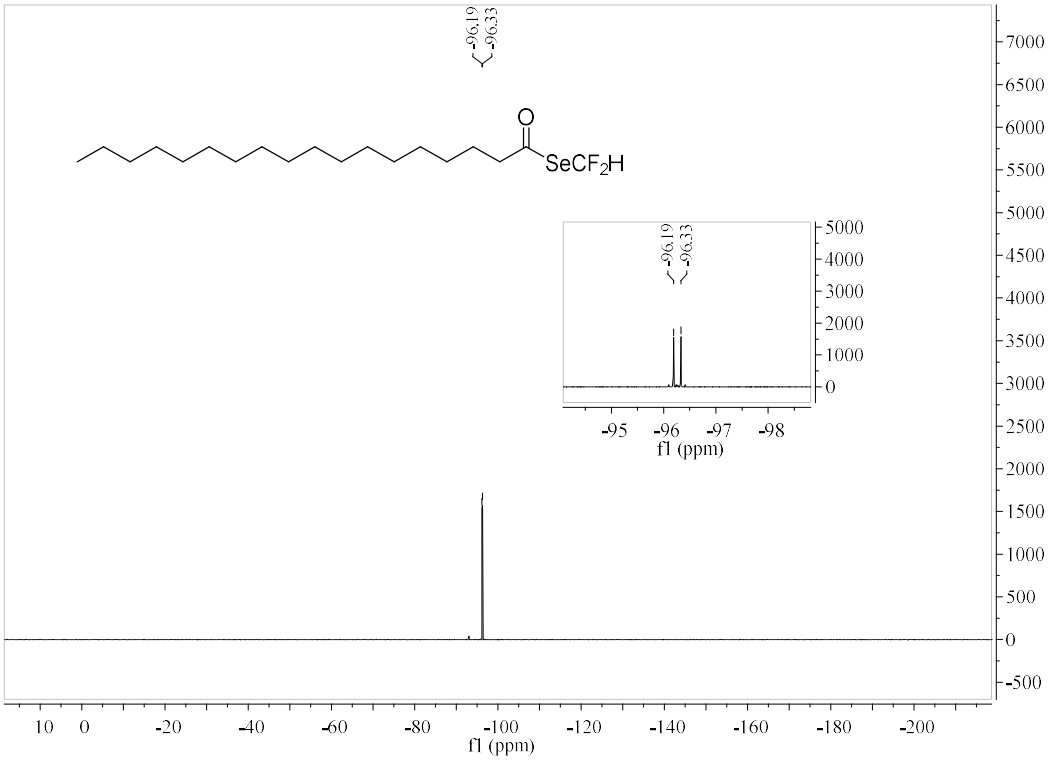
^{13}C NMR spectra of compound **3bb**



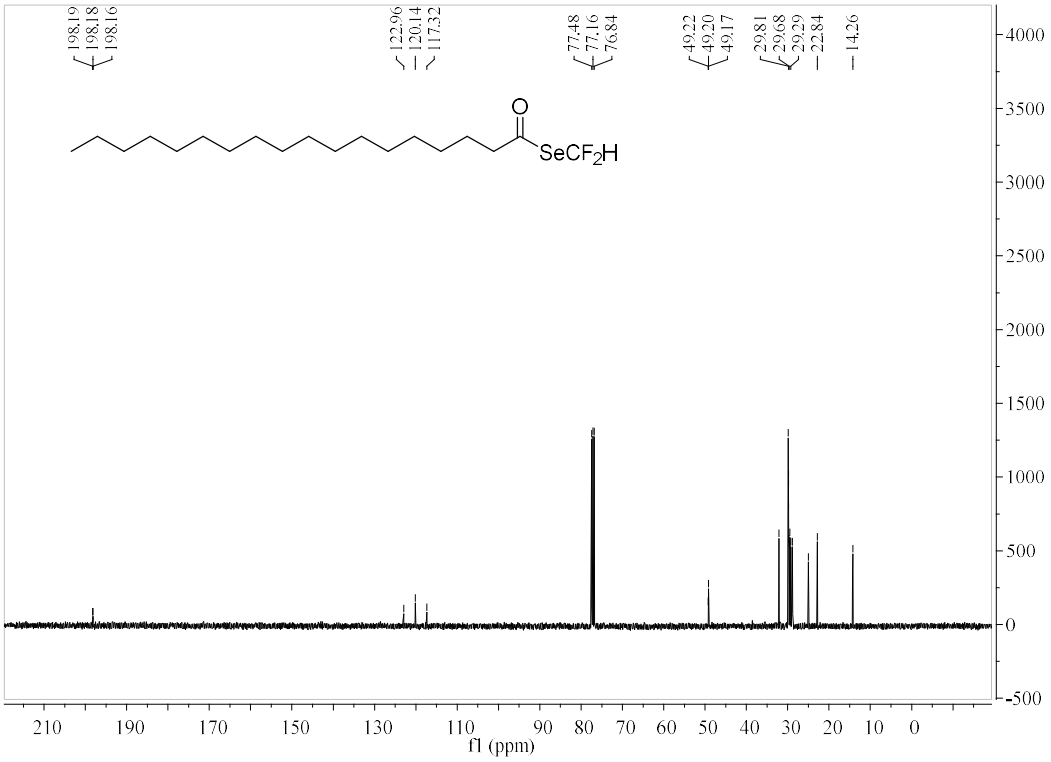
^{1}H NMR spectra of compound **3bc**



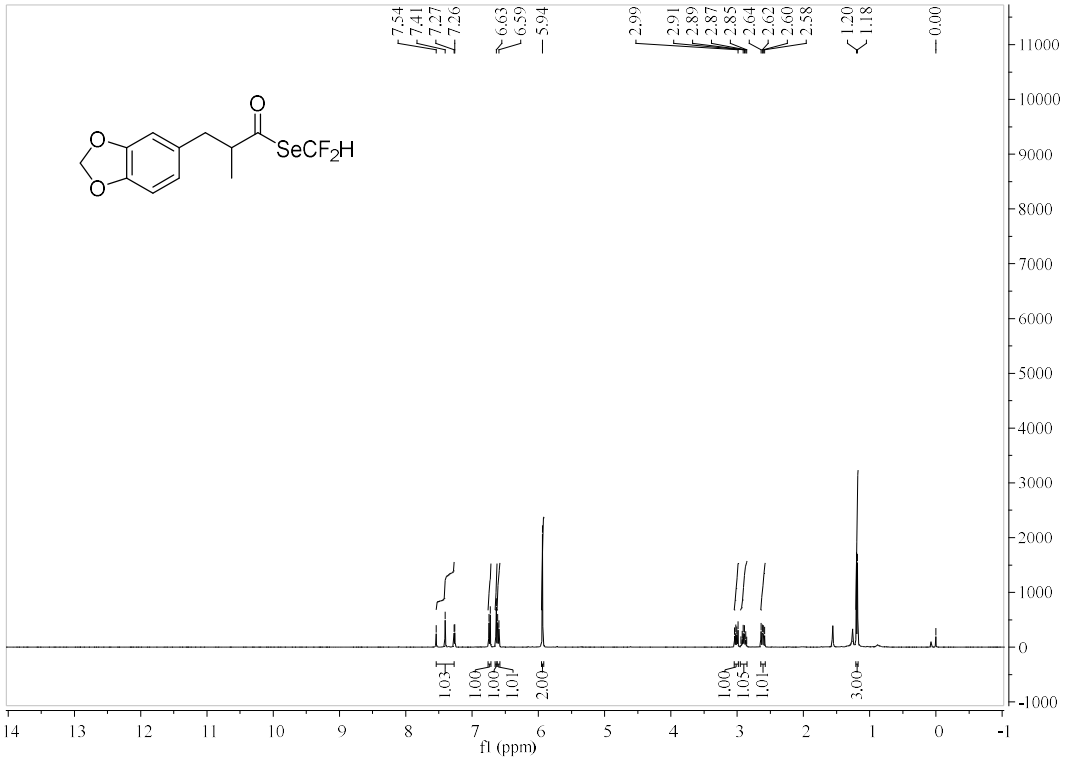
^{19}F NMR spectra of compound **3bc**



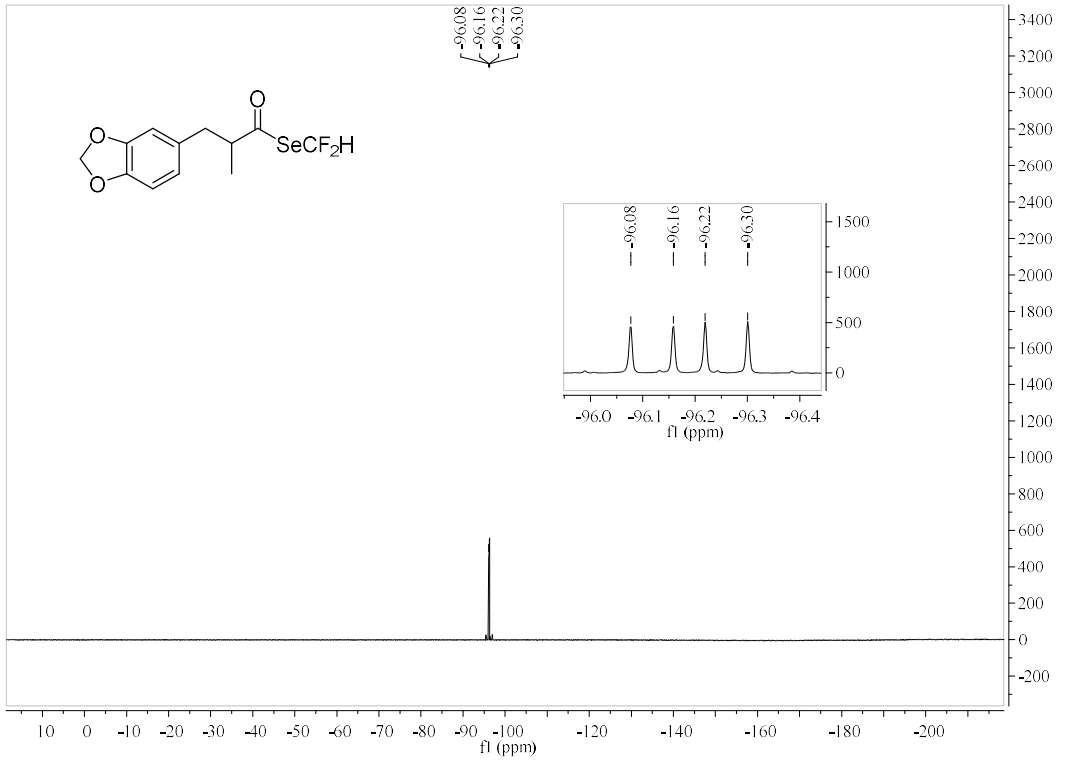
^{13}C NMR spectra of compound **3bc**



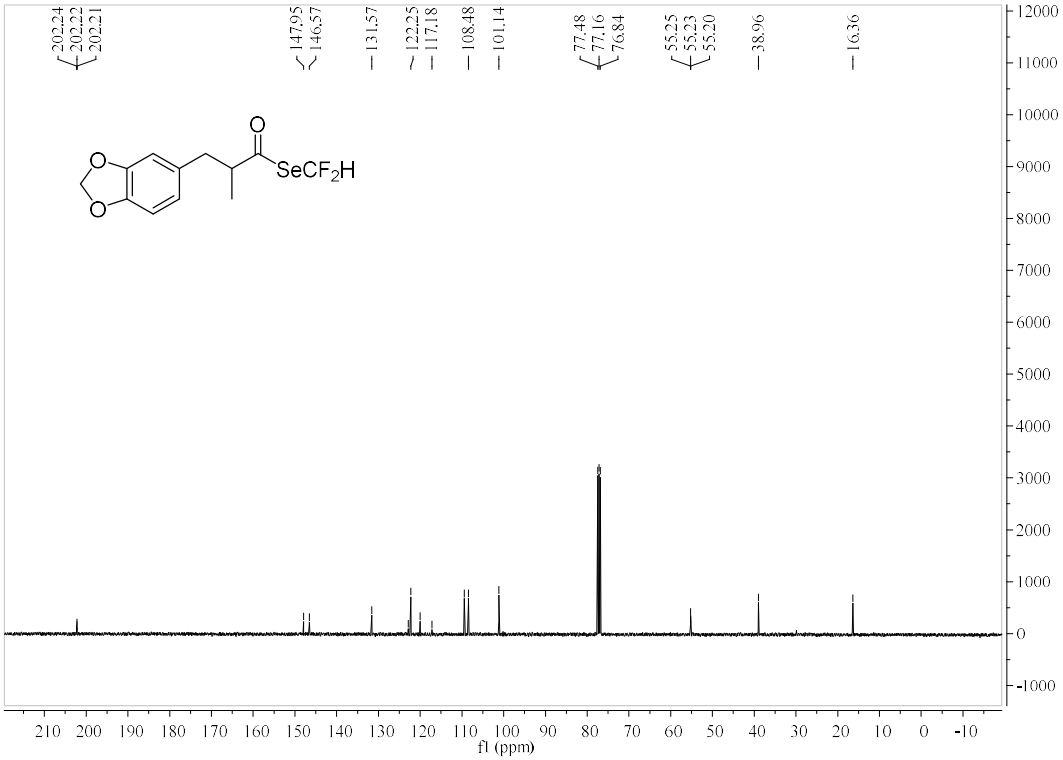
^{1}H NMR spectra of compound **3bd**



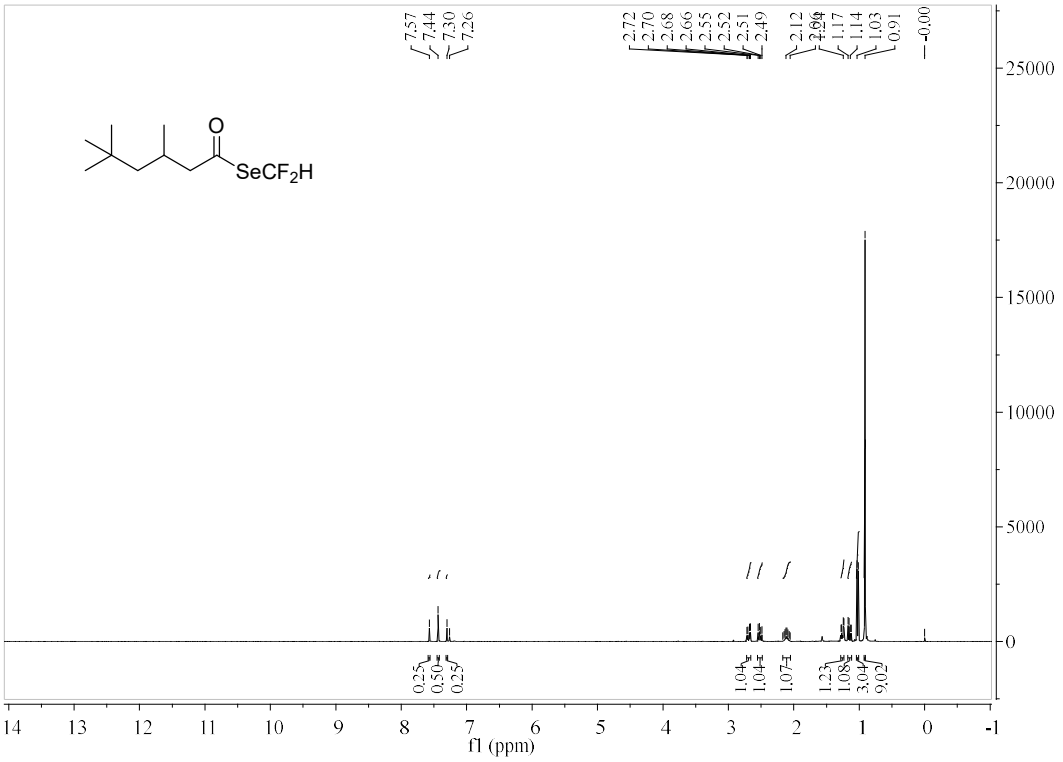
^{19}F NMR spectra of compound **3bd**



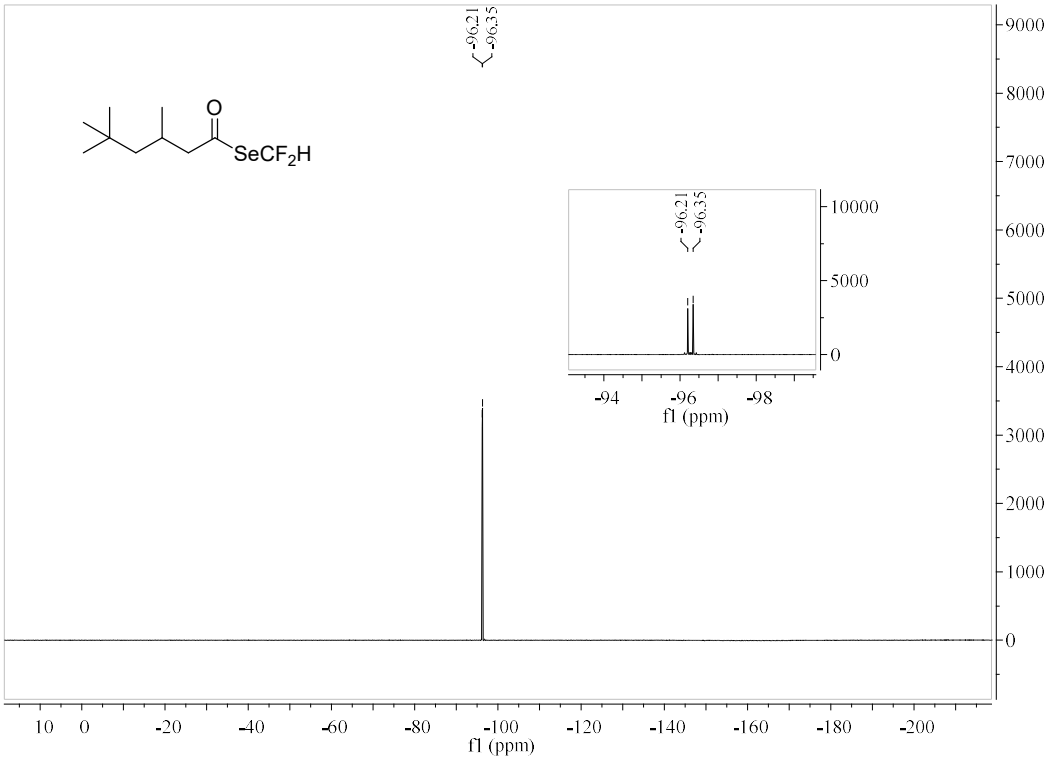
^{13}C NMR spectra of compound **3bd**



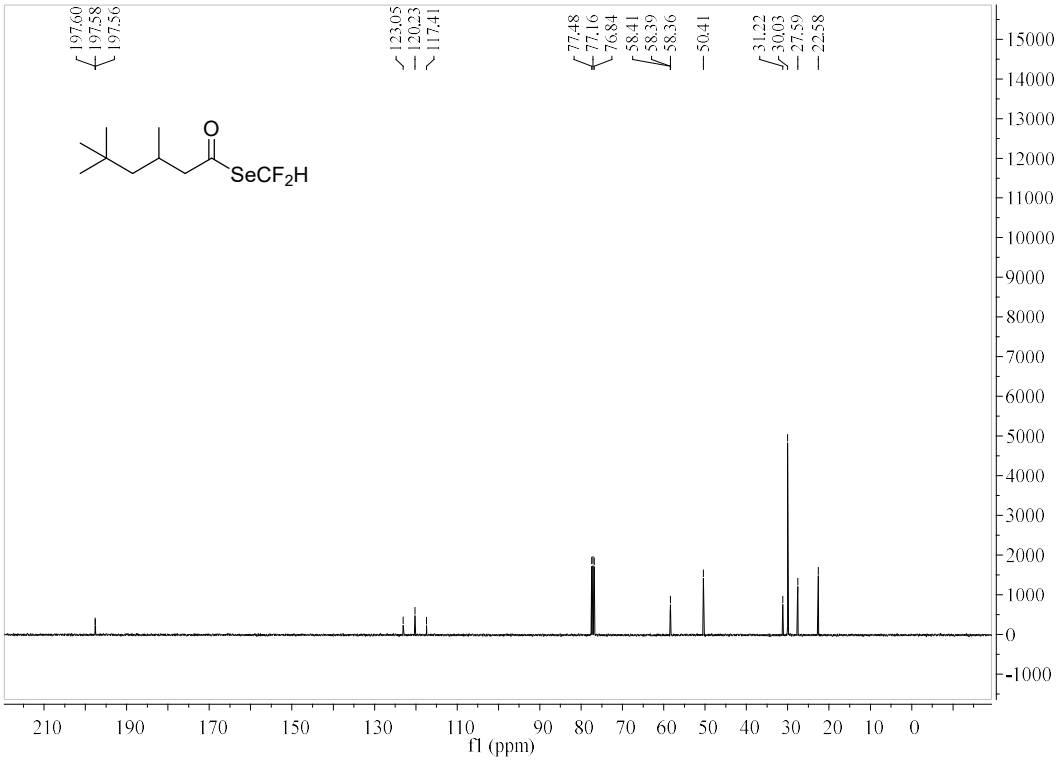
^{1}H NMR spectra of compound **3be**



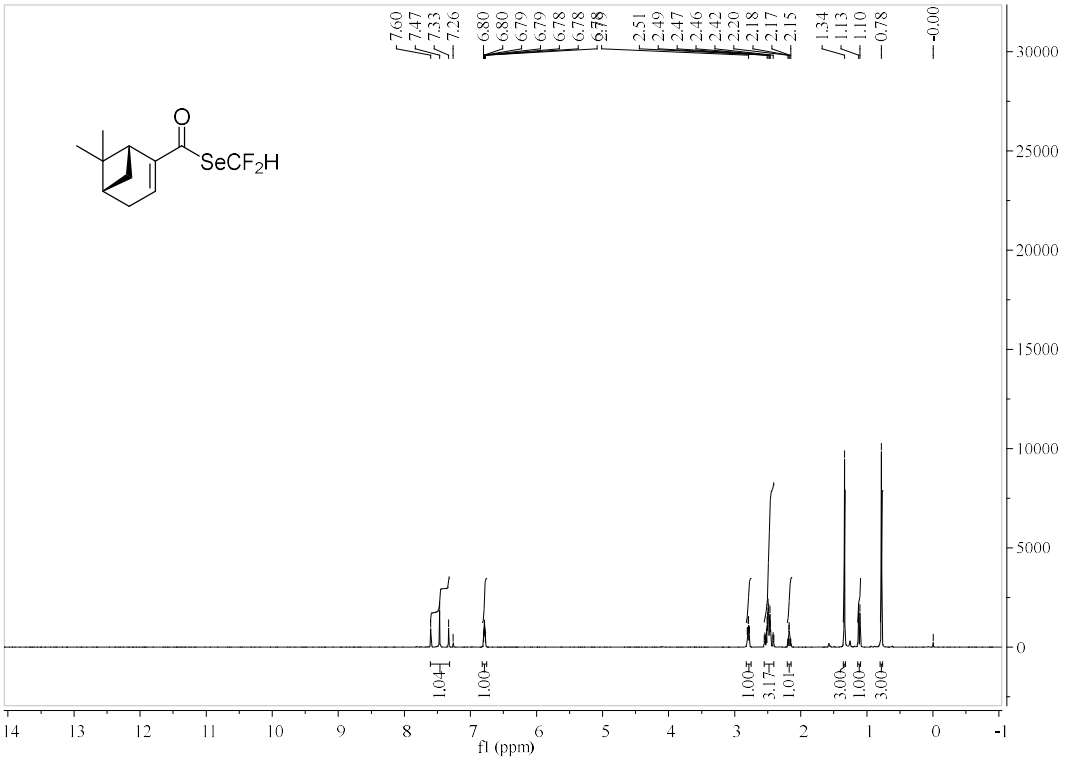
^{19}F NMR spectra of compound **3be**



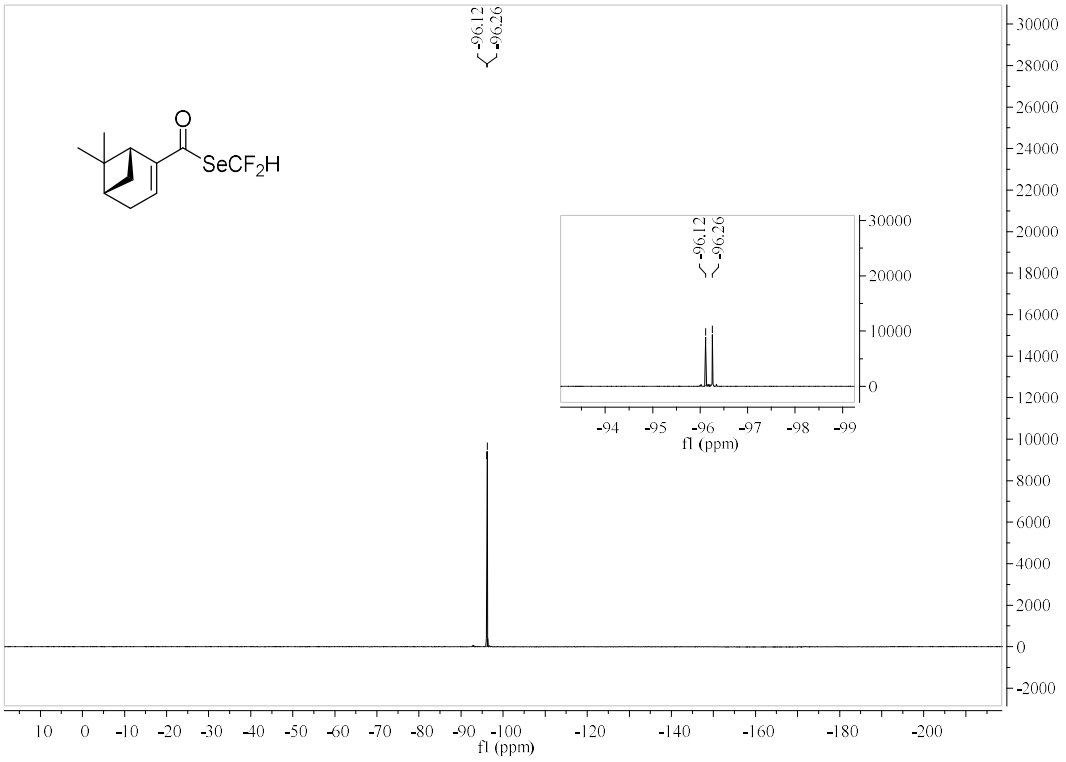
^{13}C NMR spectra of compound **3be**



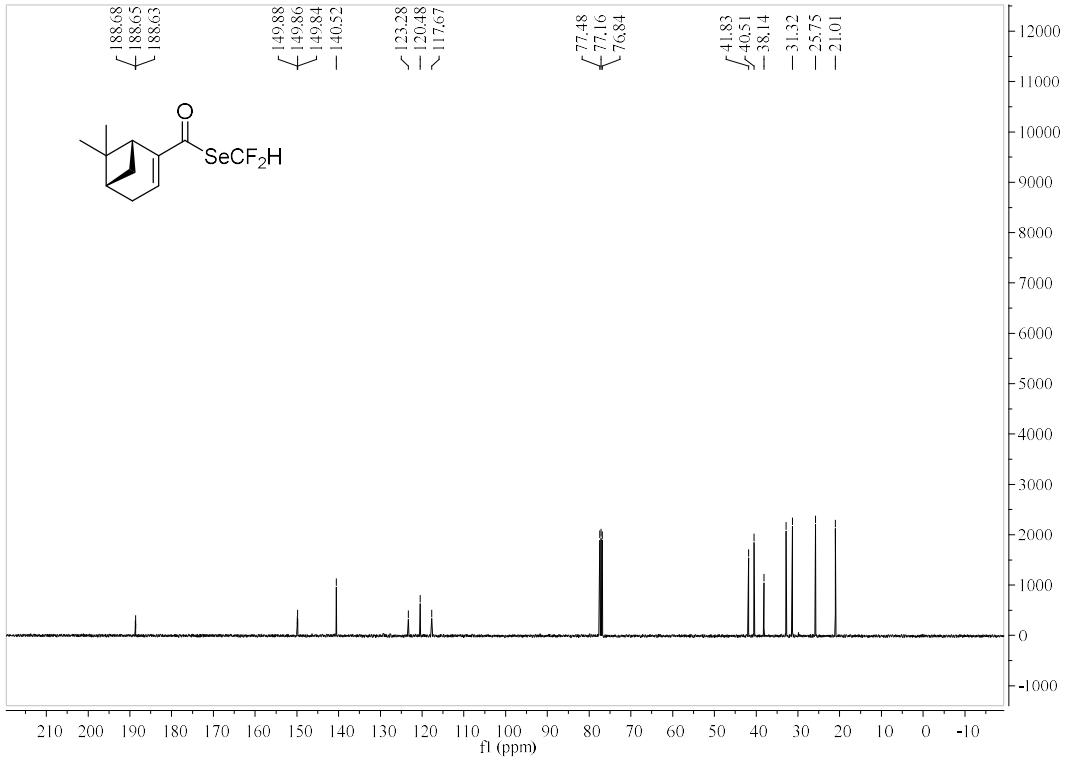
^{1}H NMR spectra of compound **3bf**



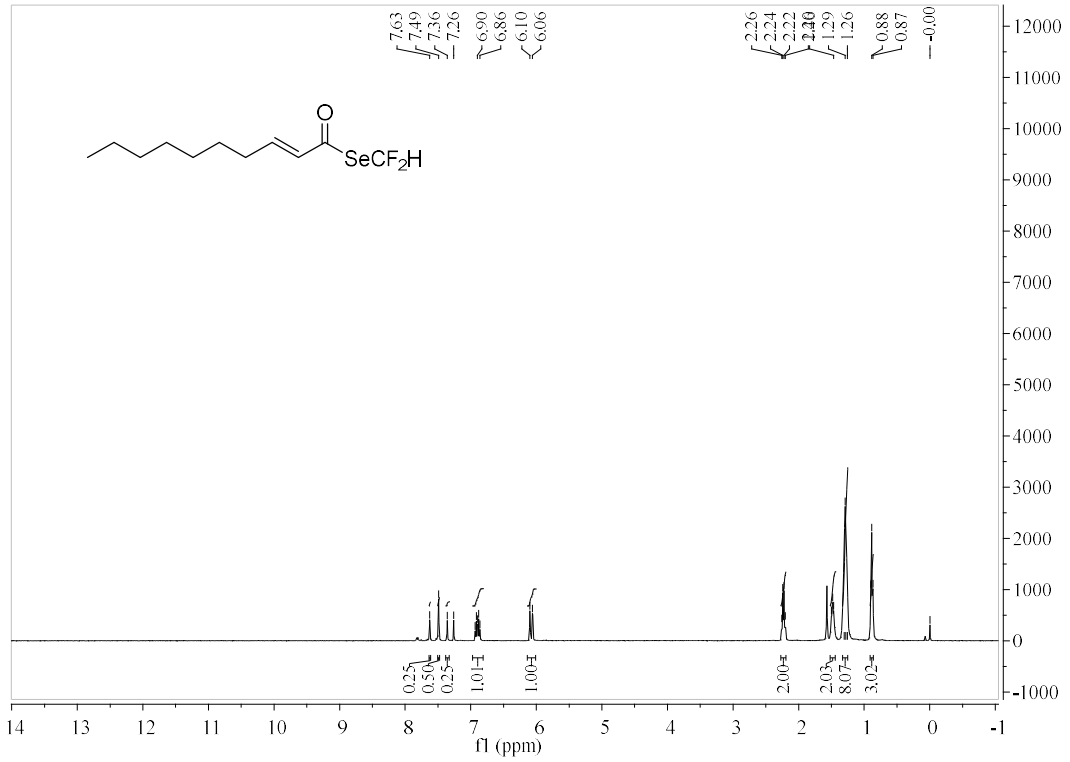
^{19}F NMR spectra of compound **3bf**



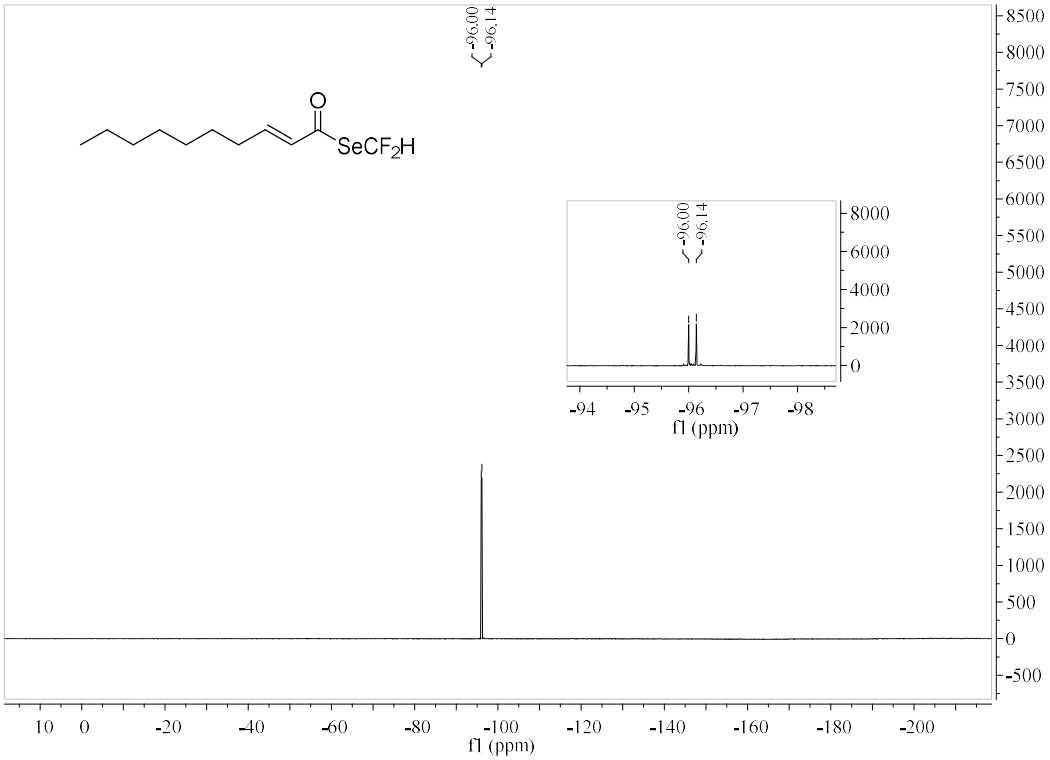
^{13}C NMR spectra of compound **3bf**



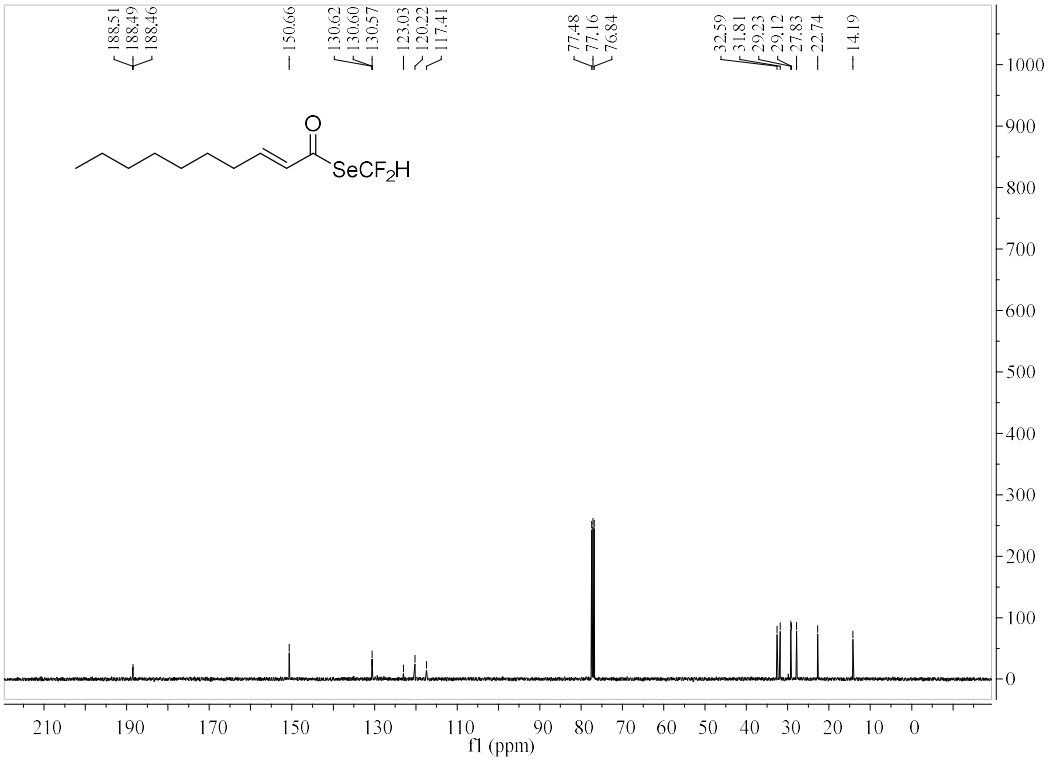
^{1}H NMR spectra of compound **3bg**



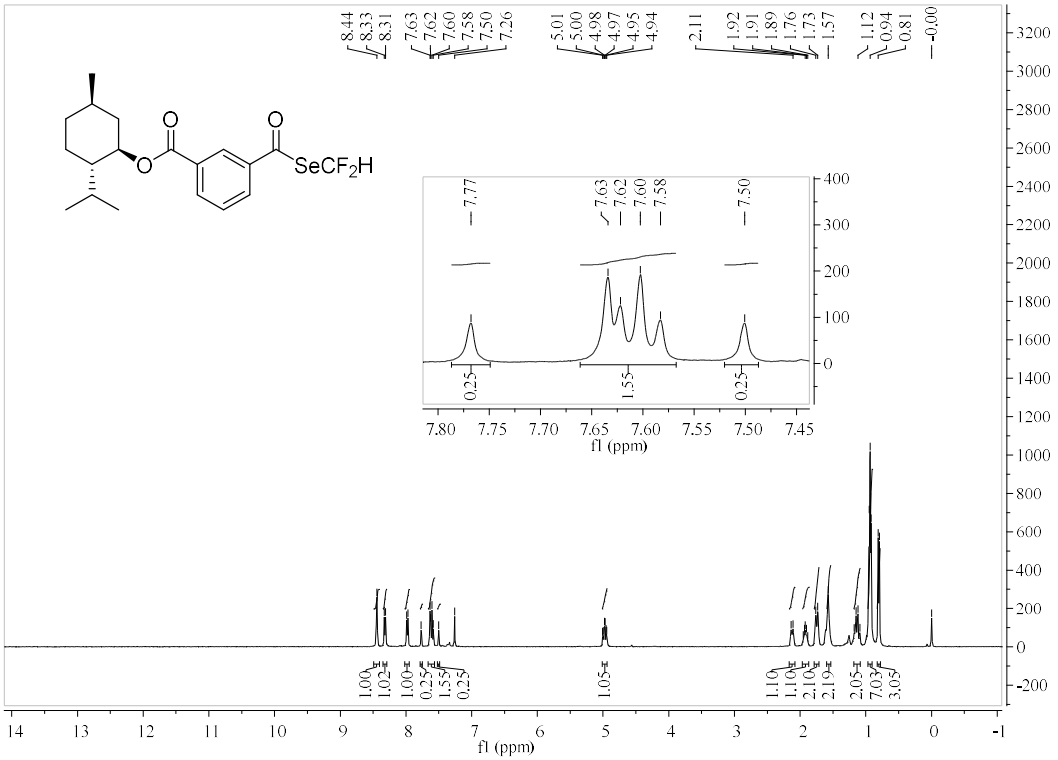
^{19}F NMR spectra of compound **3bg**



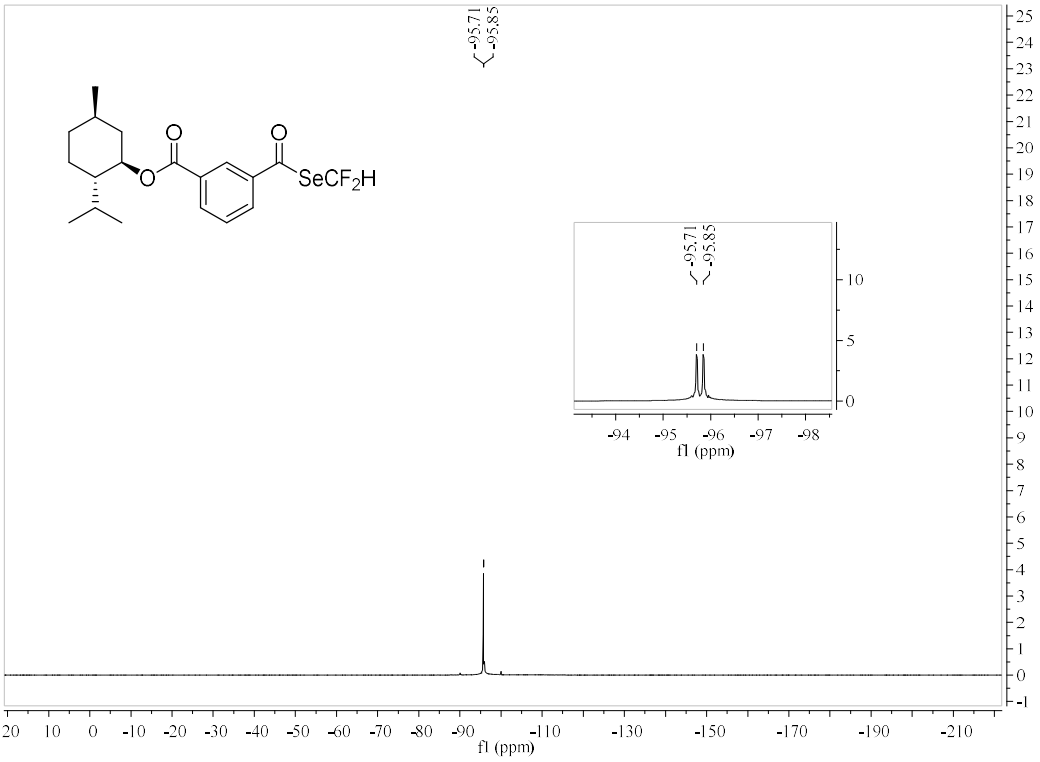
^{13}C NMR spectra of compound **3bg**



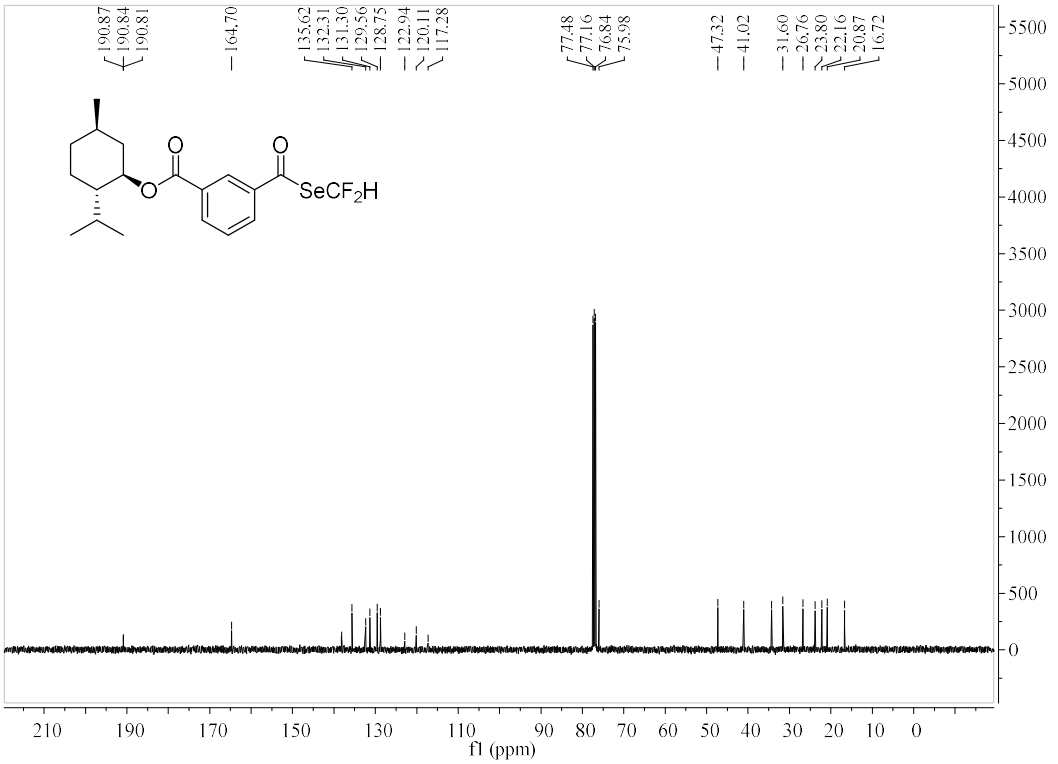
^{1}H NMR spectra of compound **3ca**



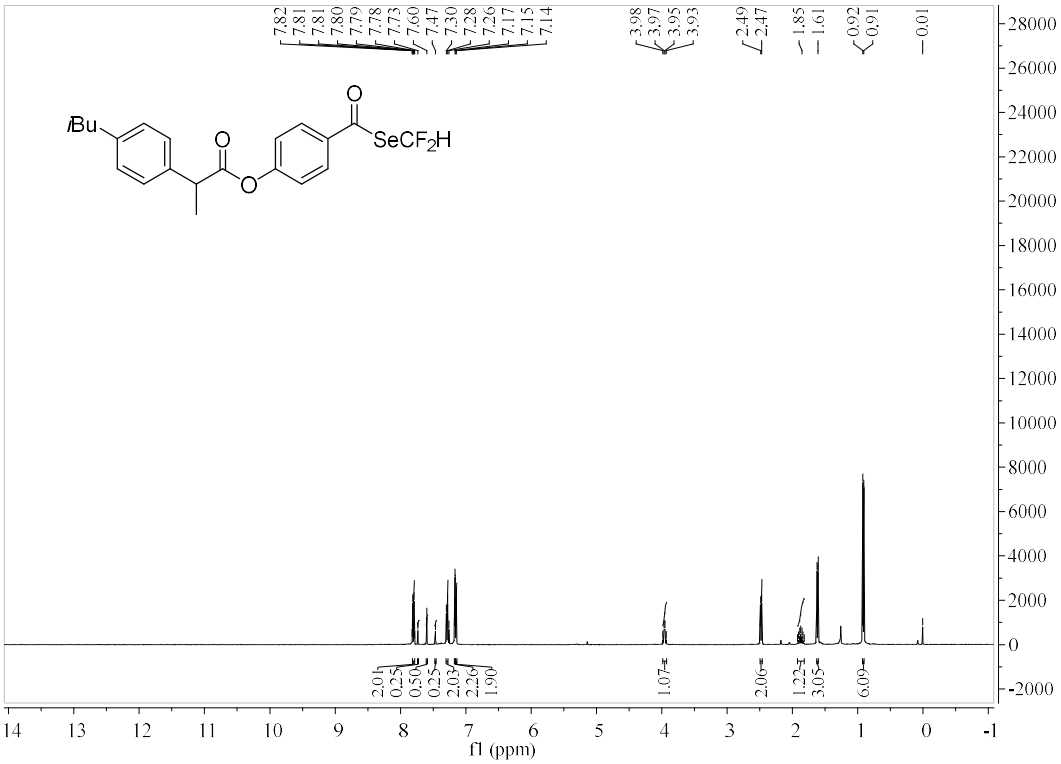
^{19}F NMR spectra of compound **3ca**



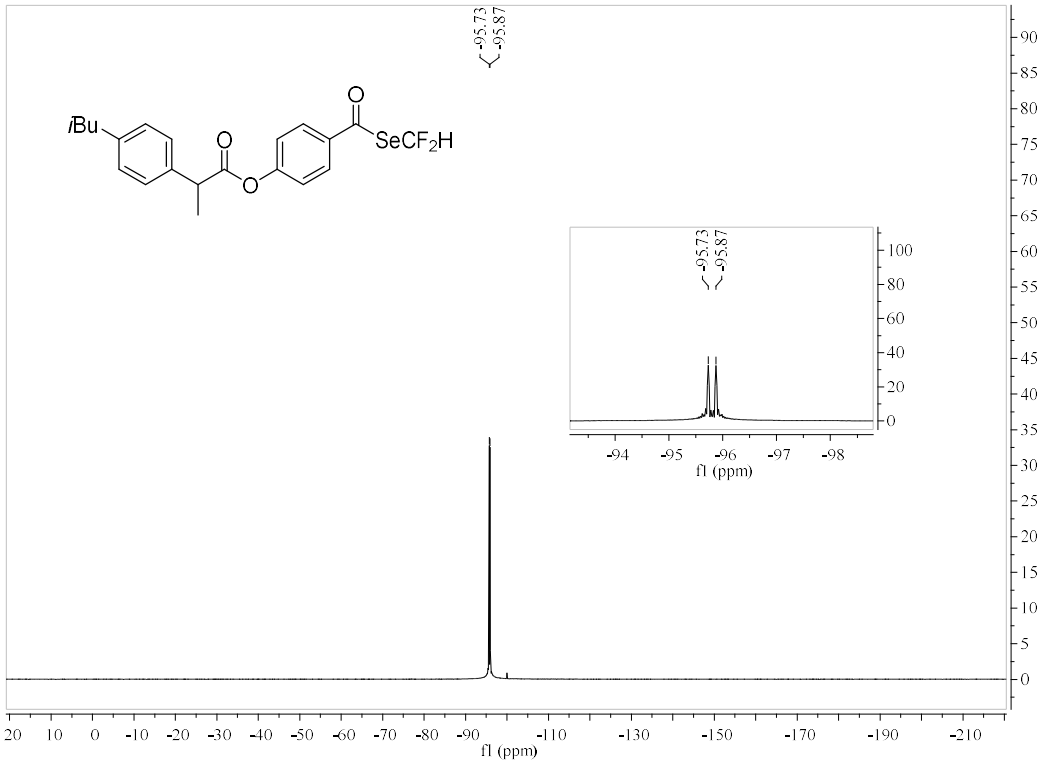
^{13}C NMR spectra of compound **3ca**



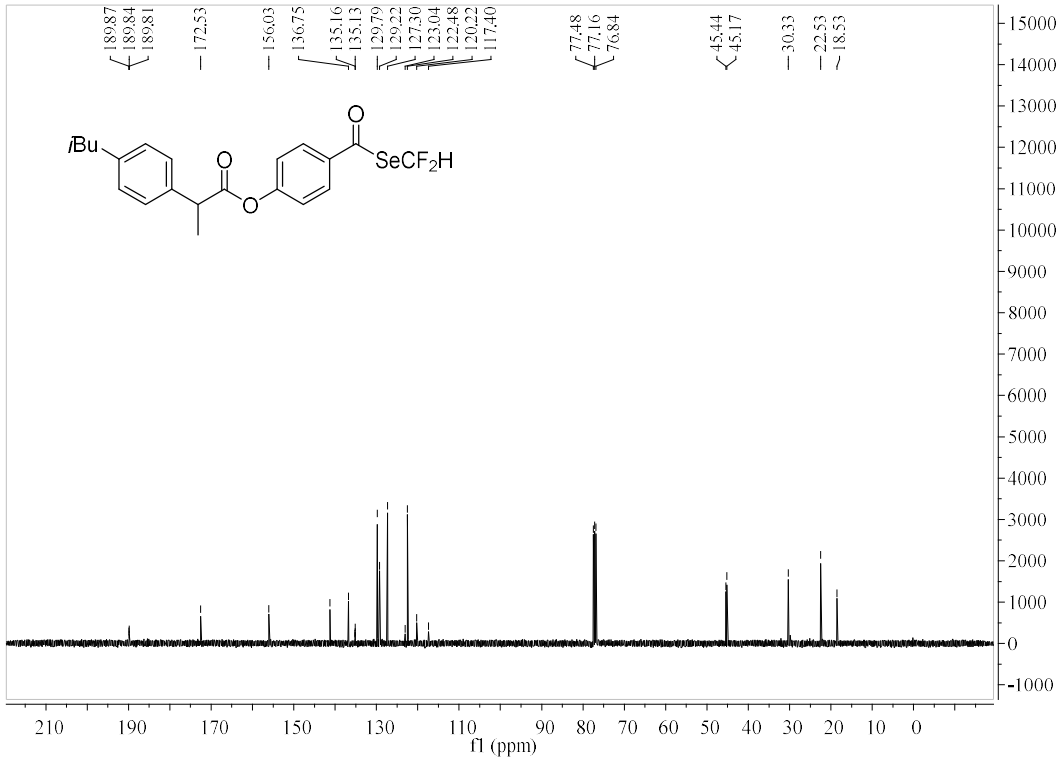
^{1}H NMR spectra of compound **3cb**



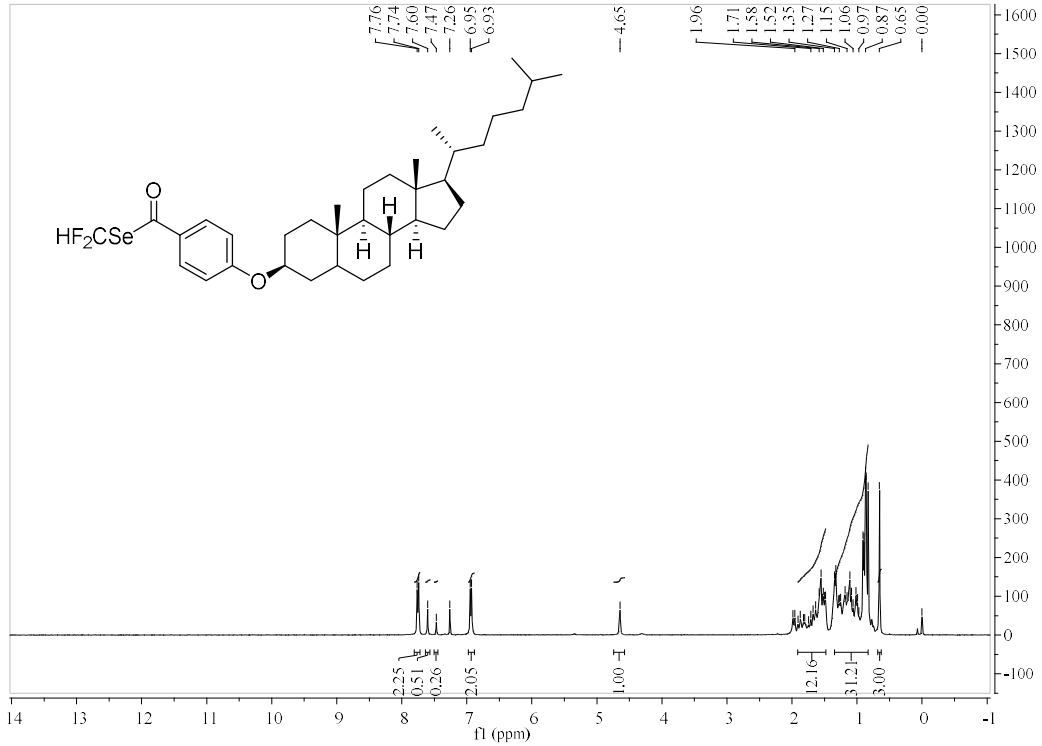
^{19}F NMR spectra of compound **3cb**



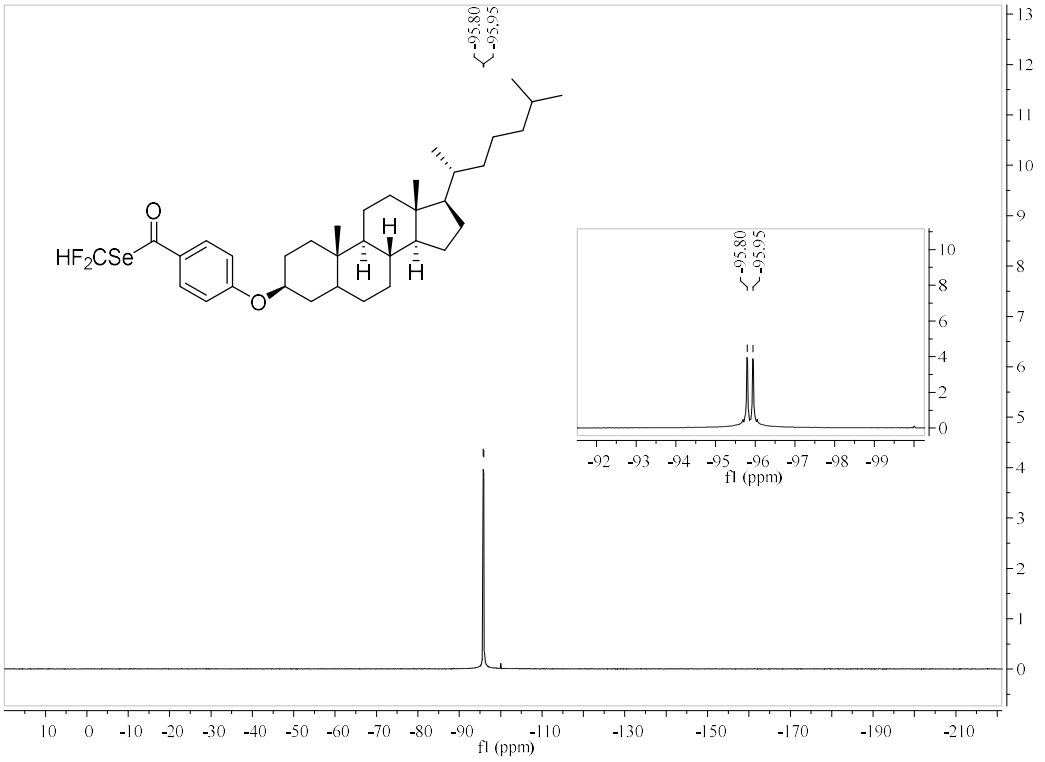
^{13}C NMR spectra of compound **3cb**



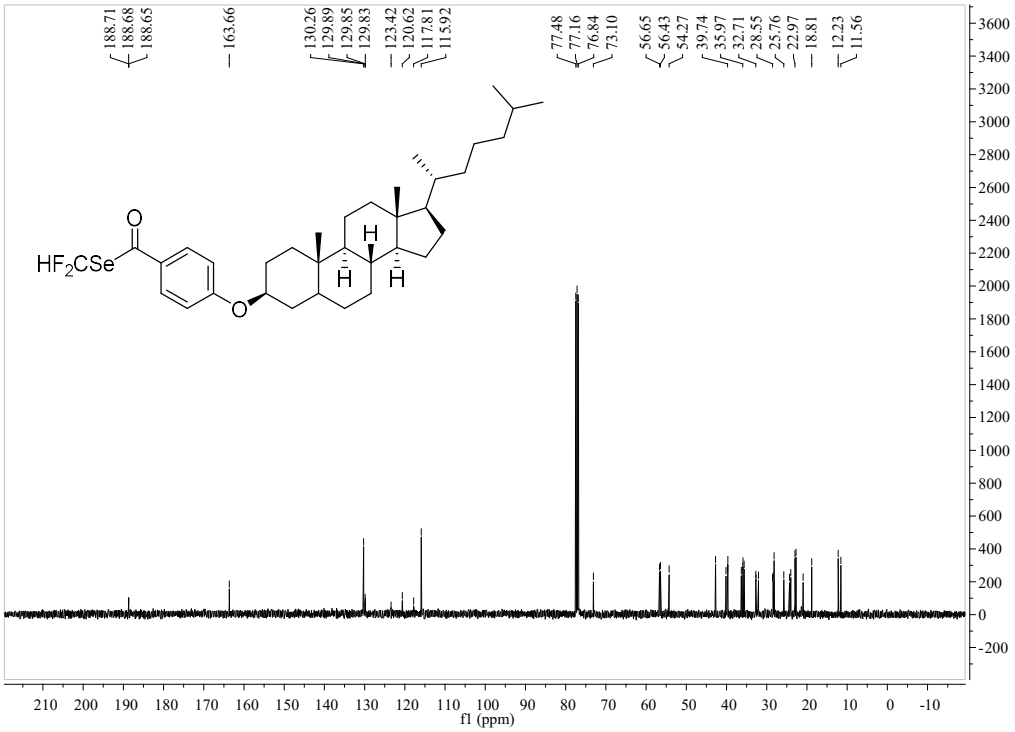
^{1}H NMR spectra of compound **3cc**



^{19}F NMR spectra of compound **3cc**

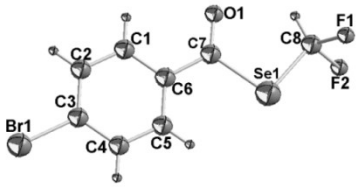


^{13}C NMR spectra of compound **3cc**



7. X-ray crystalstructure of compounds 3g and 3ad

X-ray Crystal Structure of *Se*-(difluoromethyl)-4-bromobenzoselenoate (3g)(CCDC:1985689)



X-ray Crystal Structure of *Se*-(difluoromethyl)-1-tosyl-1H-indole-3-carboselenoate (3ad)(CCDC:1985690)