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Supporting Information for

Synthesis of 3-Fluoroalkenyl-3-trifluoromethyl-2-oxindoles by the Reaction of Indoline-2,3-diones with Difluoromethylene Phosphabetaine

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1. General Remarks

^{1}H, ^{13}C and ^{19}F NMR spectra were recorded on a Bruker AM-400 spectrometer for solution in $CDCl_3$ with tetramethylsilane (TMS) as an internal standard; J-values are in Hz. Mass spectra were recorded by EI methods, and HRMS was measured on a Finnigan MA+ mass spectrometer. 1,4-dioxane and toluene were distilled from sodium (Na) under argon (N_2) atmosphere. CH_3CN, DMF, DMSO, NMP were distilled from CaH_2 under argon (Ar) atmosphere. Commercially obtained reagents were used without further purification. All reactions were monitored by TLC with Huanghai GF 254 silica gel coated plates. Flash column chromatography was carried out using 300-400 mesh silica gel at increased pressure.

2. Preparation of the known substrates 1a-1p.

Substrates **1a -1p** were prepared according to the reported methods.[1-4]

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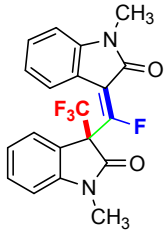
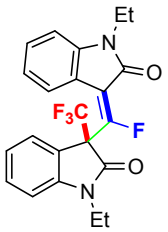
(1) A. A. Nagle, S. A. Reddy, H. Bertrand, H. Tajima, T.-M. Dang, S.-C. Wong, J. D. Hayes, G. Wells and E.-H. Chew, *ChemMedChem* 2014, **9**, 1763. (2) C.-T. Chiou, W.-C. Lee, J.-H. Liao, J.-J. Cheng, L.-C. Lin, C.-Y. Chen, J.-S. Song, M.-H. Wu, K.-S. Shia and W.-T. Li, *Eur. J. Med. Chem.*2015, **98**, 1. (3) D. Rambabu, K. Kumar, B. Y. Sreenivas, S. Sandra, A. Kandale, P. Misra, M. V. B. Rao and M. Pal, *Tetrahedron Lett.* 2013, **54**, 495. (4) X. Zhang and L. Wang *Green Chem*. 2012, **14**, 2141.

3. General procedure for the synthesis of 3-fluoromethylenyl-3-trifluoromethyl substituted dioxindoles 3.

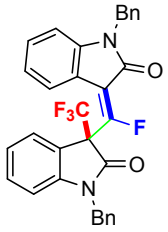
Into a 25 mL Schlenk tube with a magnetic stirrer, indoline-2,3-dione **1a** (81 mg, 0.5 mmol) and difluoromethylene phosphabetaine (356 mg, 1.0 mmol) were added. The mixture was degassed and then NMP (1.0 mL) was added under N_2. The reaction mixture was stirred at 80 °C for 12 h. After cooling to room temperature, ethyl acetate (EA) (10 mL) was added. The organic phases were washed with H_2O (5 mL × 3) and brine (5 mL × 1). After that, the organic phases were dried with Na_2SO_4 and the solvent was removed under reduced pressure. The residue was purified by flash chromatography on silica gel to afford product **3a**.



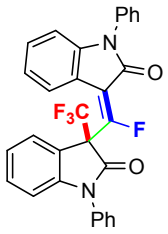
3-(fluoro(1-methyl-2-oxoindolin-3-ylidene)methyl)-1-methyl-3-(trifluoromethyl)indolin-2-one 3a. Column chromatography (petroleum ether : ethyl acetate = 3:1) on silica gel gave a pale yellow solid (72 %): mp 160–161 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 (d, *J* = 7.4 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 1H), 7.40 (d, *J* = 7.3 Hz, 1H), 7.31 (t, *J* = 7.7 Hz, 1H), 7.11 (d, *J* = 6.7 Hz, 2H), 6.99 (d, *J* = 7.7 Hz, 1H), 6.75 (d, *J* = 7.7 Hz, 1H), 3.40 (s, 3H), 3.05 (s, 3H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -68.15 (s, 3F), -87.49 (td, *J* = 20.1, 12.5 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.7 (d, *J* = 6.1 Hz), 164.8 (d, *J* = 20.1 Hz), 161.4, 158.5, 146.6, 142.3, 130.9, 130.0 (d, *J* = 2.7 Hz), 125.3 (d, *J* = 13.4 Hz), 124.7, 123.0, 122.8 (qd, *J* = 283.7, 2.8 Hz), 122.6, 121.4, 119.9, 108.6, 107.9, 60.9 – 59.9 (m), 27.3, 26.0. IR $(KBr)_{max}$ 3061, 2934,1736, 1660, 1609, 1479, 1344, 1271, 1239, 1189, 1085, 970, 747, 668 cm^{-1}; MS (EI) m/z 390.0 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{20}H_{14}F_4N_2O_2$, 390.0991; Found, 390.0996.



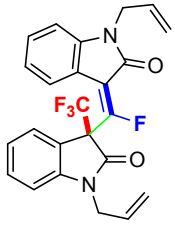
1-ethyl-3-((1-ethyl-2-oxoindolin-3-ylidene)fluoromethyl)-3-(trifluoromethyl)indolin-2-one 3b. Column chromatography (petroleum ether : ethyl acetate = 4:1) on silica gel gave a pale yellow solid (81 %): mp 138–139 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (d, *J* = 7.6 Hz, 1H), 7.43 (t, *J* = 7.8 Hz, 1H), 7.38 (d, *J* = 7.4 Hz, 1H), 7.29 (d, *J* = 7.6 Hz, 1H), 7.08 (t, *J* = 7.6 Hz, 2H), 7.00 (d, *J* = 7.9 Hz, 1H), 6.78 (d, *J* = 7.8 Hz, 1H), 4.04 (dq, *J* = 14.4, 7.3 Hz, 1H), 3.81 (dq, *J* = 14.2, 7.1 Hz, 1H), 3.67 – 3.51 (m, 2H), 1.41 (t, *J* = 7.2 Hz, 3H), 1.13 (t, *J* = 7.2 Hz, 3H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -68.36 (s, 3F), -87.37 (q, *J* = 20.7 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.8 (d, *J* = 5.4 Hz), 164.2 (d, *J* = 19.9 Hz), 161.3, 158.4, 145.8, 141.5, 130.7, 129.9 (d, *J* = 2.8 Hz), 125.5 (d, *J* = 13.5 Hz), 124.8, 122.9 (qd, *J* = 285.7, 2.8 Hz), 122.7, 122.3, 121.6, 120.1, 108.6, 108.0, 61.0 – 60.0 (m), 36.0, 34.4, 12.6, 12.3. IR $(KBr)_{max}$ 3059, 2980, 1732, 1608, 1476, 1360, 1261, 1224, 1182, 1091, 798, 678 cm^{-1}; MS (EI) m/z 418.0 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{22}H_{18}F_4N_2O_2$, 418.1304; Found, 418.1312.



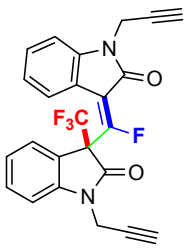
1-benzyl-3-((1-benzyl-2-oxoindolin-3-ylidene)fluoromethyl)-3-(trifluoromethyl)indolin-2-one 3c. Column chromatography (petroleum ether : ethyl acetate = 7:1) on silica gel gave a pale yellow solid (73 %): mp 178–179 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (d, *J* = 7.5 Hz, 1H), 7.47 – 7.42 (m, 3H), 7.38 (t, *J* = 7.2 Hz, 2H), 7.30 (dt, *J* = 17.2, 8.4 Hz, 5H), 7.21 (t, *J* = 7.8 Hz, 1H), 7.16 (d, *J* = 7.1 Hz, 2H), 7.10 (dd, *J* = 14.1, 7.0 Hz, 2H), 6.83 (d, *J* = 7.9 Hz, 1H), 6.64 (d, *J* = 7.8 Hz, 1H), 5.57 (d, *J* = 16.0 Hz, 1H), 4.86 (d, *J* = 15.9 Hz, 1H), 4.70 (t, *J* = 16.1 Hz, 2H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -67.84 (s, 3F), -86.71 (q, *J* = 20.3 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.8 (d, *J* = 4.5 Hz), 165.0 (d, *J* = 20.1 Hz), 161.8, 158.9, 146.2, 141.4, 135.5 (d, *J* = 8.5 Hz), 130.8, 130.0 (d, *J* = 2.5 Hz), 128.8, 128.7, 127.6 (d, *J* = 4.1 Hz), 127.2, 127.1, 125.5, 125.3, 124.8, 123.1, 123.0 (q, *J* = 285.9 Hz), 122.7, 121.4, 120.0, 113.8 (d, *J* = 17.6 Hz), 109.7, 109.1, 61.5 – 60.3 (m), 45.5, 43.5. IR $(KBr)_{max}$ 3060, 2925, 1740, 1660, 1607, 1480, 1353, 1252, 1179, 947, 743, 698 cm^{-1}; MS (EI) m/z 542.0 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{32}H_{22}F_4N_2O_2$, 542.1617; Found, 542.1614.



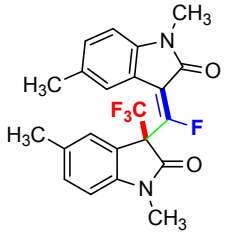
3-(fluoro(2-oxo-1-phenylindolin-3-ylidene)methyl)-1-phenyl-3-(trifluoromethyl)indolin-2-one 3d. Column chromatography (petroleum ether : ethyl acetate = 8:1) on silica gel gave a pale yellow solid (61 %): mp 220–221 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 7.4 Hz, 1H), 7.60 (d, *J* = 7.2 Hz, 2H), 7.56 – 7.51 (m, 2H), 7.48 (t, *J* = 7.8 Hz, 4H), 7.40 – 7.24 (m, 5H), 7.21 – 7.09 (m, 2H), 6.80 (dd, *J* = 14.2, 7.9 Hz, 2H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -68.22 (s, 3F), -86.03 (q, *J* = 20.5 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.5, 164.2 (d, *J* = 20.0 Hz), 162.1, 159.2, 146.9, 142.39, 134.1 (d, *J* = 29.7 Hz), 130.7, 130.0 (d, *J* = 2.6 Hz), 129.7, 129.4, 128.7, 128.0, 127.4, 126.6, 125.6 (d, *J* = 13.5 Hz), 124.9, 123.0 (qd, *J* = 282.7, 2.9 Hz), 123.3, 123.2, 120.8, 119.9, 113.8 (d, *J* = 17.7 Hz), 109.8, 109.4, 61.2 – 60.1 (m). IR $(KBr)_{max}$ 3062, 2912, 1748, 1602, 1496, 1372, 1222, 1191, 1101, 745, 696 cm^{-1}; MS (EI) m/z 514.0 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{30}H_{18}F_4N_2O_2$, 514.1304; Found, 514.1300.



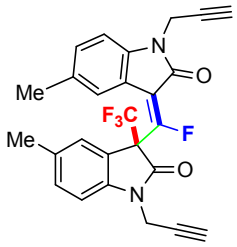
1-allyl-3-((1-allyl-2-oxoindolin-3-ylidene)fluoromethyl)-3-(trifluoromethyl)indolin-2-one 3e. Column chromatography (petroleum ether : ethyl acetate = 5:1) on silica gel gave a pale yellow solid (54 %): mp 147–149 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, *J* = 7.6 Hz, 1H), 7.41 (t, *J* = 6.3 Hz, 2H), 7.28 (t, *J* = 7.7 Hz, 1H), 7.10 (t, *J* = 7.5 Hz, 2H), 6.99 (d, *J* = 7.9 Hz, 1H), 6.77 (d, *J* = 7.8 Hz, 1H), 6.03 (ddd, *J* = 15.9, 10.0, 4.9 Hz, 1H), 5.70 (ddd, *J* = 16.2, 10.3, 5.2 Hz, 1H), 5.40 (d, *J* = 17.2 Hz, 1H), 5.31 (d, *J* = 10.3 Hz, 1H), 5.18 (s, 1H), 5.14 (d, *J* = 10.9 Hz, 1H), 4.73 (dd, *J* = 16.5, 3.3 Hz, 1H), 4.31 (dd, *J* = 16.6, 4.8 Hz, 1H), 4.25 – 4.13 (m, 2H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -68.13 (s, 3F), -87.04 (q, *J* = 20.5 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.1 (d, *J* = 5.0 Hz), 164.4 (d, *J* = 20.0 Hz), 161.5, 158.6, 146.0, 141.6, 131.6, 131.4, 130.8, 129.9 (d, *J* = 2.7 Hz), 125.4 (d, *J* = 13.5 Hz), 124.7, 123.0, 122.8 (qd, *J* = 284.2, 2.7Hz), 122.6, 121.4, 119.9, 117.7 (d, *J* = 7.2 Hz), 113.7 (d, *J* = 17.6 Hz), 109.6, 108.9, 61.55 – 59.89 (m), 43.9, 42.1. IR $(KBr)_{max}$ 3071, 2920, 1730, 1657, 1607, 1475, 1351, 1253, 1179, 941,747 cm^{-1}; MS (EI) m/z 442.0 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{24}H_{18}F_4N_2O_2$, 442.1304; Found, 442.1309.



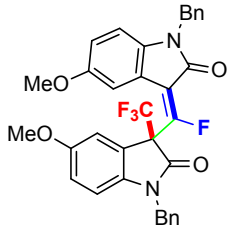
3-(fluoro(2-oxo-1-(prop-2-yn-1-yl)indolin-3-ylidene)methyl)-1-(prop-2-yn-1-yl)-3-(trifluoromethyl)indolin-2-one 3f. Column chromatography (petroleum ether : ethyl acetate = 6:1) on silica gel gave a pale yellow solid (72 %): mp 212–213 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, *J* = 6.0 Hz, 1H), 7.49 (s, 1H), 7.42 (d, *J* = 5.6 Hz, 1H), 7.36 (s, 1H), 7.27 (d, *J* = 6.7 Hz, 1H), 7.16 (s, 2H), 7.02 (d, *J* = 6.5 Hz, 1H), 4.99 (d, *J* = 17.6 Hz, 1H), 4.34 (dd, *J* = 23.1, 16.8 Hz, 3H), 2.38 (s, 1H), 2.21 (s, 1H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -68.11 (s, 3F), -86.43 (q, *J* = 20.0 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.6, 163.8 (d, *J* = 20.2 Hz), 161.6, 158.7, 145.0, 140.4, 131.0, 130.1 (d, *J* = 2.6 Hz), 125.4 (d, *J* = 13.5 Hz), 124.9, 123.5, 123.1, 122.7 (q, *J* = 284.6 Hz), 121.0, 119.8, 109.7, 109.2, 76.5, 76.5, 72.9, 72.7, 61.3 - 60.5 (m), 30.8, 29.0. IR $(KBr)_{max}$ 3299, 3039, 2922, 1741, 1660, 1609, 1477,1351, 1181, 1108, 916, 744, 672 cm^{-1}; MS (EI) m/z 438.0 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{24}H_{14}F_4N_2O_2$, 438.0991; Found, 438.0995.



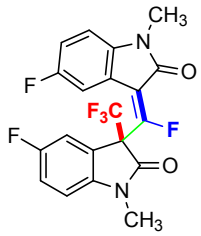
3-((1,5-dimethyl-2-oxoindolin-3-ylidene)fluoromethyl)-1,5-dimethyl-3-(trifluoromethyl)indolin-2-one 3g. Column chromatography (petroleum ether : ethyl acetate = 3:1) on silica gel gave a pale yellow solid (85 %): mp 158–159 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (s, 1H), 7.21 (d, *J* = 8.0 Hz, 1H), 7.17 (s, 1H), 7.09 (d, *J* = 7.8 Hz, 1H), 6.84 (d, *J* = 8.0 Hz, 1H), 6.61 (d, *J* = 7.9 Hz, 1H), 3.34 (s, 3H), 3.00 (s, 3H), 2.36 (s, 3H), 2.31 (s, 3H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -68.16 (s, 3F), -87.76 (q, *J* = 20.4 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.7 (d, *J* = 5.8 Hz), 164.8 (d, *J* = 20.2 Hz, 161.3, 158.4, 144.2, 140.1, 132.7, 132.0, 131.2, 130.3 (d, *J* = 2.8 Hz), 126.0 (d, *J* = 13.5 Hz), 125.5, 121.4, 122.9 (qd. *J* = 285.2, 2.9 Hz), 119.9 (d, *J* = 1.3) Hz), 108.3, 107.6. 60.8 – 60.2 (m). 27.3, 26.1, 21.1, 21.0. IR $(KBr)_{max}$ 3024, 2925, 2853, 1737, 1614, 1496, 1349, 1233, 1177, 1091, 972, 809, 649 cm^{-1}; MS (EI) m/z 418.4 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{22}H_{18}F_4N_2O_2$, 418.1304; Found, 418.1307.



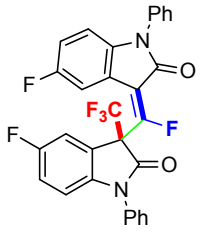
3-(fluoro(5-methyl-2-oxo-1-(prop-2-yn-1-yl)indolin-3-ylidene)methyl)-5-methyl-1-(prop-2-yn-1-yl)-3-(trifluoromethyl)indolin-2-one 3h. Column chromatography (petroleum ether : ethyl acetate = 6:1) on silica gel gave a pale yellow solid (74 %): mp 192–193 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (s, 1H), 7.28 (d, *J* = 7.9 Hz, 1H), 7.22 (s, 1H), 7.16 (t, *J* = 6.3 Hz, 2H), 6.91 (d, *J* = 7.9 Hz, 1H), 4.96 (d, *J* = 17.8 Hz, 1H), 4.39 – 4.24 (m, 3H), 2.40 (s, 3H), 2.35 (s, 4H), 2.19 (s, 1H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -68.07 (s, 3F), -86.76 (q, *J* = 20.3 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.5 (d, *J* = 4.2 Hz), 163.86 (d, *J* = 20.4 Hz), 161.5, 158.6, 142.6, 138.2, 133.2, 132.6, 131.4, 130.4 (d, *J* = 2.7 Hz), 126.1 (d, *J* = 13.5 Hz), 125.6, 122.74 (qd, *J* = 283.0, 2.6 Hz), 121.1, 119.9 (d, *J* = 1.4 Hz), 113.7 (d, *J* = 17.9 Hz), 109.4, 108.9, 76.7, 72.8, 72.5, 60.89 – 60.10 (m), 30.8, 29.0, 21.2, 21.0. IR $(KBr)_{max}$ 3297, 2922, 1742, 1660, 1610, 1494, 1433, 1343, 1194, 966, 811, 667 cm^{-1}; MS (EI) m/z 466.0 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{26}H_{18}F_4N_2O_2$, 466.1304; Found, 466.1308.



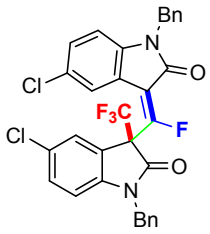
1-benzyl-3-((1-benzyl-5-methoxy-2-oxoindolin-3-ylidene)fluoromethyl)-5-methoxy-3-(trifluoromethyl)indolin-2-one 3i. Column chromatography (petroleum ether : ethyl acetate = 7:1) on silica gel gave a pale yellow solid (73 %): mp 159–160 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 (dd, *J* = 19.4, 7.8 Hz, 5H), 7.34 – 7.24 (m, 4H), 7.16 (d, *J* = 6.7 Hz, 2H), 7.05 (s, 1H), 6.85 (d, *J* = 8.2 Hz, 1H), 6.76 (d, *J* = 8.2 Hz, 1H), 6.70 (d, *J* = 8.5 Hz, 1H), 6.51 (d, *J* = 8.5 Hz, 1H), 5.54 (d, *J* = 16.1 Hz, 1H), 4.77 (dd, *J* = 66.7, 16.1 Hz, 2H), 4.63 (d, *J* = 16.2 Hz, 1H), 3.82 (s, 3H), 3.78 (s, 3H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -67.79 (s, 3F), -86.94 (q, *J* = 20.3 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.4 (d, *J* = 4.3 Hz), 164.8 (d, *J* = 19.8 Hz), 161.6, 158.8, 156.1, 155.8, 139.7, 135.6, 135.5, 135.3, 128.8, 128.7, 127.6 (d, *J* = 3.3 Hz), 127.2, 127.0, 123.0 (q, *J* = 285.6 Hz), 122.3, 120.7, 115.6 (d, *J* = 2.2 Hz), 115.3, 114.4 (d, *J* = 16.8 Hz), 112.1, 111.8 (d, *J* = 13.6 Hz), 110.2, 109.5, 61.3 – 60.6 (m), 55.9, 55.8, 45.5, 43.6. IR $(KBr)_{max}$ 3029, 2923, 2840, 1725, 1654, 1490, 1345, 1236, 1192, 1024, 806, 698 cm^{-1}; MS (EI) m/z 602.1 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{34}H_{26}F_4N_2O_4$, 602.1829; Found, 602.1816.



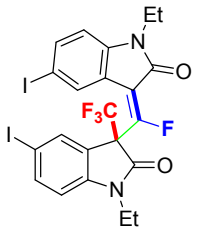
5-fluoro-3-(fluoro(5-fluoro-1-methyl-2-oxoindolin-3-ylidene)methyl)-1-methyl-3-(trifluoromethyl)indolin-2-one 3j. Column chromatography (petroleum ether : ethyl acetate = 3:1) on silica gel gave a pale yellow solid (74 %): mp 166–167 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (s, 1H), 7.16 (s, 2H), 7.06 (s, 1H), 6.93 (s, 1H), 6.70 (s, 1H), 3.38 (s, 3H), 3.06 (s, 3H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -68.14 (s, 3F), -85.08 – -87.66 (m, 1F), -119.24 (s, 1F), -120.29 (s, 1F).^{13}C NMR (101 MHz, $CDCl_3$) δ 167.2 (d, *J* = 3.9 Hz), 164.5 (d, *J* = 19.3 Hz), 161.5, 160.2 (d, *J* = 10.1 Hz), 158.6, 157.8 (d, *J* = 7.5 Hz), 142.8, 138.4, 122.5 (q, *J* = 284.9 Hz), 122.1 (d, *J* = 9.4 Hz), 120.5 (d, *J* = 9.7 Hz), 117.4 (d, *J* = 23.3 Hz), 116.6 (d, *J* = 24.0 Hz), 113.2 (d, *J* = 26.4 Hz), 113.0 (d, *J* = 25.5), 109.3 (d, *J* = 8.0 Hz), 108.4 (d, *J* = 8.3 Hz), 61.0– 59.6 (m,), 27.5, 26.2. IR $(KBr)_{max}$ 3080, 2929, 1741, 1661, 1615, 1491, 1345, 1270, 1229, 1201, 977, 869, 810 cm^{-1}; MS (EI) m/z 426.0 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{20}H_{12}F_6N_2O_2$, 426.0803; Found, 426.0798.



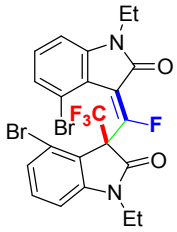
5-fluoro-3-(fluoro(5-fluoro-2-oxo-1-phenylindolin-3-ylidene)methyl)-1-phenyl-3-(trifluoromethyl)indolin-2-one 3k. Column chromatography (petroleum ether : ethyl acetate = 8:1) on silica gel gave a pale yellow solid (63 %): mp 248–249 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 (d, *J* = 8.2 Hz, 1H), 7.58 – 7.53 (m, 4H), 7.48 (dd, *J* = 14.3, 7.2 Hz, 3H), 7.39 (t, *J* = 7.3 Hz, 1H), 7.33 – 7.28 (m, 2H), 7.24 (d, *J* = 7.0 Hz, 1H), 7.09 – 6.98 (m, 2H), 6.79 – 6.71 (m, 2H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -68.17 (s, 3F), -84.83 (q, *J* = 20.6 Hz, 1F), -118.64 – -119.01 (m, 1F), -119.28 – -119.75 (m, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.0 (d, *J* = 4.5 Hz), 163.9 (d, *J* = 19.2 Hz), 162.1, 160.4 (d, *J* = 3.9 Hz), 159.2, 158.0, 143.1, 138.5, 133.9 (d, *J* = 30.4 Hz), 129.8, 129.6, 128.9, 128.2, 127.3, 126.4, 122.7 (qd, *J* = 284.5, 2.8 Hz), 120.6 (d, *J* = 9.6 Hz), 117.4 (d, *J* = 23.3 Hz), 116.7 (d, *J* = 24.0 Hz), 113.3 (d, *J* = 13.4 Hz), 113.1, 112.85, 112.96, 110.6 (d, *J* = 7.9 Hz), 110.1 (d, *J* = 8.1 Hz), 61.3 - 60.57 (m). IR $(KBr)_{max}$ 3063, 2924,1749, 1658, 1606, 1488, 1364, 1196, 817, 747, 695 cm^{-1}; MS (EI) m/z 550.1 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{30}H_{16}F_6N_2O_2$, 550.1116; Found, 550.1119.



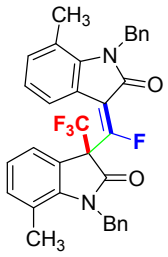
1-benzyl-3-((1-benzyl-5-chloro-2-oxoindolin-3-ylidene)fluoromethyl)-5-chloro-3-(trifluoromethyl)indolin-2-one 3l. Column chromatography (petroleum ether : ethyl acetate = 7:1) on silica gel gave a pale yellow solid (57 %): mp 196–197 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (s, 1H), 7.39 (d, J = 11.0 Hz, 5H), 7.30 (d, J = 8.1 Hz, 5H), 7.19 (d, J = 8.1 Hz, 1H), 7.13 (d, J = 6.4 Hz, 2H), 6.73 (d, J = 8.2 Hz, 1H), 6.56 (d, J = 8.2 Hz, 1H), 5.53 (d, J = 16.0 Hz, 1H), 4.78 (dd, J = 54.9, 15.9 Hz, 2H), 4.62 (d, J = 16.0 Hz, 1H). ^{19}F NMR (377 MHz, $CDCl_3$) δ -67.72 (s, 3F), -84.87 (q, J = 20.3 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.1 (d, J = 5.2 Hz), 164.5 (d, J = 19.5 Hz), 161.8, 158.9, 144.8, 139.9, 134.9 (d, J = 7.1 Hz), 131.0, 130.0, 128.9, 128.9, 128.5, 128.3, 127.8, 127.1, 127.0, 125.7, 125.5, 125.1, 122.6 (q, J = 286.1 Hz), 122.4, 121.0, 113.6 (d, J = 18.3 Hz), 110.8, 110.1, 61.0 – 60.1 (m), 45.6, 43.6. IR $(KBr)_{max}$ 3067, 2924, 1745, 1661, 1607, 1482, 1342, 1250, 1180, 1116, 1077, 813, 738, 694 cm^{-1}; MS (EI) m/z 610.0 $[M]^+$; HRMS (EI) m/z $[M]^+$ calcd for $C_{32}H_{20}Cl_2F_4N_2O_2$, 610.0838; Found, 610.0833.



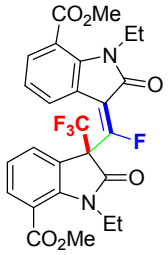
1-ethyl-3-((1-ethyl-5-iodo-2-oxoindolin-3-ylidene)fluoromethyl)-5-iodo-3-(trifluoromethyl)indolin-2-one 3m. Column chromatography (petroleum ether : ethyl acetate = 2:1) on silica gel gave a pale yellow solid (49 %): mp 166–167 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (d, J = 1.7 Hz, 1H), 7.72 (dd, J = 8.3, 1.7 Hz, 1H), 7.61 (dd, J = 8.3, 1.8 Hz, 2H), 6.75 (d, J = 8.3 Hz, 1H), 6.56 (d, J = 8.2 Hz, 1H), 3.94 (dt, J = 14.4, 7.1 Hz, 1H), 3.74 (dq, J = 14.5, 7.3 Hz, 1H), 3.59 – 3.51 (m, 2H), 1.35 (t, J = 7.3 Hz, 3H), 1.11 (t, J = 7.2 Hz, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.28 (s, 3F), -85.49 (q, J = 20.6 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.0 (d, J = 3.3 Hz), 163.6 (d, J = 19.5 Hz), 161.3, 158.4, 145.5, 141.0 (d, J = 12.5 Hz), 139.7, 138.6 (d, J = 2.7 Hz), 135.0, 134.0 (d, J = 14.2 Hz), 133.3, 123.3, 122.5 (qd, J = 286.5, 2.9 Hz), 121.9, 110.6, 110.1, 84.6 (d, J = 6.2 Hz), 61.3 – 59.8 (m), 36.2, 34.5, 12.5, 12.2. IR $(KBr)_{max}$ 3031, 2981, 2936, 1733, 1661, 1601, 1476, 1343, 1223, 1186, 1100, 810, 735 cm^{-1}; MS (ESI) m/z 671.0 $[M+H]^+$; HRMS (ESI) m/z $[M+H]^+$ calcd for $C_{22}H_{17}F_4I_2N_2O_2$, 670.9310; Found, 670.9305.



4-bromo-3-((4-bromo-1-ethyl-2-oxoindolin-3-ylidene)fluoromethyl)-1-ethyl-3-(trifluoromethyl)indolin-2-one 3n. Column chromatography (petroleum ether : ethyl acetate = 2:1) on silica gel gave a pale yellow solid (53 %): mp 181–182 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.25 (dd, *J* = 15.6, 8.4 Hz, 2H), 7.16 (d, *J* = 7.5 Hz, 1H), 7.10 (t, *J* = 8.0 Hz, 1H), 6.89 (d, *J* = 7.7 Hz, 1H), 6.68 (d, *J* = 7.7 Hz, 1H), 3.91 (dq, *J* = 14.5, 7.3 Hz, 1H), 3.76 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.62 – 3.42 (m, 2H), 1.34 (t, *J* = 7.3 Hz, 3H), 1.07 (t, *J* = 7.2 Hz, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -59.58 (q, *J* = 21.4 Hz, 1F), -66.20 (s, 3F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.7, 164.4 (d, *J* = 19.0 Hz), 159.4, 156.4, 147.8, 143.8, 131.6, 130.7 (d, *J* = 1.6 Hz), 128.6, 127.0, 123.0 (qd, *J* = 288.6, 3.2 Hz), 121.2, 120.6 (d, *J* = 5.6 Hz), 119.1, 118.9 (d, *J* = 3.3 Hz), 107.3, 106.8, 63.3 – 62.1 (m), 36.2, 34.6, 12.5, 12.1. IR $(KBr)_{max}$ 3048, 2982, 2938, 1736, 1644, 1598, 1453, 1340, 1263, 1195, 1109, 773,671 cm^{-1}; MS (ESI) m/z 576.0 $[M+H+2]^+$; HRMS (ESI) m/z $[M+H]^+$ calcd for $C_{22}H_{17}Br_2F_4N_2O_2$, 574.9587; Found, 574.9577.



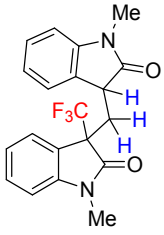
1-benzyl-3-((1-benzyl-7-methyl-2-oxoindolin-3-ylidene)fluoromethyl)-7-methyl-3-(trifluoromethyl)indolin-2-one 3o. Column chromatography (petroleum ether : ethyl acetate = 7:1) on silica gel gave a pale yellow solid (42 %): mp 192–194 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.66 (m, 1H), 7.34 – 7.15 (m, 9H), 7.07 (d, *J* = 7.7 Hz, 1H), 7.01 – 6.89 (m, 5H), 5.50 (d, *J* = 17.4 Hz, 1H), 5.10 (d, *J* = 16.8 Hz, 1H), 4.95 (d, *J* = 13.3 Hz, 1H), 4.91 (d, *J* = 13.6 Hz, 1H), 2.26 (s, 3H), 2.17 (s, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -67.91 (s, 3F), -86.72 (q, *J* = 20.5 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.9 (d, *J* = 4.5 Hz), 166.0 (d, *J* = 20.2 Hz), 161.9, 159.1, 144.5, 139.6, 137.9, 137.5, 134.8, 133.9 (d, *J* = 2.8 Hz), 128.8 (d, *J* = 5.9 Hz), 127.1 (d, *J* = 6.5 Hz), 125.9, 125.7, 123.5 (d, *J* = 15.0 Hz), 123.0 (qd, *J* = 284.5, 3.6 Hz), 122.9, 122.8, 122.7, 122.1, 120.7 (d, *J* = 2.6 Hz), 120.2, 119.7, 113.4 (d, *J* = 16.9 Hz), 60.3 (dd, *J* = 26.9, 20.7 Hz), 46.8, 44.8, 18.9, 18.7. IR $(KBr)_{max}$ 3063, 3030, 2929, 1738, 1658, 1599, 1446, 1352, 1228, 1190, 1074, 951, 911, 792, 728 cm^{-1}; MS (ESI) m/z 571.2 $[M+H]^+$; HRMS (ESI) m/z $[M+H]^+$ calcd for $C_{34}H_{27}F_4N_2O_2$, 571.2003; Found, 571.1995.



methyl 1-ethyl-3-((1-ethyl-7-(methoxycarbonyl)-2-oxoindolin-3-ylidene)fluoromethyl)-2-oxo-3-(trifluoromethyl)indoline-7-carboxylate 3p. Column chromatography (petroleum ether : ethyl acetate = 4:1) on silica gel gave a pale yellow solid (39 %): mp 170–171 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88 (d, *J* = 6.8 Hz, 1H), 7.67 (d, *J* = 7.0 Hz, 1H), 7.53 (d, *J* = 7.3 Hz, 1H), 7.40 (d, *J* = 7.1 Hz, 1H), 7.06 (dt, *J* = 12.5, 7.6 Hz, 2H), 4.04 (ddd, *J* = 19.4, 16.4, 7.1 Hz, 2H), 3.96 (s, 3H), 3.88 (s, 3H), 3.73 (ddt, *J* = 21.2, 14.1, 7.1 Hz, 2H), 1.29 (t, *J* = 7.2 Hz, 3H), 0.93 (t, *J* = 7.1 Hz, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.30 (s, 3F), -86.15 (q, *J* = 21.1 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.0, 167.1, 167.0, 165.2 (d, *J* = 19.5 Hz), 162.0, 159.1, 144.6, 139.8, 132.2, 131.1(d, *J* = 2.7 Hz), 128.1, 128.0, 127.4, 123.5, 122.5 (qd, *J* = 286.3, 3.4 Hz), 121.9, 121.7, 116.2, 115.9, 60.4, 52.6, 52.6, 39.0, 36.6, 12.6, 12.3. IR $(KBr)_{max}$ 3052, 2947, 1729, 1663, 1596, 1446, 1352, 1317, 1271, 1203, 1116, 1072, 1010, 800, 746 cm^{-1}; MS (ESI) m/z 535.2 $[M+H]^+$; HRMS (ESI) m/z $[M+H]^+$ calcd for $C_{26}H_{23}F_4N_2O_6$, 535.1487; Found, 535.1471.

4. General procedure for the synthesis of **4a.**

In 3 ml of methanol, the **3a** (58.5 mg, 0.15 mmol) and Pd-black (32 mg, 10%) was hydrogenated for 36 h at room temperature. The mixture was filtered and the solvent was evaporated under reduced pressure. The residue was purified by Column chromatography on silica gel gave the **4a**.

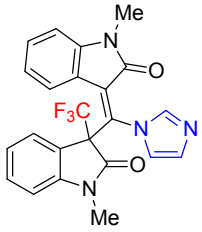


1-methyl-3-((1-methyl-2-oxoindolin-3-yl)methyl)-3-(trifluoromethyl)indolin-2-one 4a. Column chromatography (petroleum ether : ethyl acetate = 3:1) on silica gel gave a pale yellow solid (91 %): mp 155–156 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (d, *J* = 7.5 Hz, 1H), 7.18 (dd, *J* = 7.0, 5.0 Hz, 2H), 7.10 (t, *J* = 7.7 Hz, 1H), 7.02 (t, *J* = 7.6 Hz, 1H), 6.97 (t, *J* = 7.5 Hz, 1H), 6.38 (s, 1H), 6.37 (s, 1H), 3.42 (t, *J* = 4.7 Hz, 1H), 3.21 (d, *J* = 4.9 Hz, 2H), 2.70 (s, 3H), 2.69 (s, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -73.82 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.3, 171.8, 144.7, 144.3, 130.0, 128.2, 127.8, 125.9, 124.5 (q, *J* = 281.3 Hz), 124.4, 122.0, 121.7, 120.9, 107.8, 107.5, 55.0 (q, *J* = 26.1 Hz),

42.3, 28.1 (d, J = 1.9 Hz), 26.3, 25.9. IR (KBr)max 3060, 2928, 1724, 1611, 1482, 1349, 1290, 1171, 1090, 974, 762 cm-1; MS (ESI) m/z 375.1 $[M+H]^+$; HRMS (ESI) m/z $[M+H]^+$ calcd for $C_{20}H_{18}F_3N_2O_2$, 375.1299; Found, 375.1307.

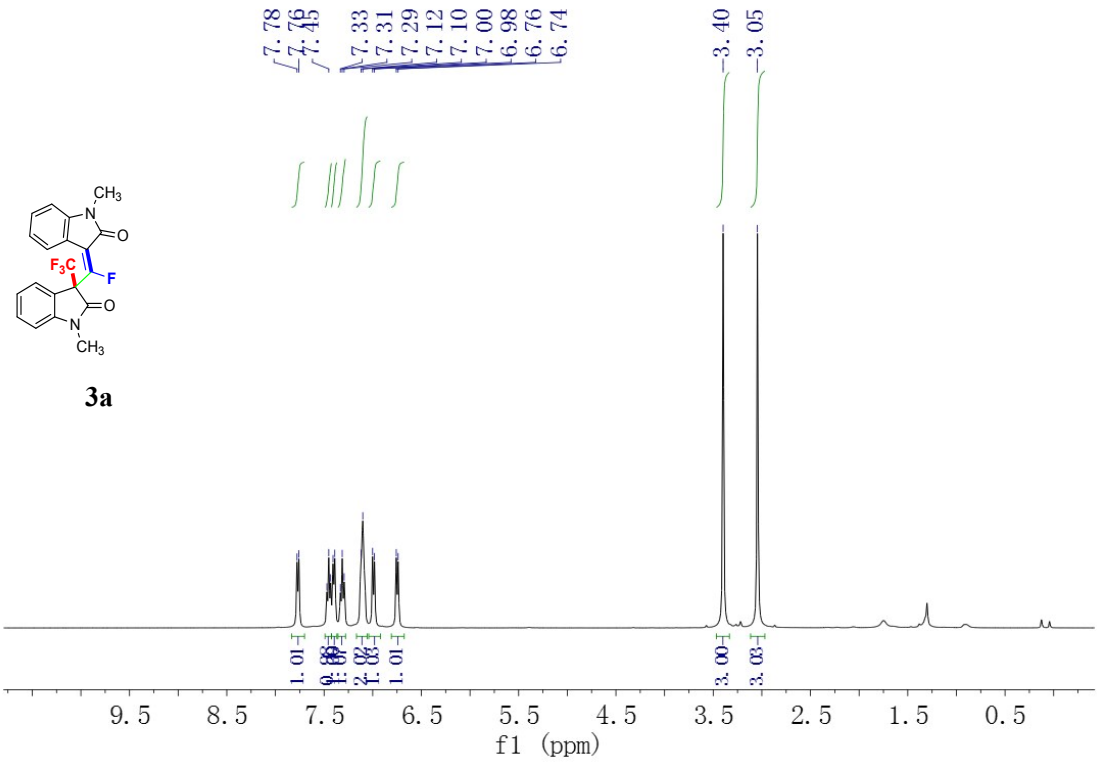
5. General procedure for the synthesis of **4b.**

A solution of pyrazole (27.2 mg, 0.4 mmol) in DMF (0.3 mL) was added dropwise to a mixture of **3a** (78.0 mg, 0.2 mmol) and K_3PO_4 (84.8 mg, 0.4 mmol) in DMF (0.3 mL) via syringe. The mixture was heated to 80 °C and stirred for 12 h (monitored by TLC). The reaction mixture was allowed to cool to room temperature and quenched with H_2O (10 mL). The aqueous phase was extracted with CH_2Cl_2 (3 × 10 mL). The organic layer was dried over $MgSO_4$ and filtered, and the filtrate was concentrated in vacuo. The crude product was purified by column chromatography on silica gel gave the **4b**.



3-((1H-imidazol-1-yl)(1-methyl-2-oxoindolin-3-ylidene)methyl)-1-methyl-3-(trifluoromethyl)indolin-2-one 4b. Column chromatography (petroleum ether : ethyl acetate = 3:1) on silica gel gave a pale yellow solid (84 %): mp 236–237 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (d, J = 32.9 Hz, 1H), 7.43 (dd, J = 17.6, 9.4 Hz, 2H), 7.33 (d, J = 7.5 Hz, 1H), 7.24 (d, J = 8.7 Hz, 1H), 7.18 (d, J = 29.1 Hz, 1H), 7.09 (t, J = 7.6 Hz, 1H), 6.98 (d, J = 7.9 Hz, 1H), 6.76 (t, J = 7.7 Hz, 1H), 6.65 (d, J = 7.8 Hz, 1H), 3.37 (s, 3H), 3.01 (s, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.05 (s, 3F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 163. 7 (d, J = 2.4 Hz), 147.6 (d, J = 2.0 Hz), 143.9 (d, J = 1.2 Hz), 135.3 (d, J = 10.0 Hz), 133.1, 131.9, 130.6 (d, J = 2.8 Hz), 130.3, 124.3 (d, J = 3.1 Hz), 123.9, 123.8, 123.3 (q, J = 285.6 Hz), 123.2, 122.9, 122.7, 119.7 (d, J = 3.2 Hz), 118.5, 108.5, 108.0, 62.2(q, J = 13.5 Hz), 27.2, 26.1. IR $(KBr)_{max}$ 3120, 3070, 2926, 2854, 1740, 1604, 1491, 1374, 1082, 1044, 960, 751, 690, 669 cm^{-1}; MS (ESI) m/z 439.2 $[M+H]^+$; HRMS (ESI) m/z $[M+H]^+$ calcd for $C_{23}H_{18}F_3N_4O_2$, 439.1376; Found, 439.1369.

6. Copies of ^{1}H NMR and ^{13}C NMR spectra for the new product.



3a

Figure S1: ^{1}H NMR of **3a**

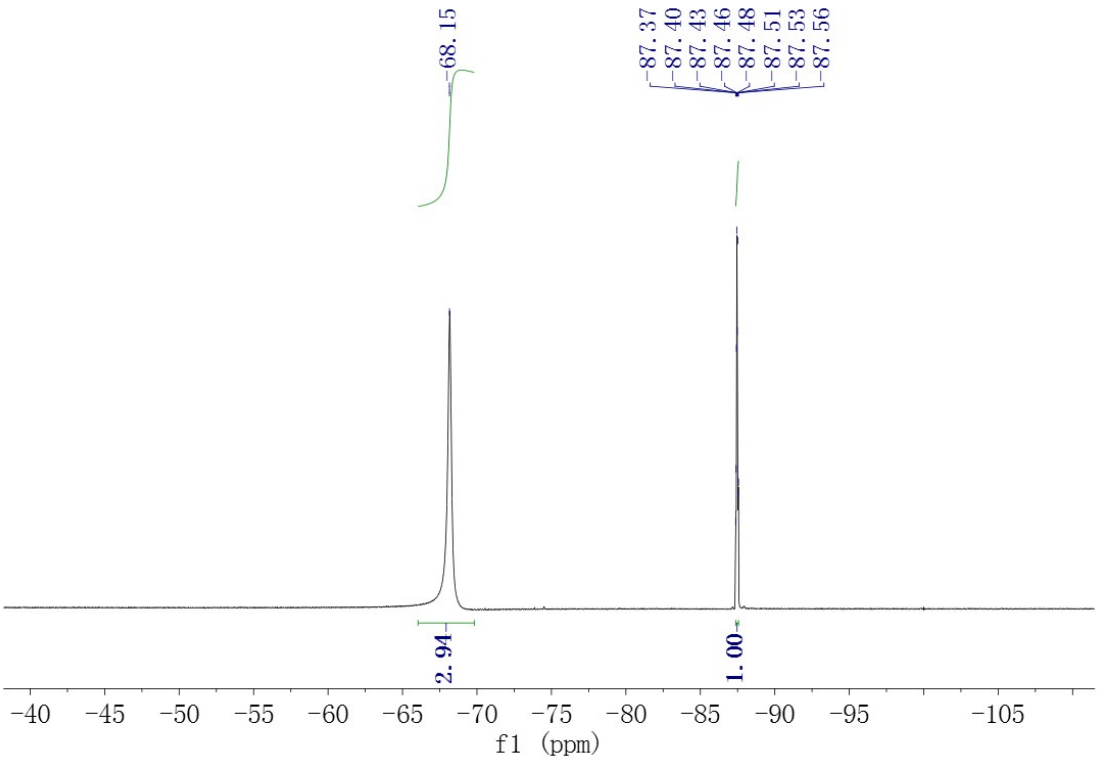


Figure S2: ^{19}F NMR of **3a**

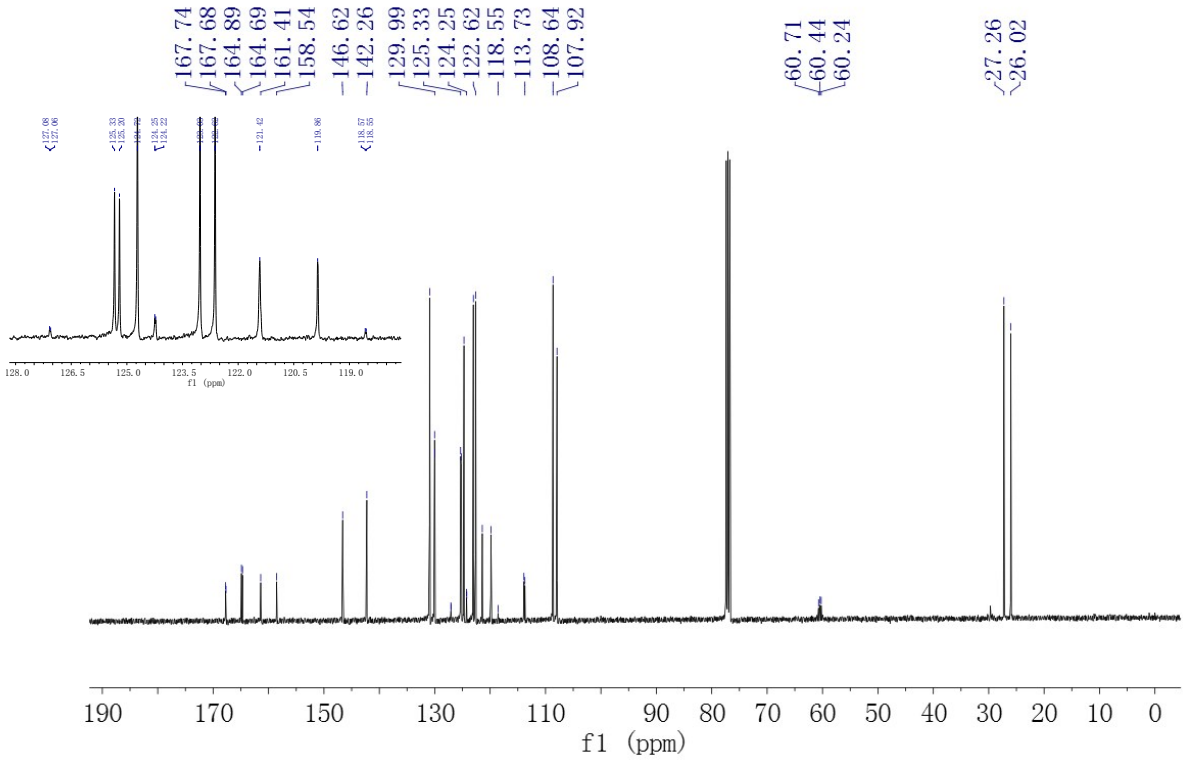
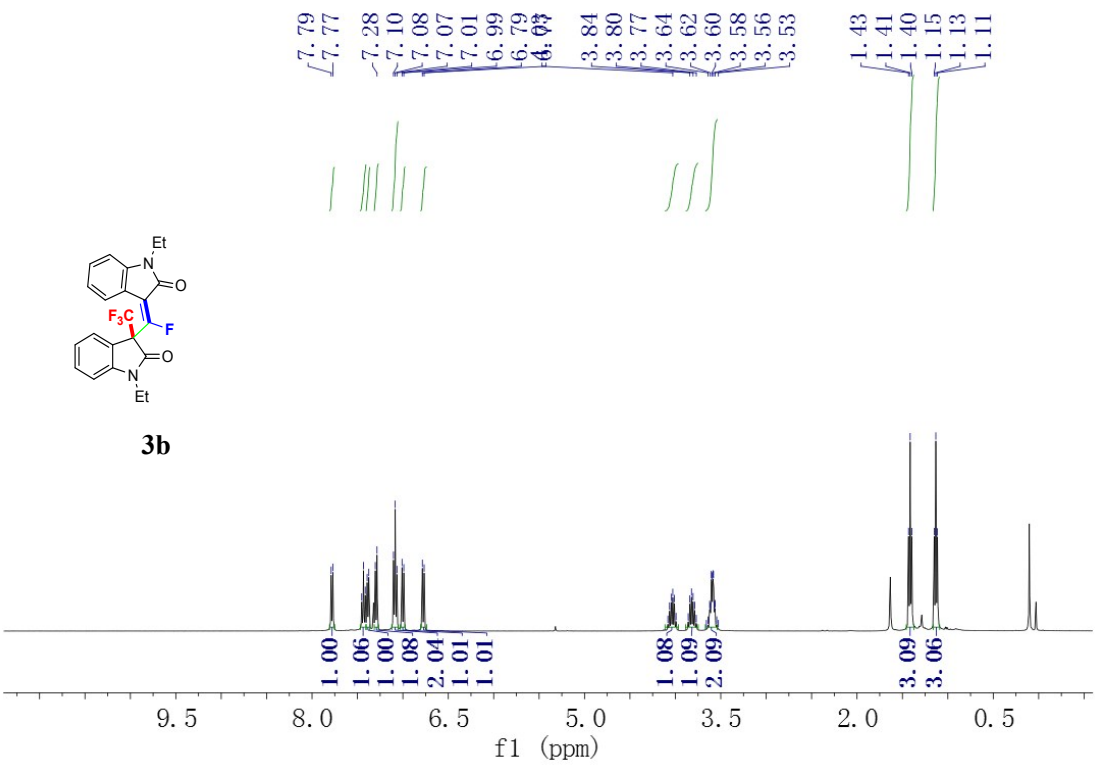


Figure S3: ^{13}C NMR of **3a**



3b

Figure S4: ^{1}H NMR of **3b**

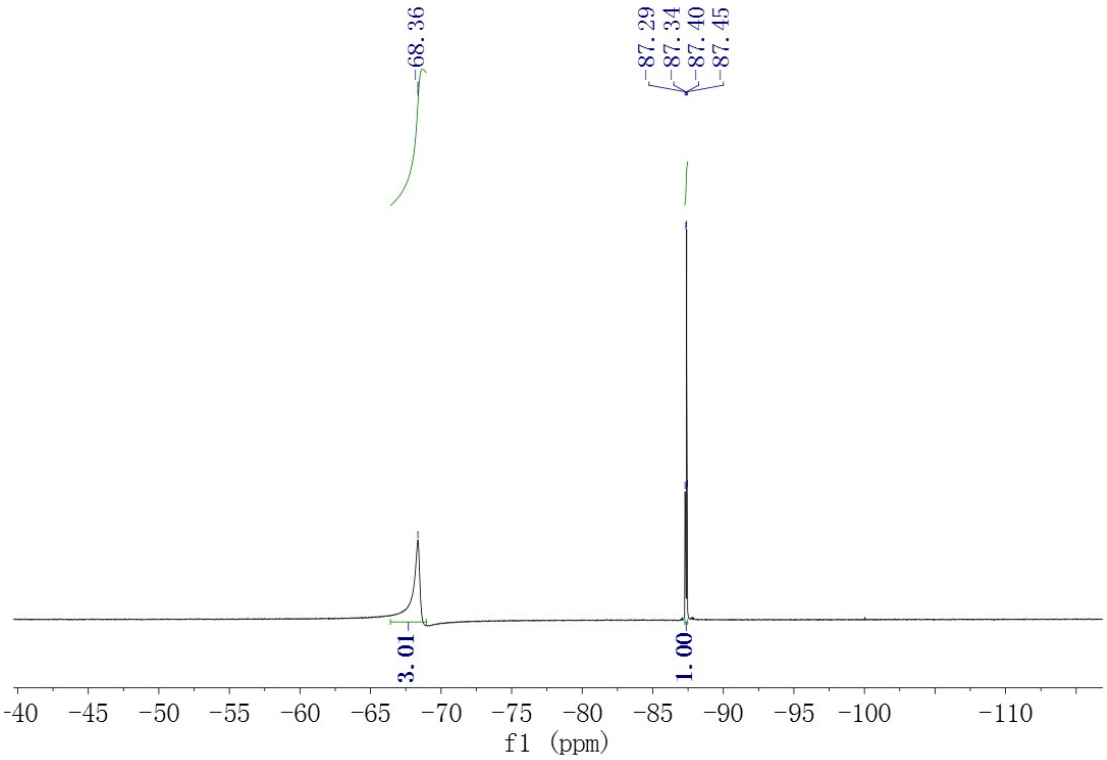


Figure S5: ^{19}F NMR of **3b**

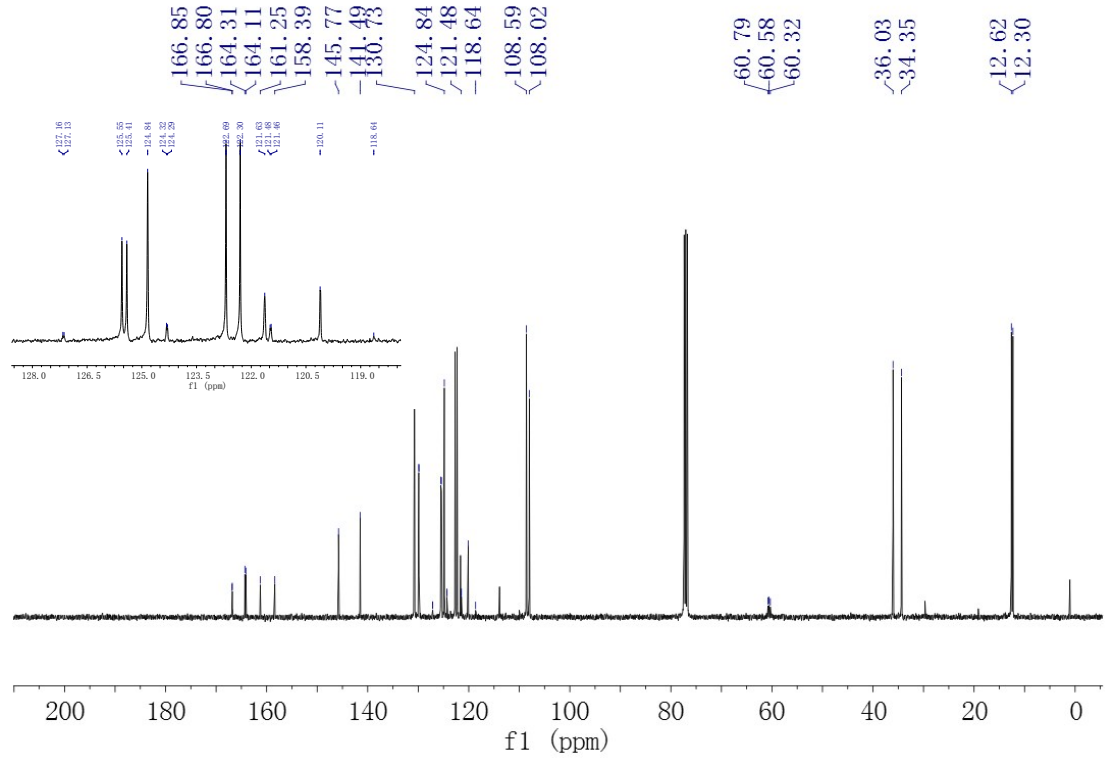


Figure S6: ^{13}C NMR of **3b**

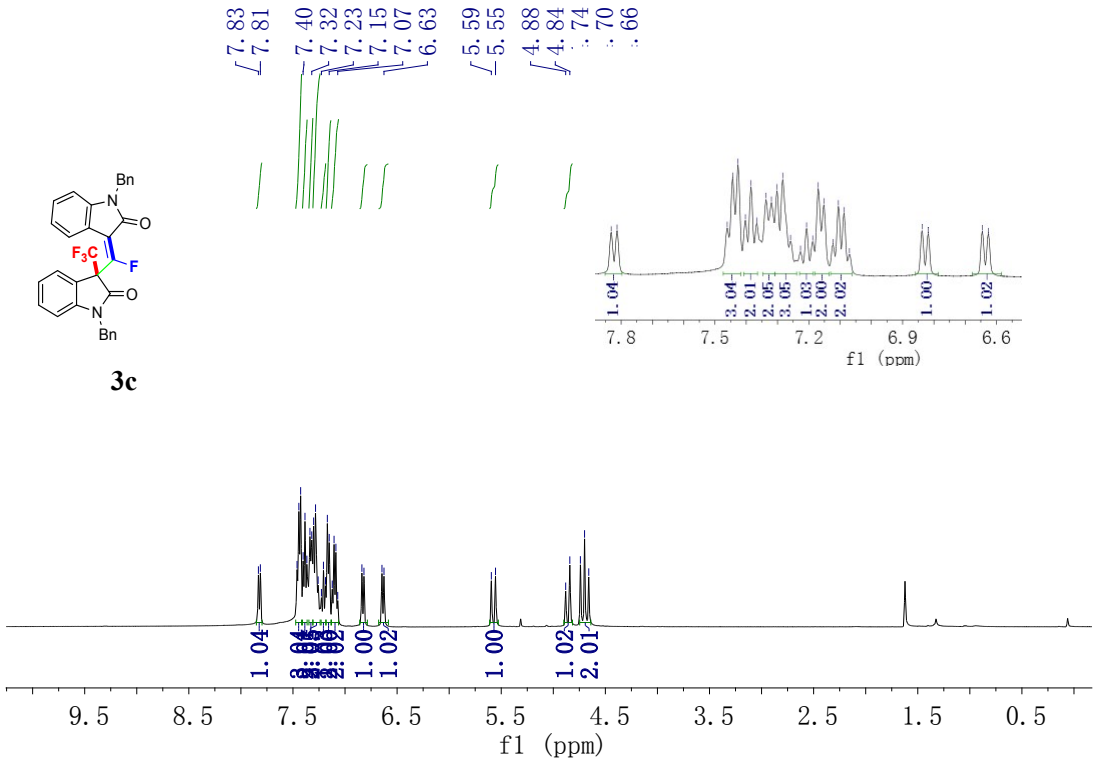


Figure S7: ^{1}H NMR of **3c**

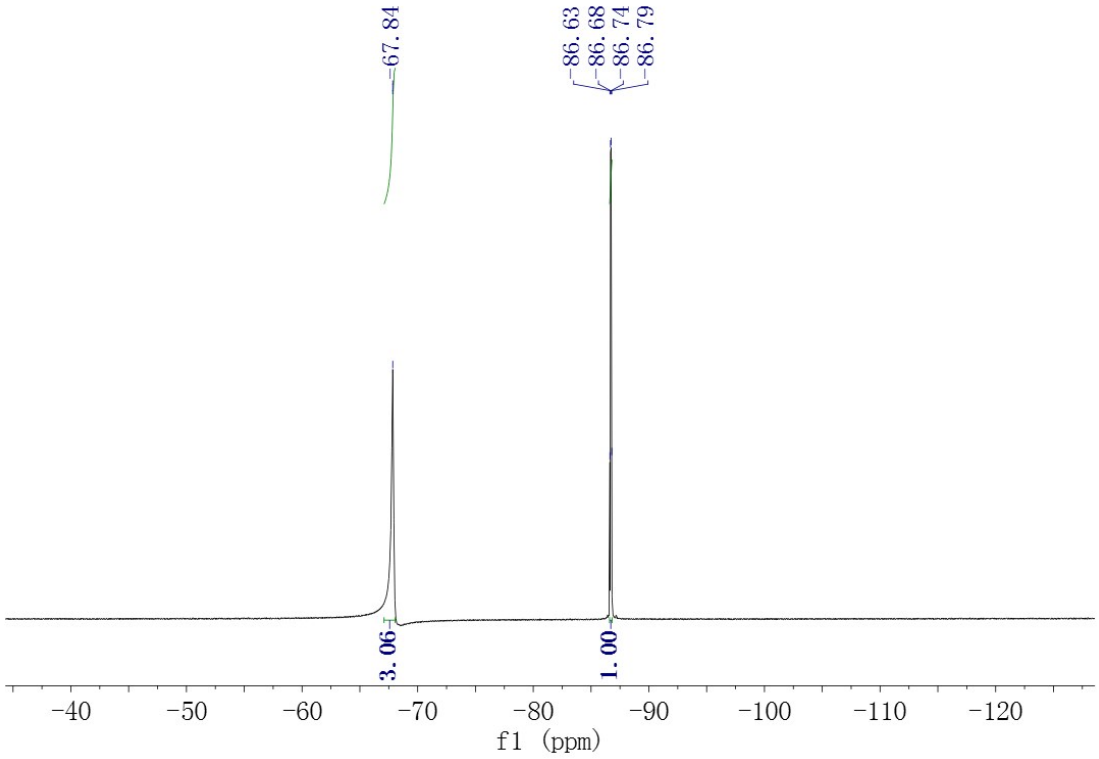


Figure S8: ^{19}F NMR of **3c**

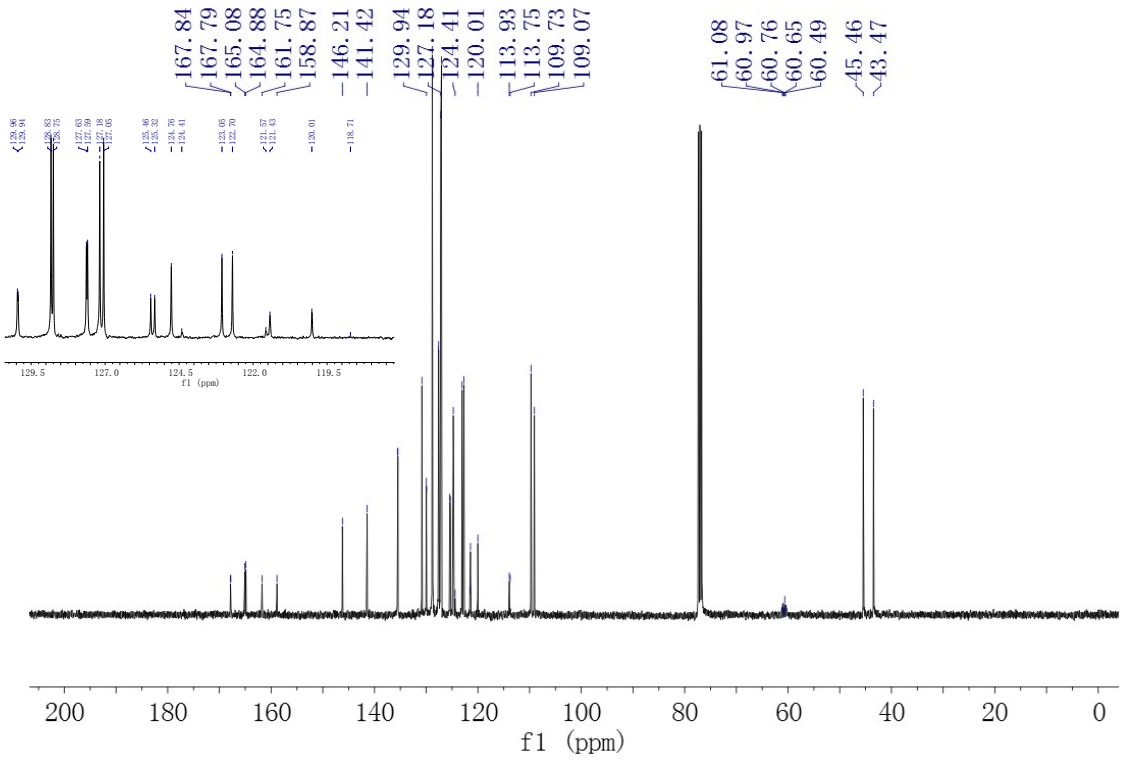


Figure S9: ^{13}C NMR of **3c**

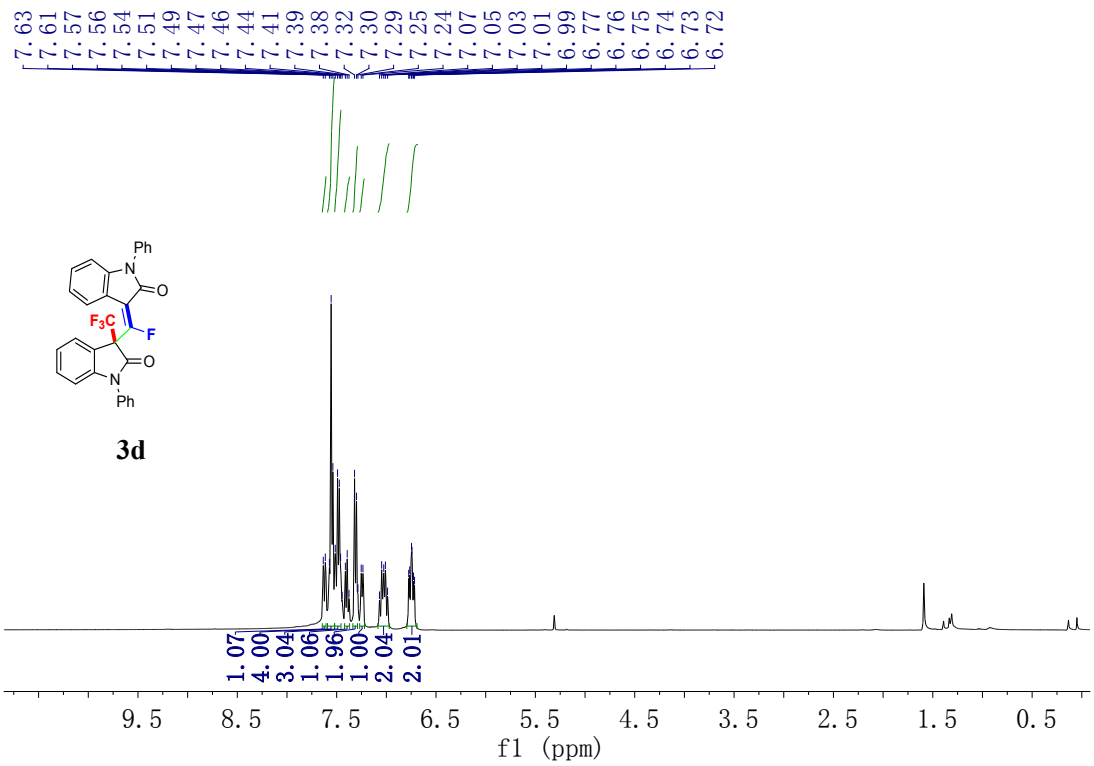


Figure S10: ^{1}H NMR of **3d**

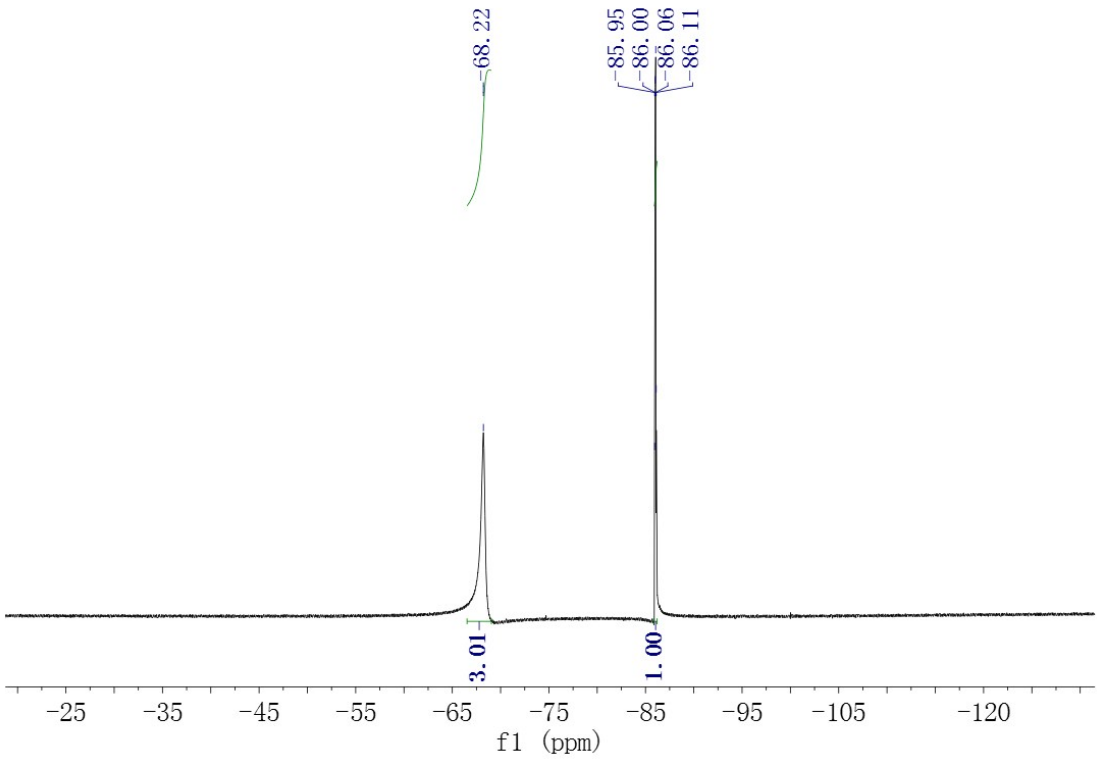


Figure S11: ^{19}F NMR of **3d**

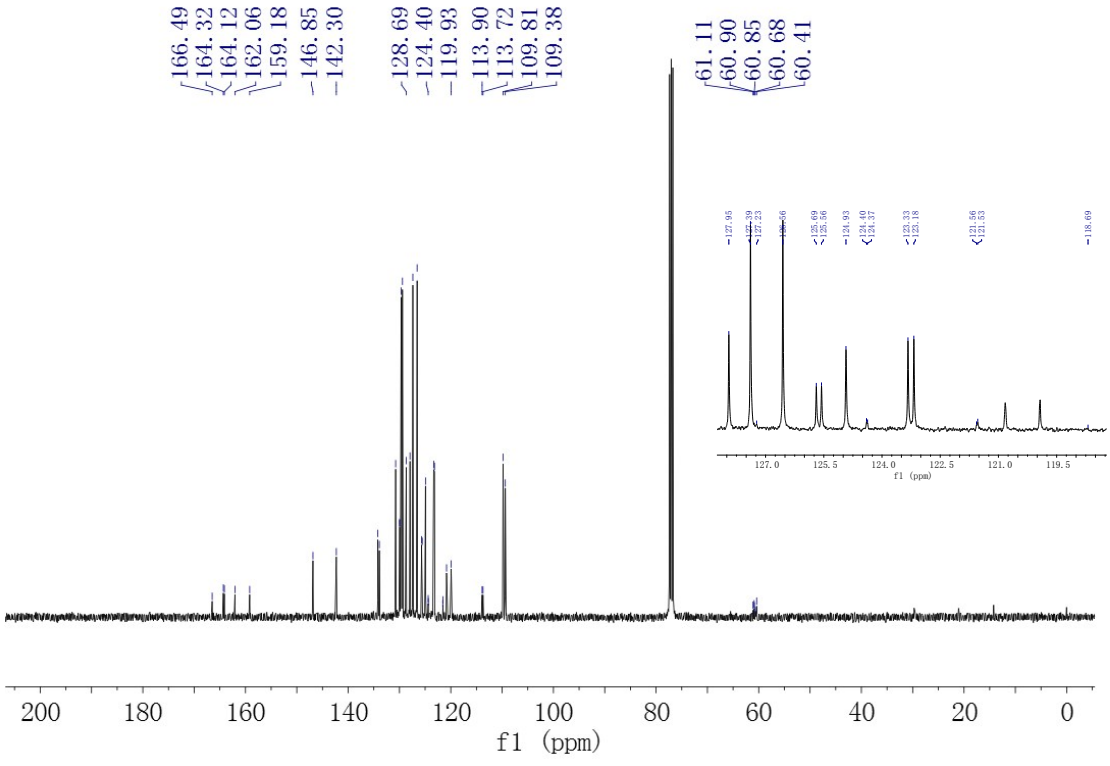
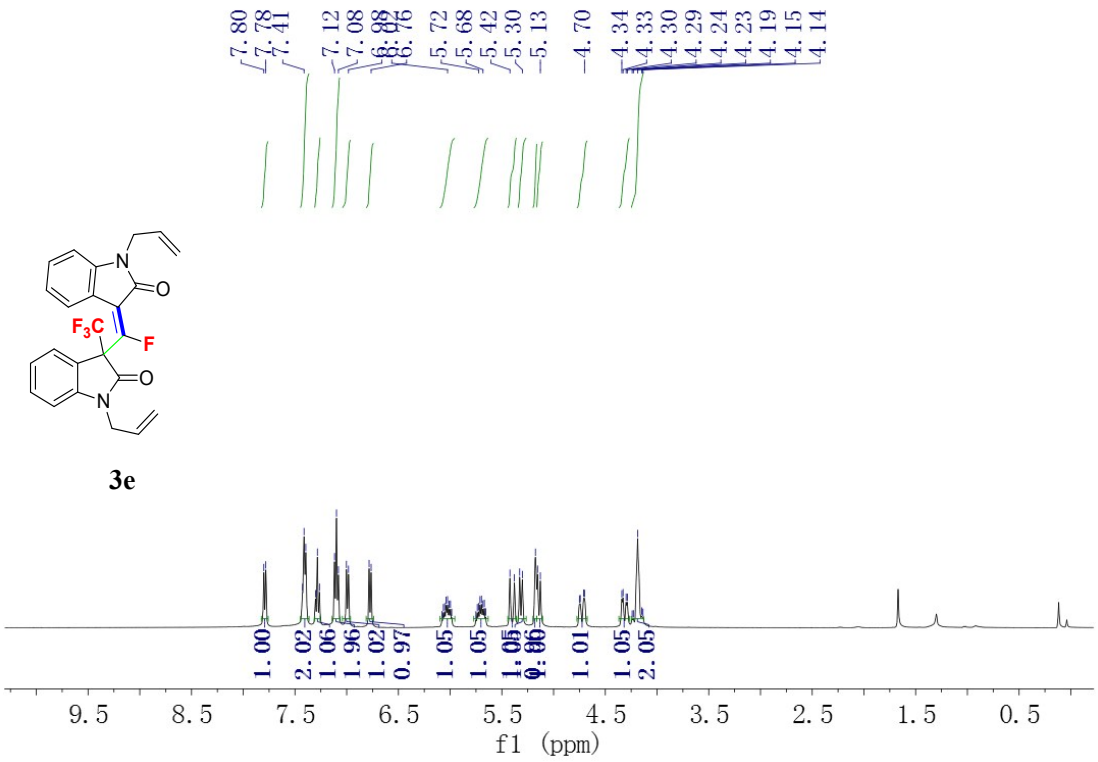


Figure S12: ^{13}C NMR of **3d**



3e

Figure S13: ^{1}H NMR of **3e**

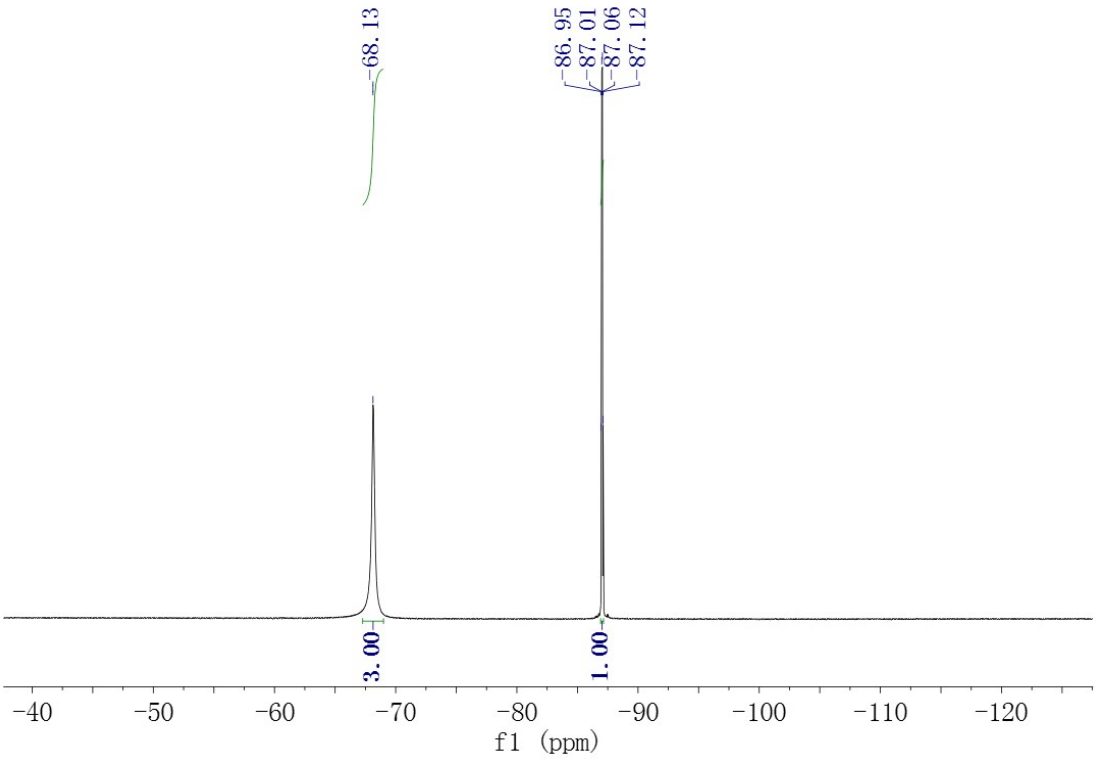


Figure S14: ^{19}F NMR of **3e**

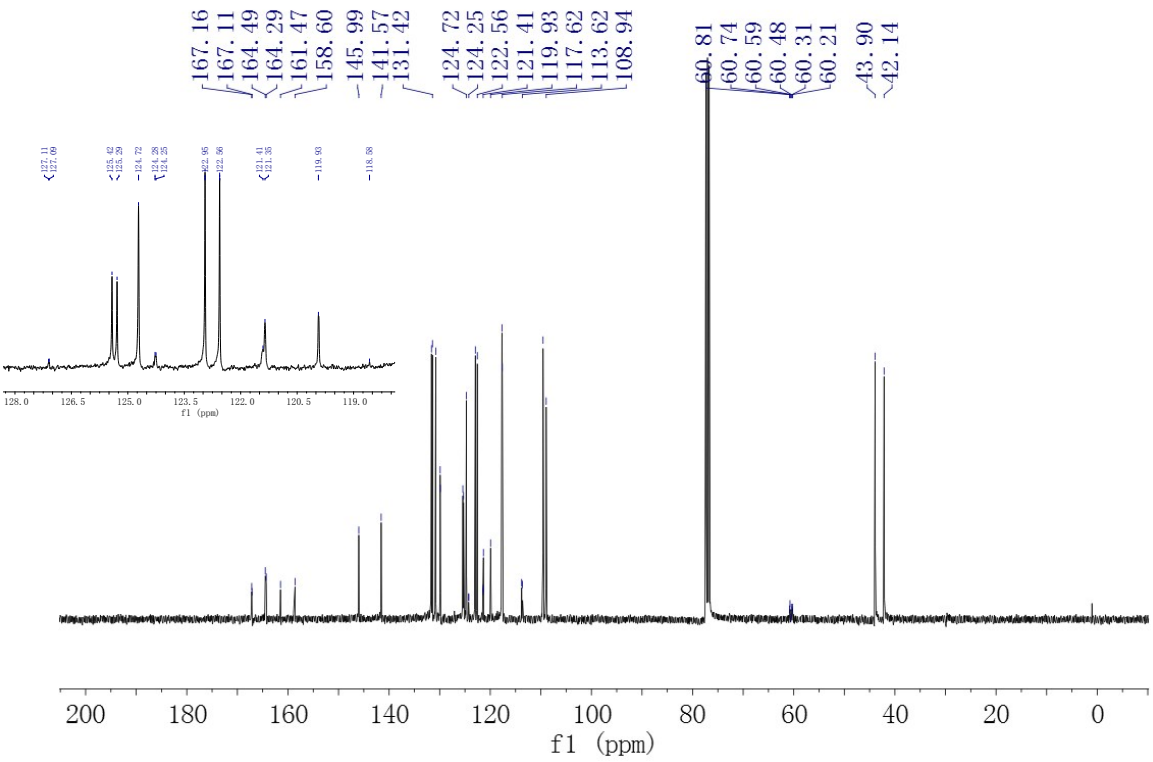
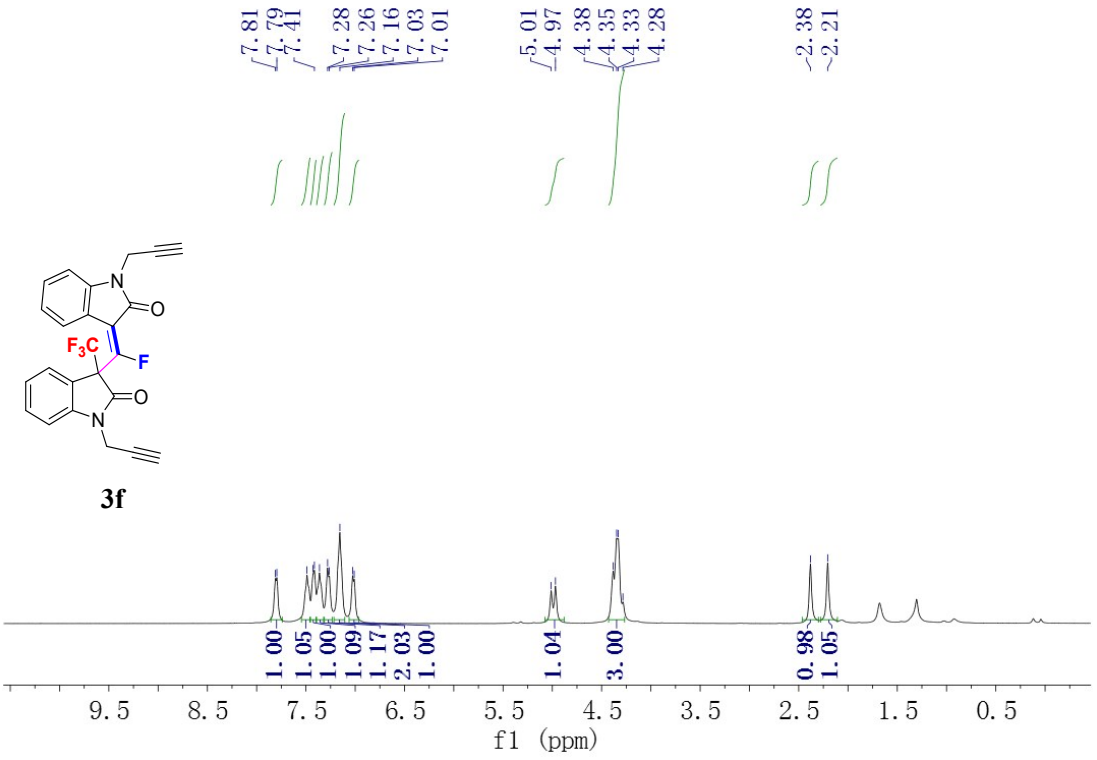


Figure S15: ^{13}C NMR of **3e**



3f

Figure S16: ^{1}H NMR of **3f**

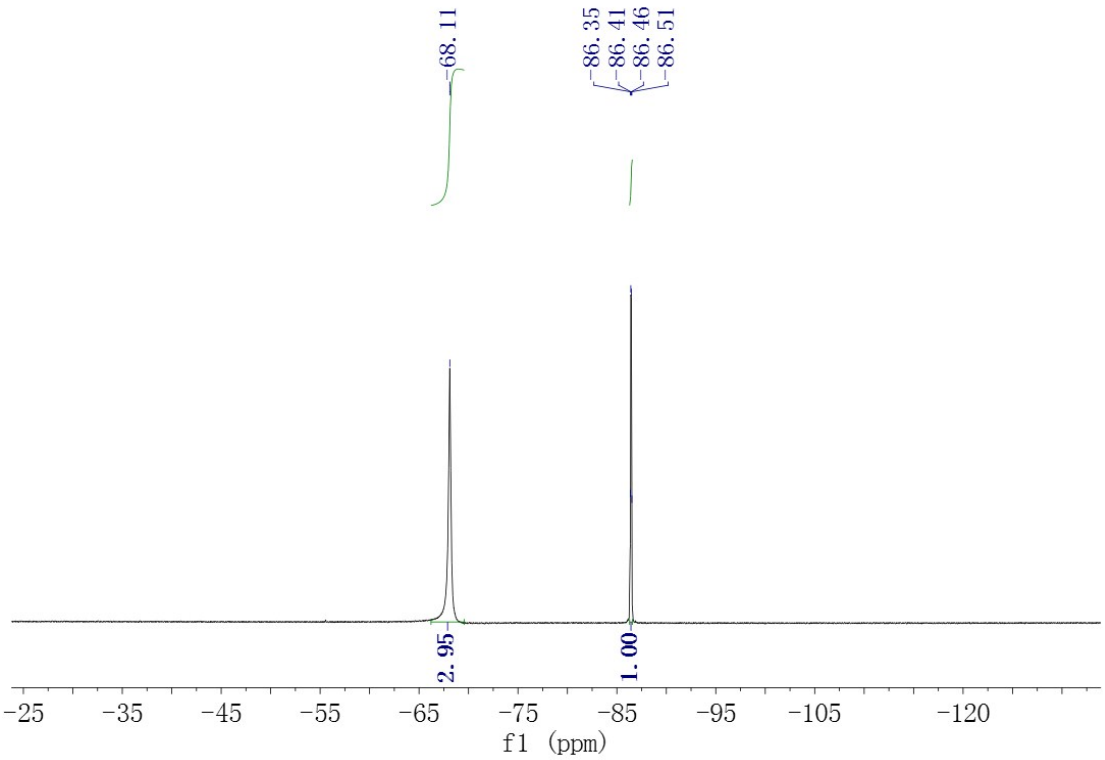


Figure S17: ^{19}F NMR of **3f**

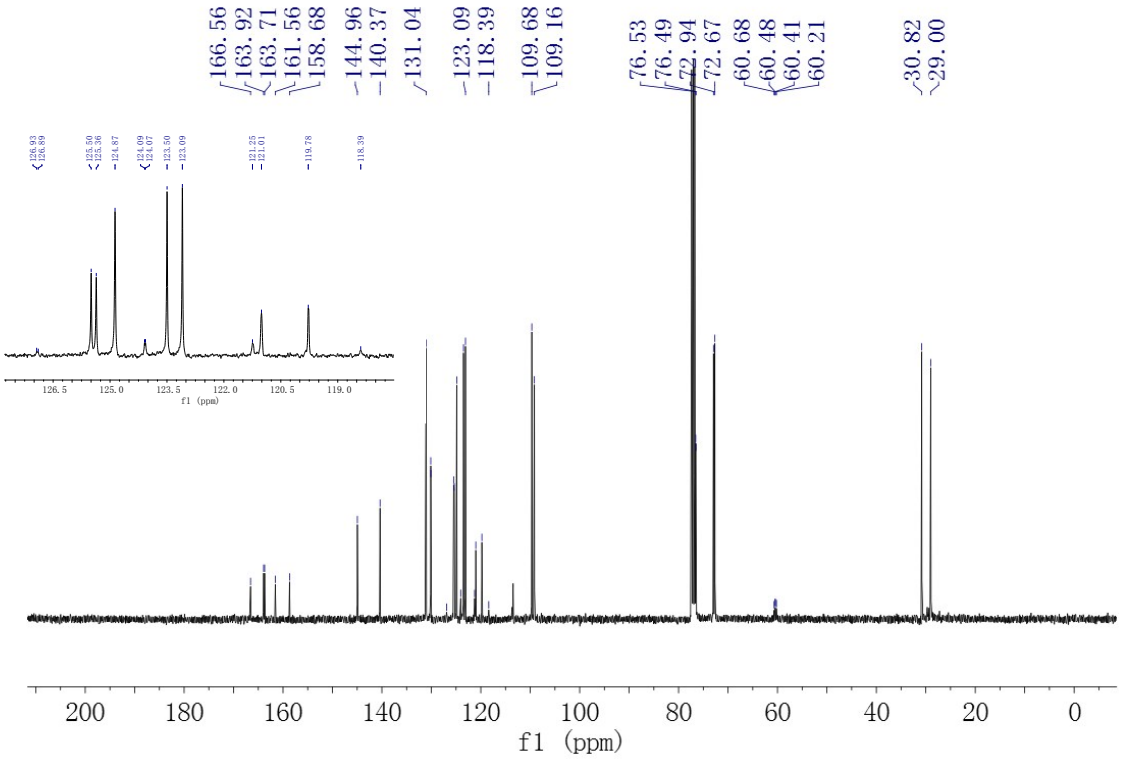
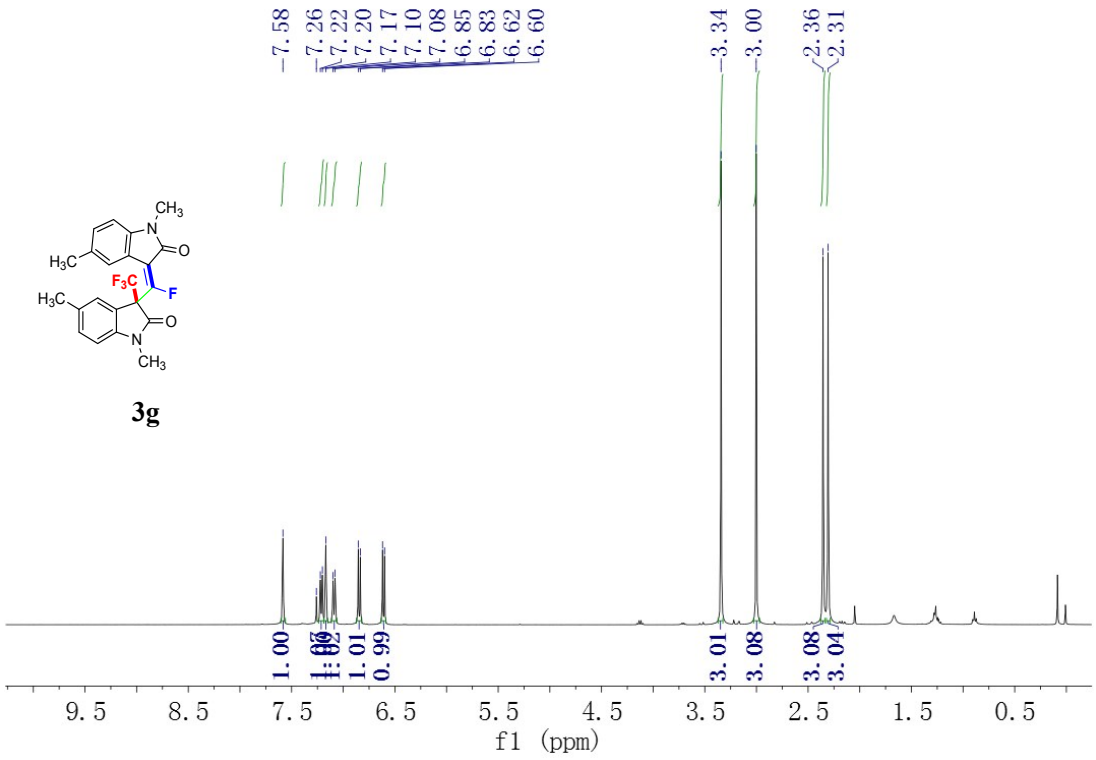


Figure S18: ^{13}C NMR of **3f**



3g

Figure S19: ^{1}H NMR of **3g**

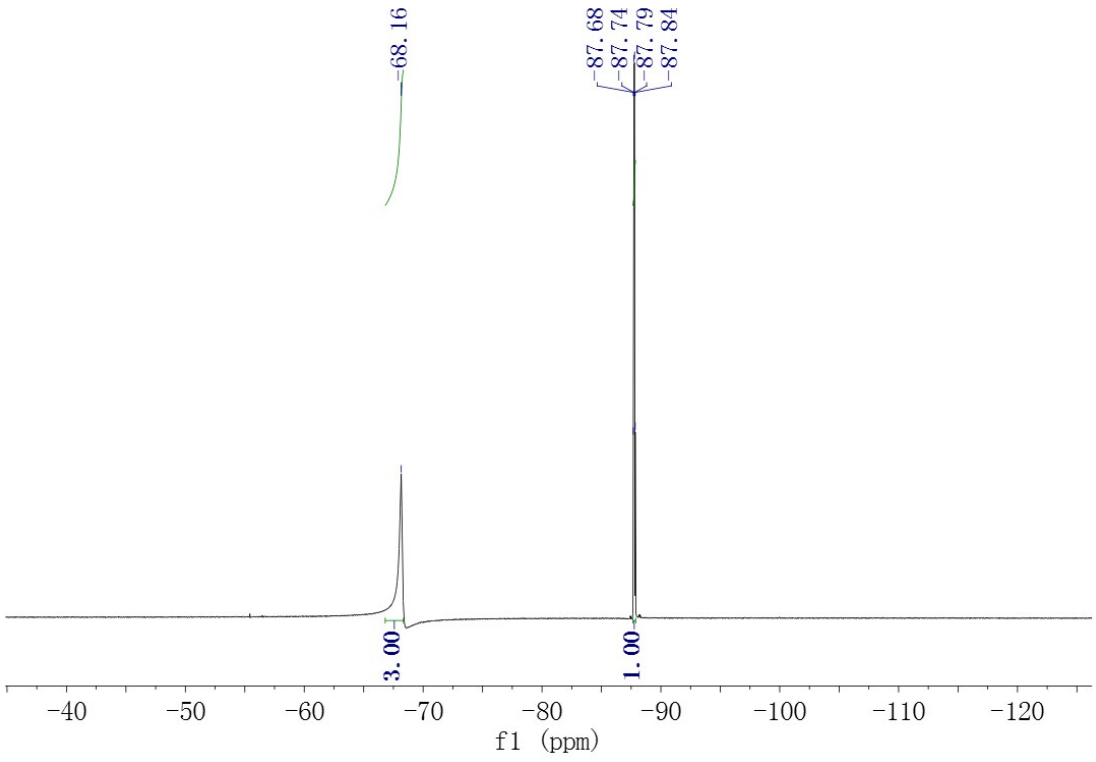


Figure S20: ^{19}F NMR of **3g**

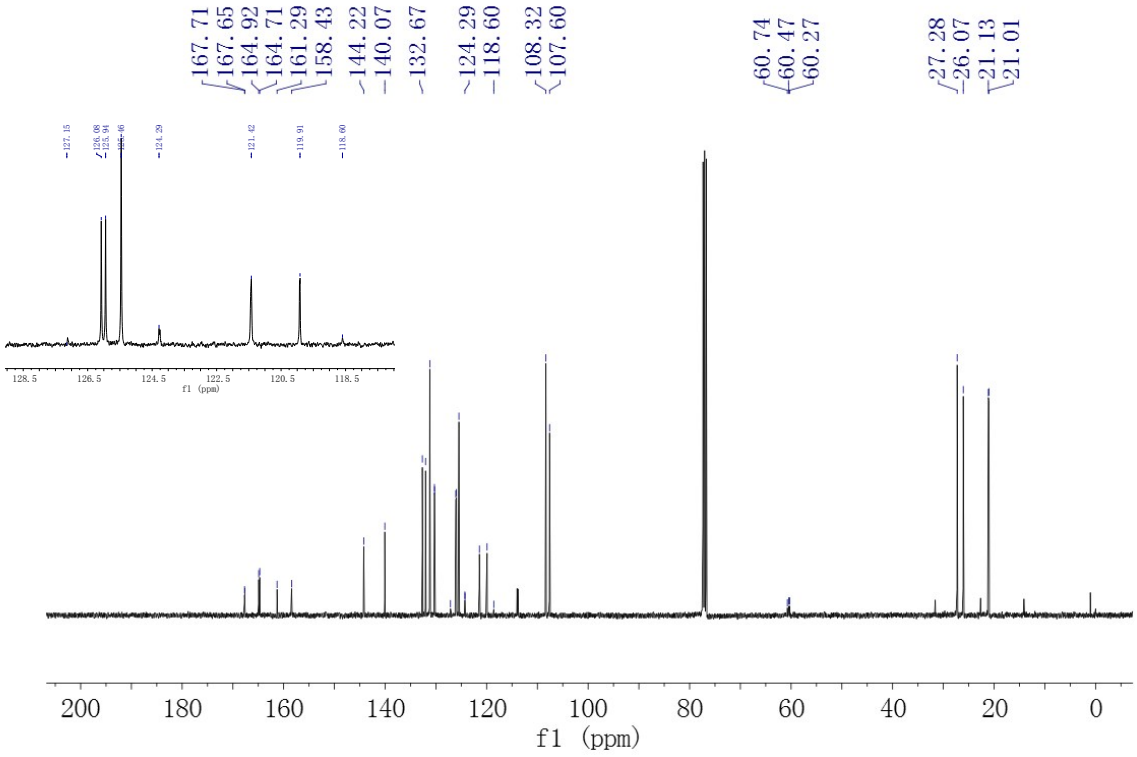


Figure S21: ^{13}C NMR of **3g**

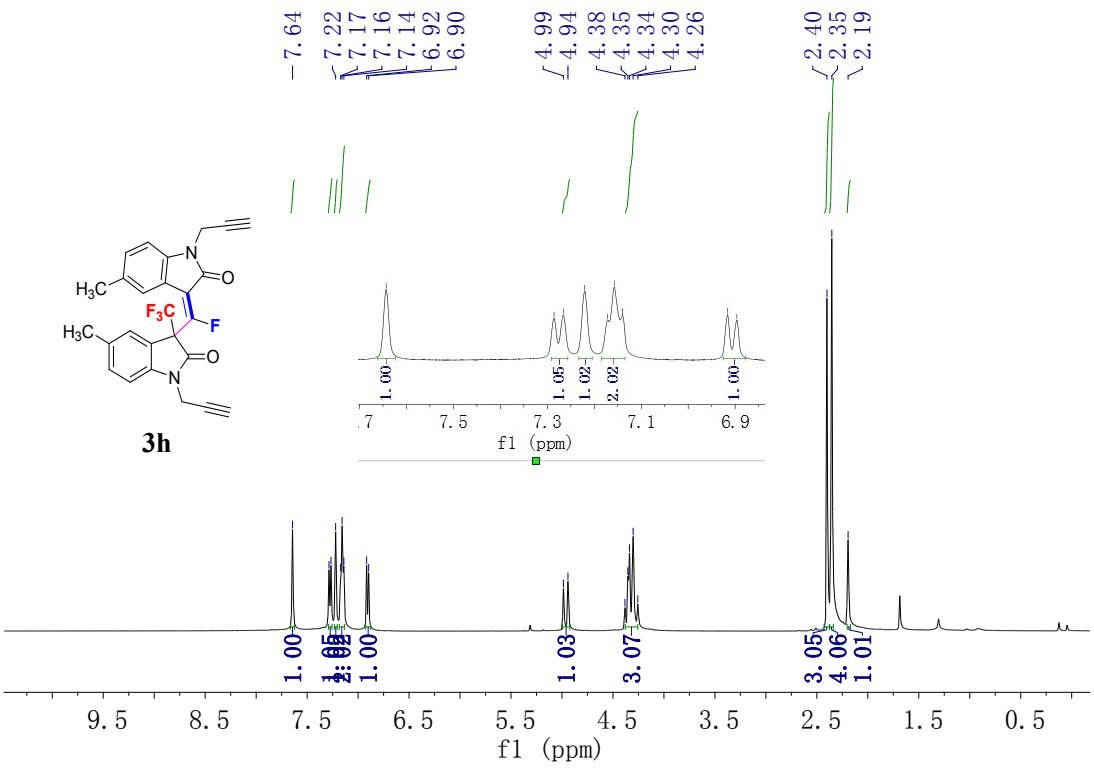


Figure S22: ^{1}H NMR of **3h**

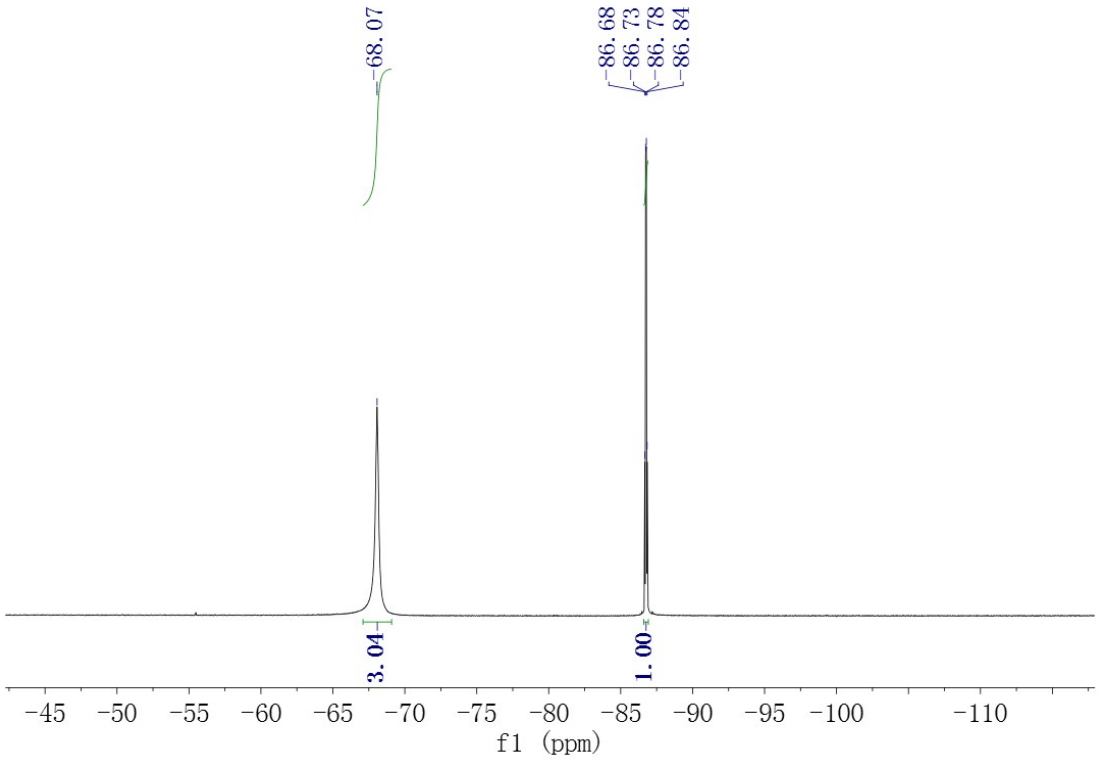


Figure S23: ^{19}F NMR of **3h**

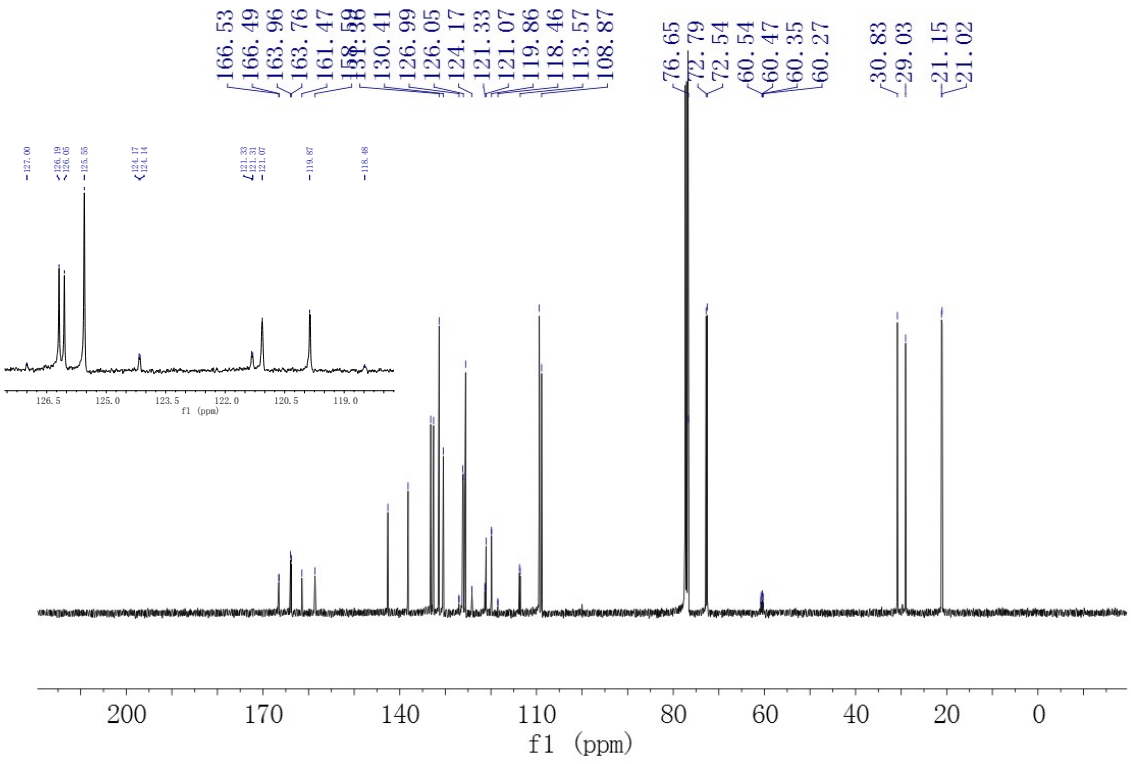


Figure S24: ^{13}C NMR of **3h**

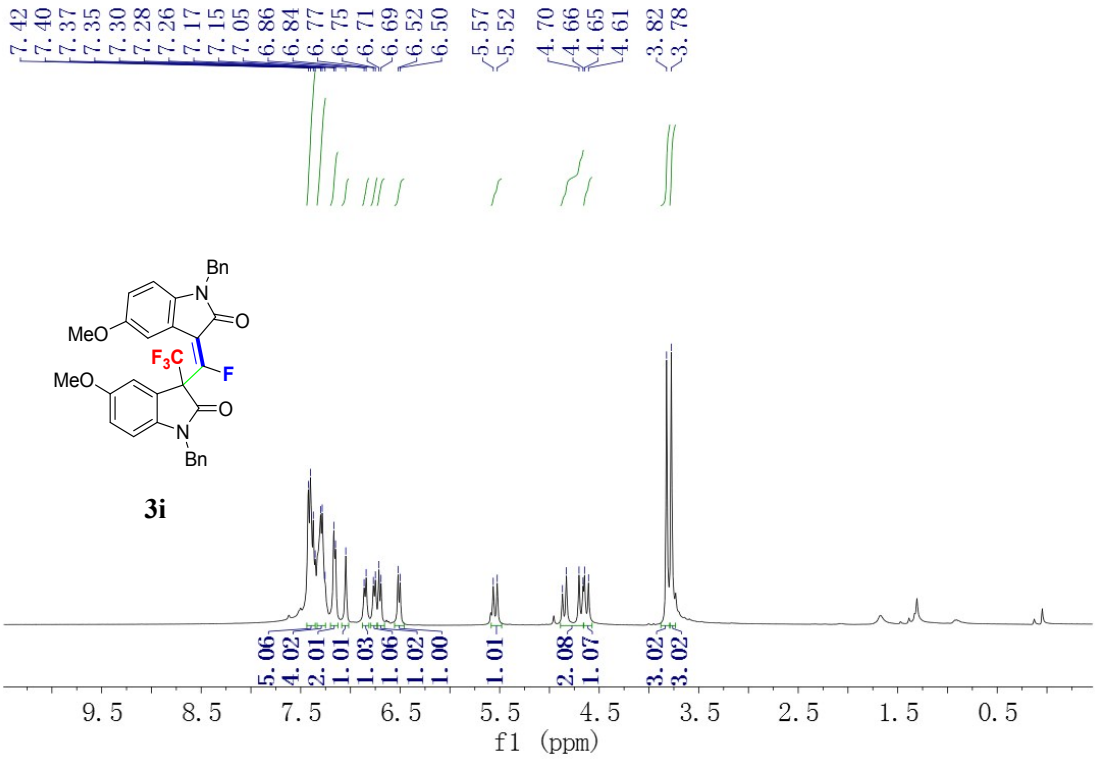


Figure S25: ^{1}H NMR of **3i**

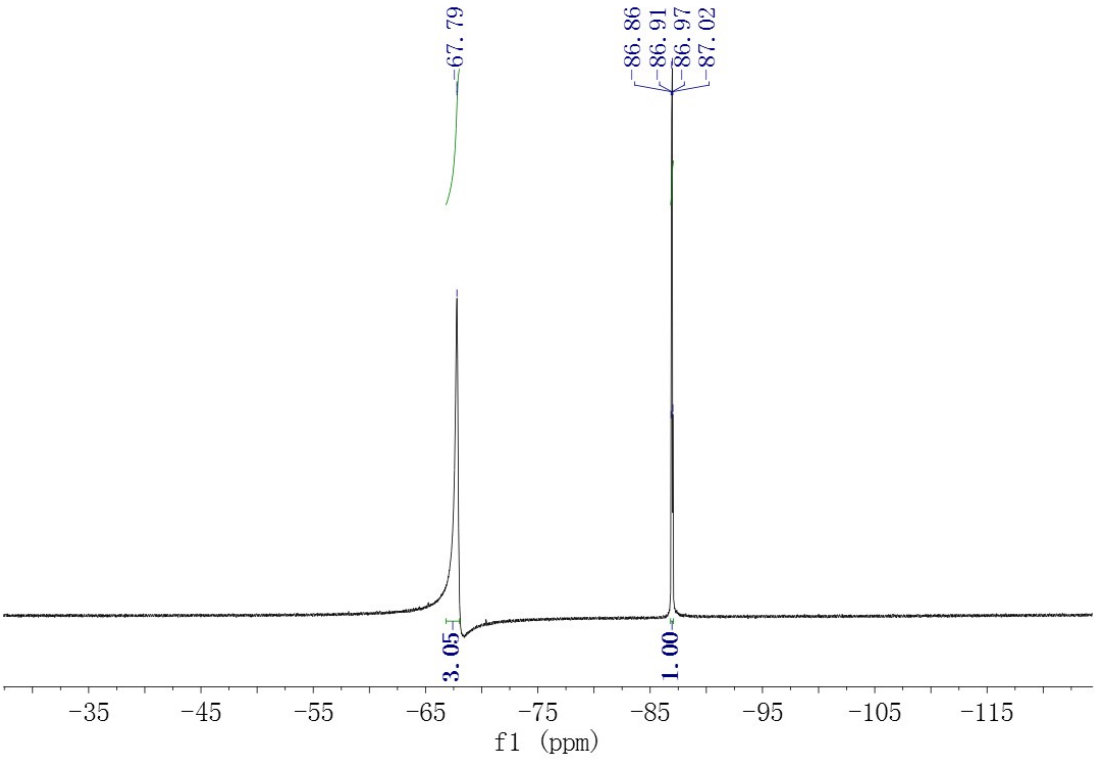


Figure S26: ^{19}F NMR of **3i**

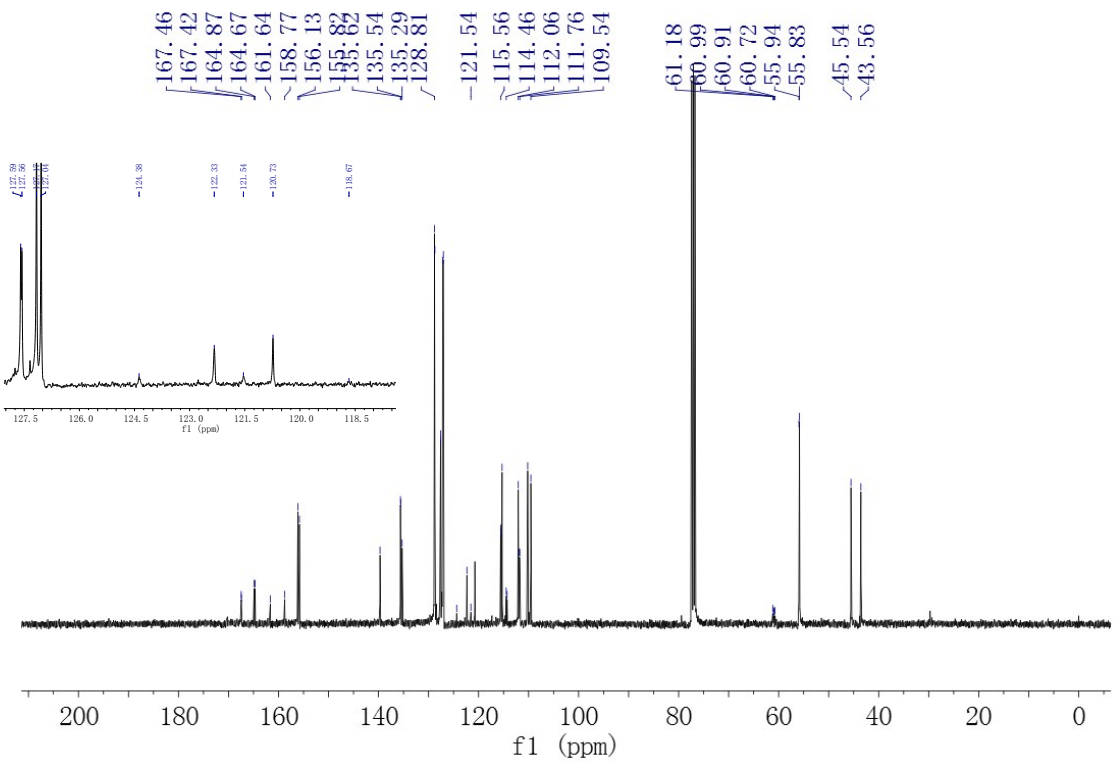
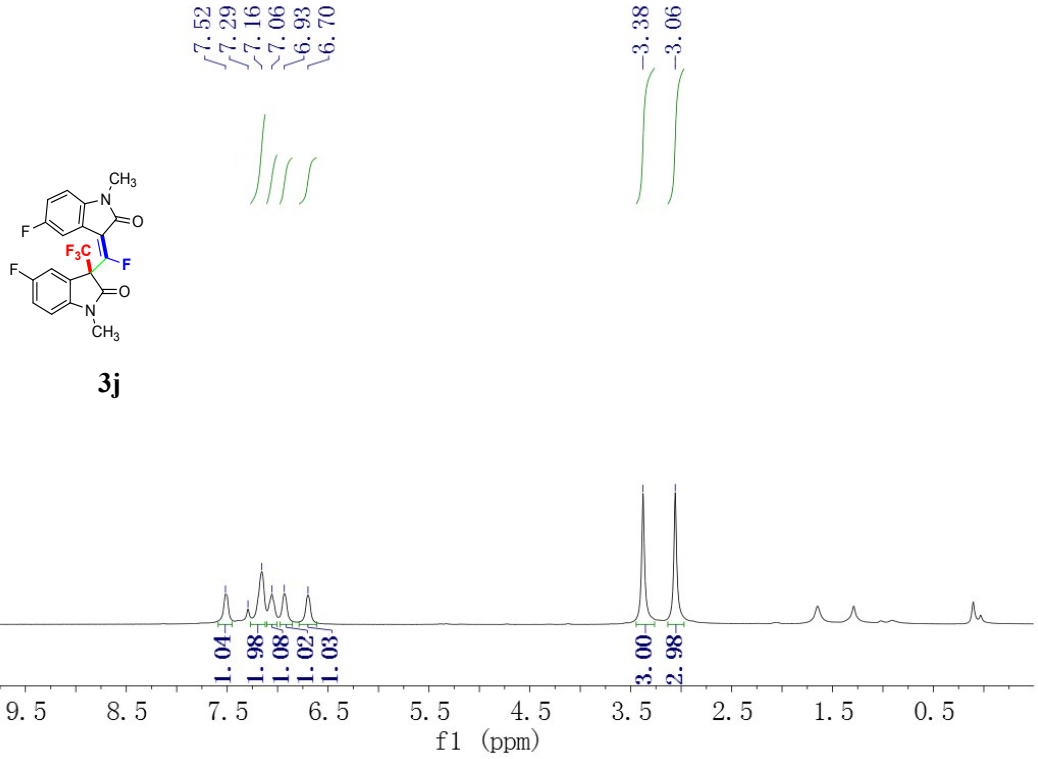


Figure S27: ^{13}C NMR of **3i**



3j

Figure S28: ^{1}H NMR of **3j**

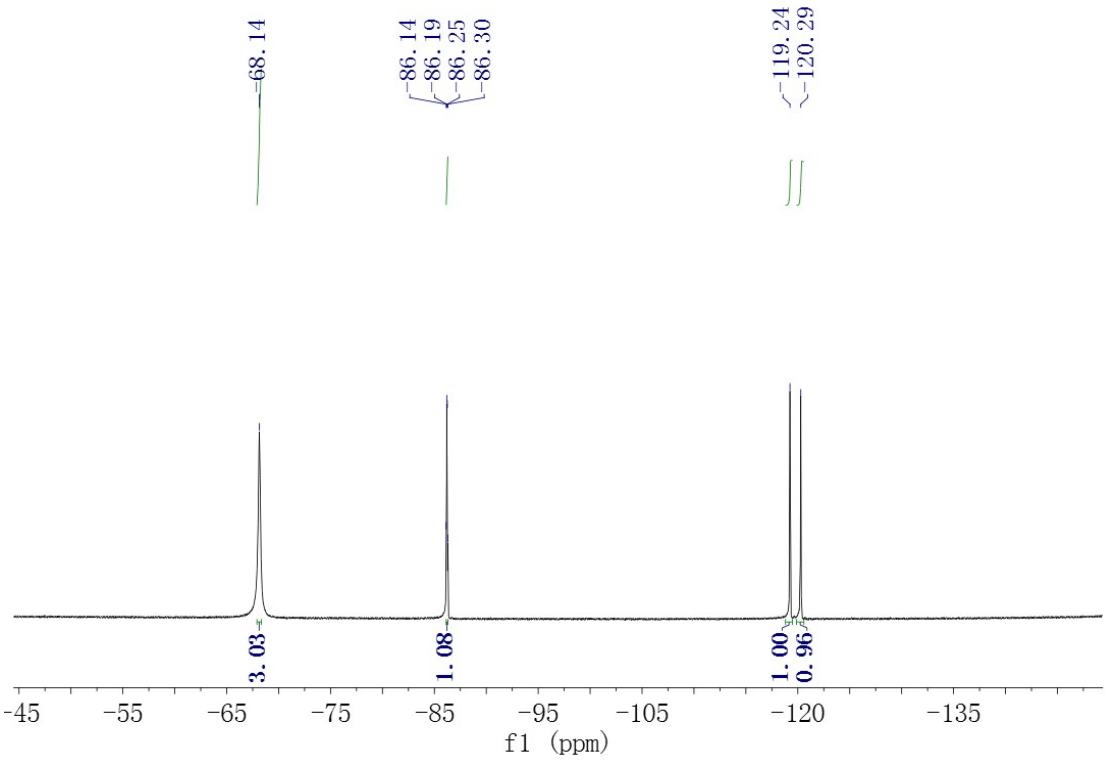


Figure S29: ^{19}F NMR of **3j**

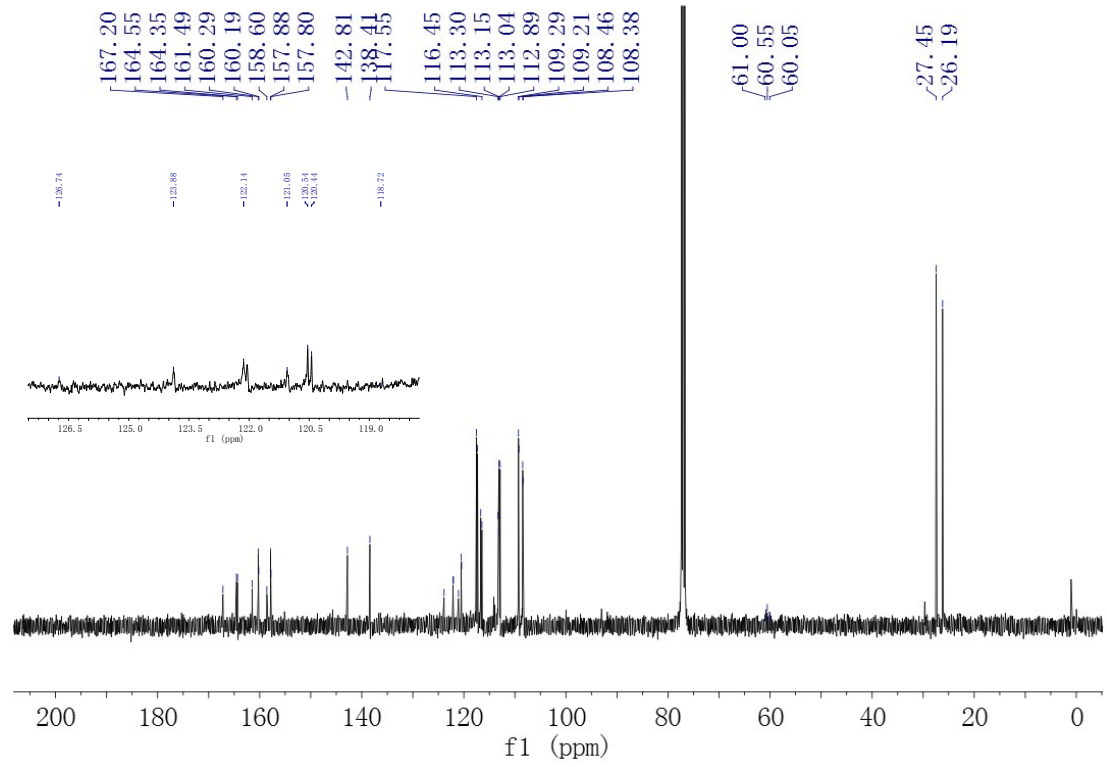


Figure S30: ^{13}C NMR of **3j**

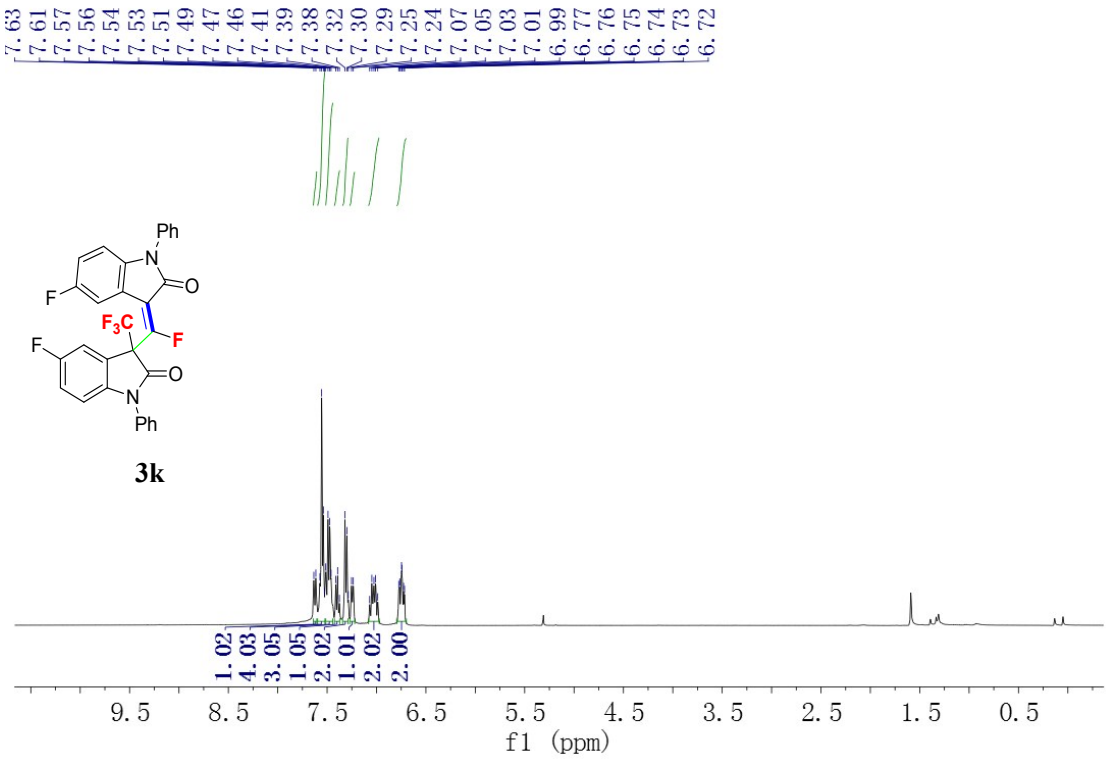


Figure S31: [1]H NMR of **3k**

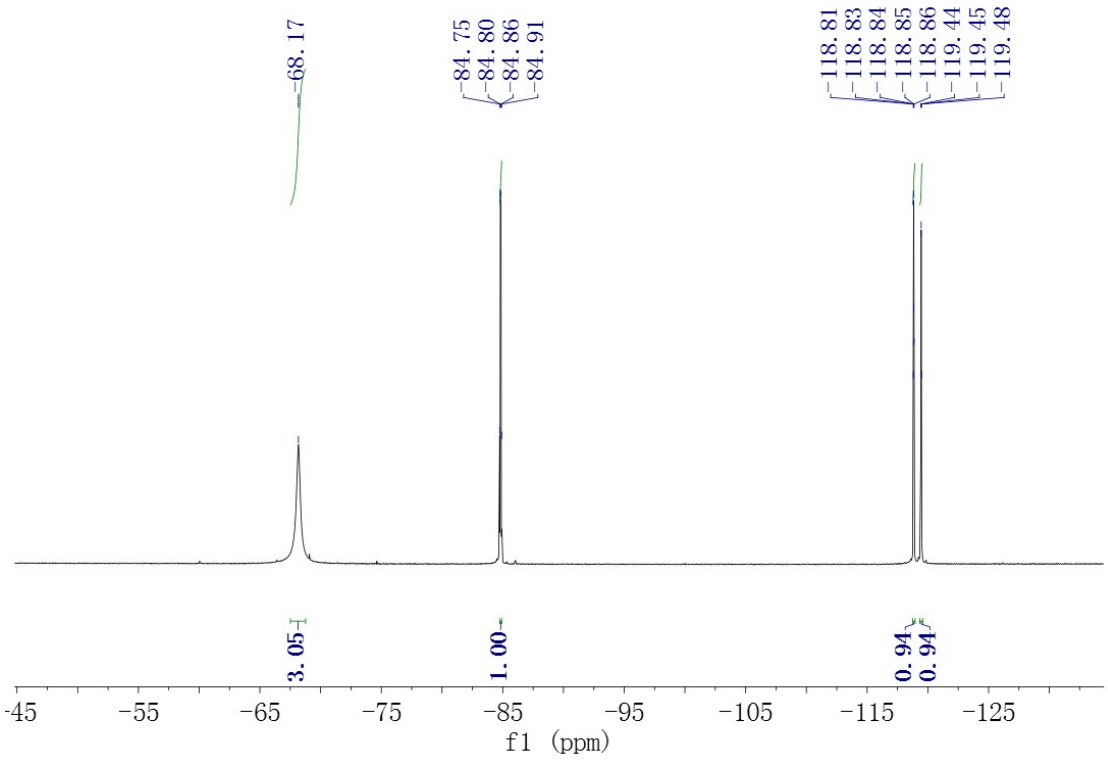


Figure S32: [19]F NMR of **3k**

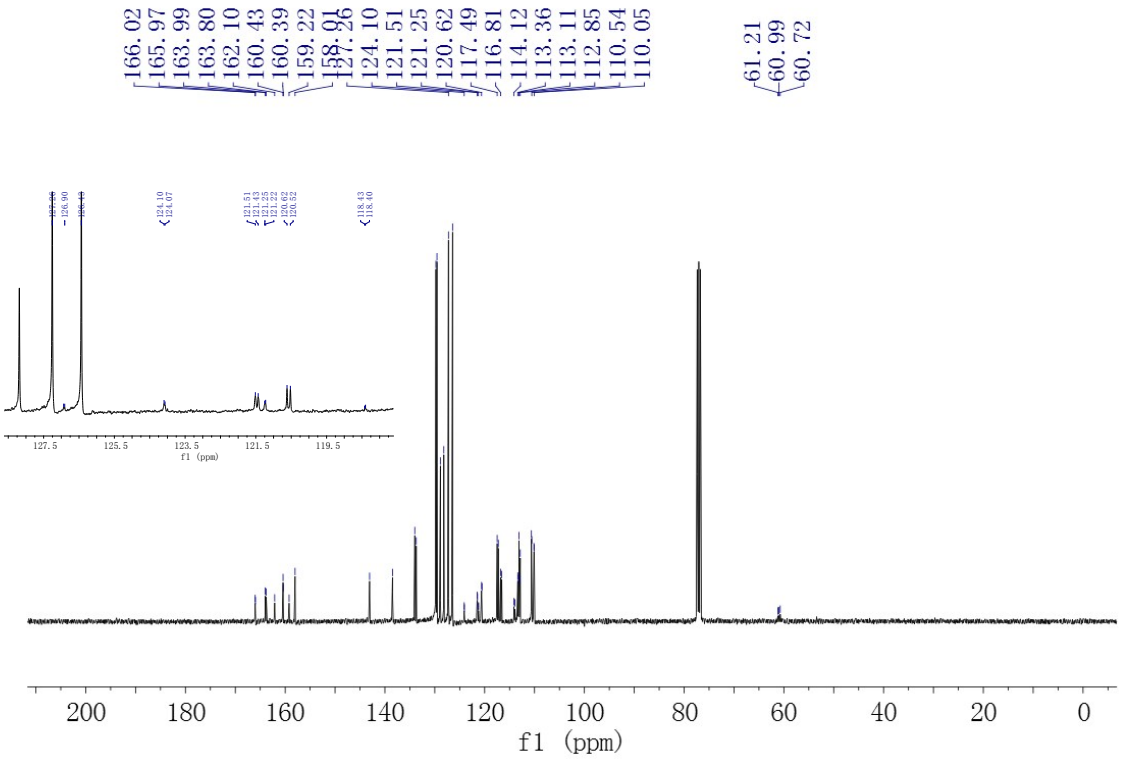


Figure S33: ^{13}C NMR of **3k**

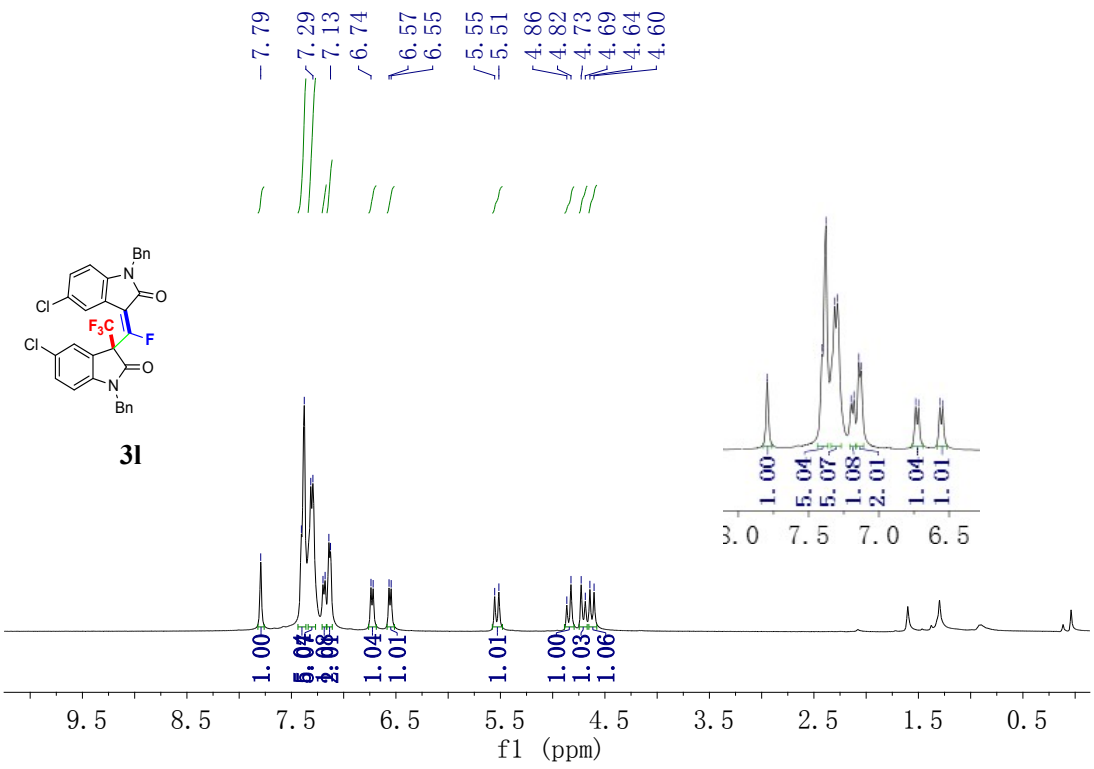


Figure S34: ^{1}H NMR of **3l**

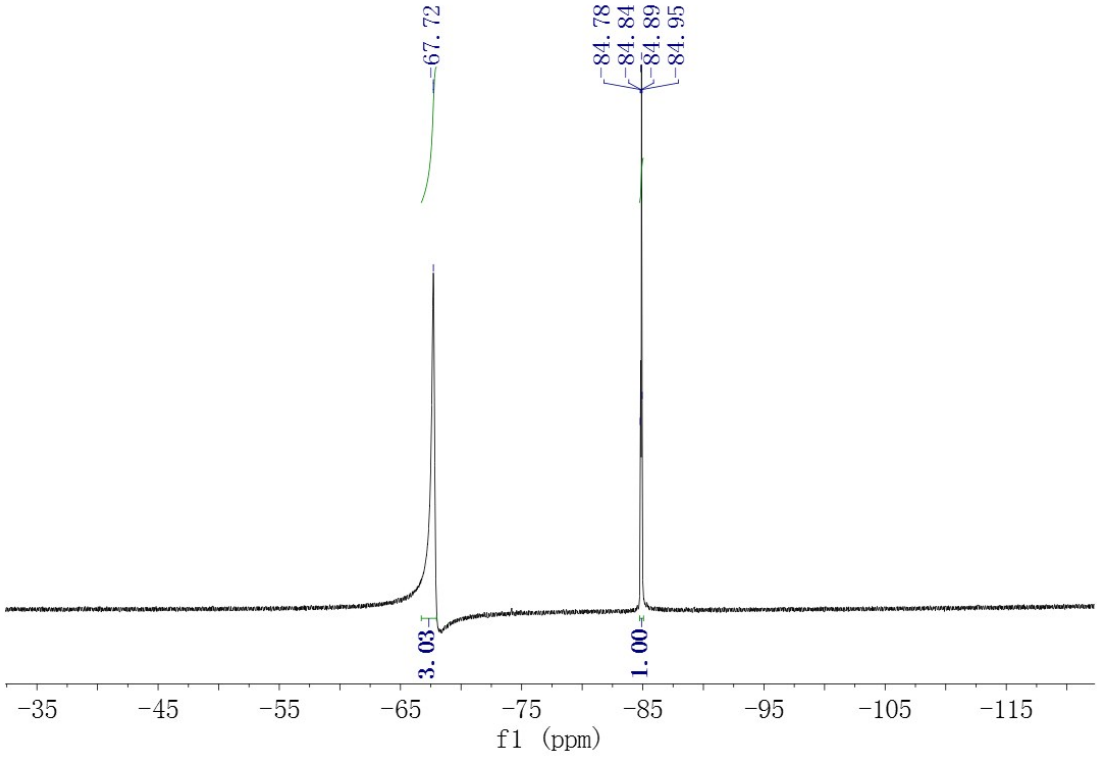


Figure S35: ^{19}F NMR of **3l**

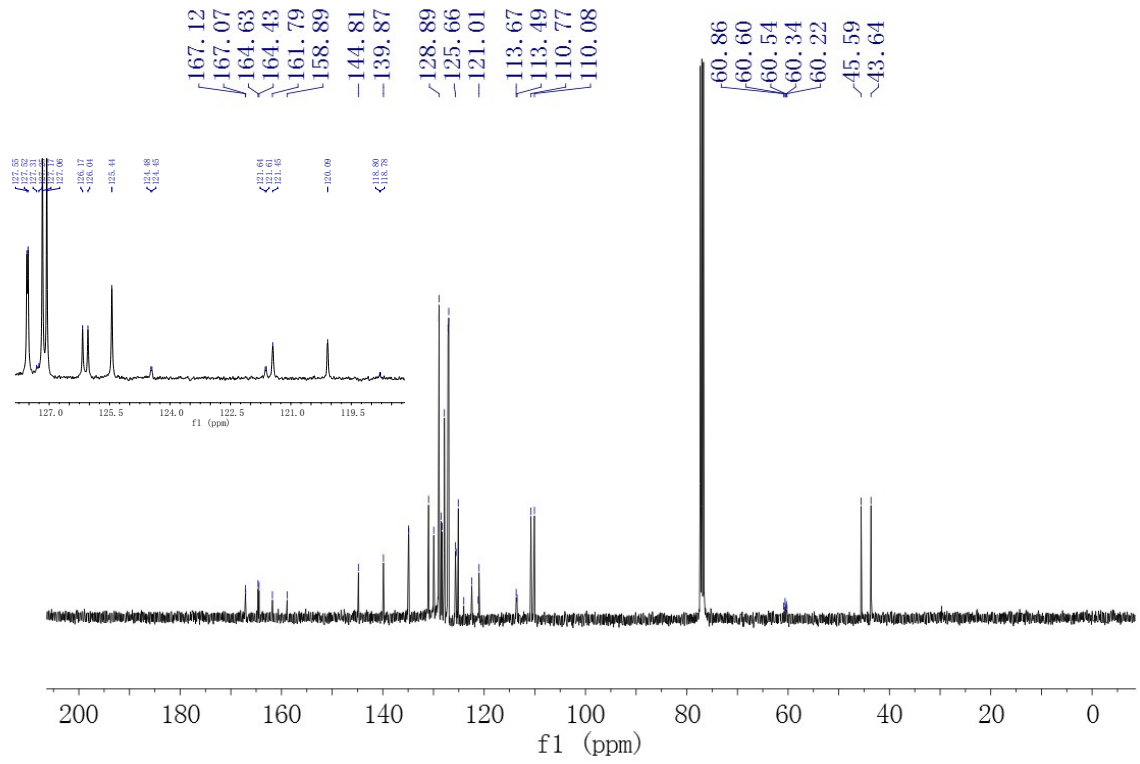


Figure S36: ^{13}C NMR of **3l**

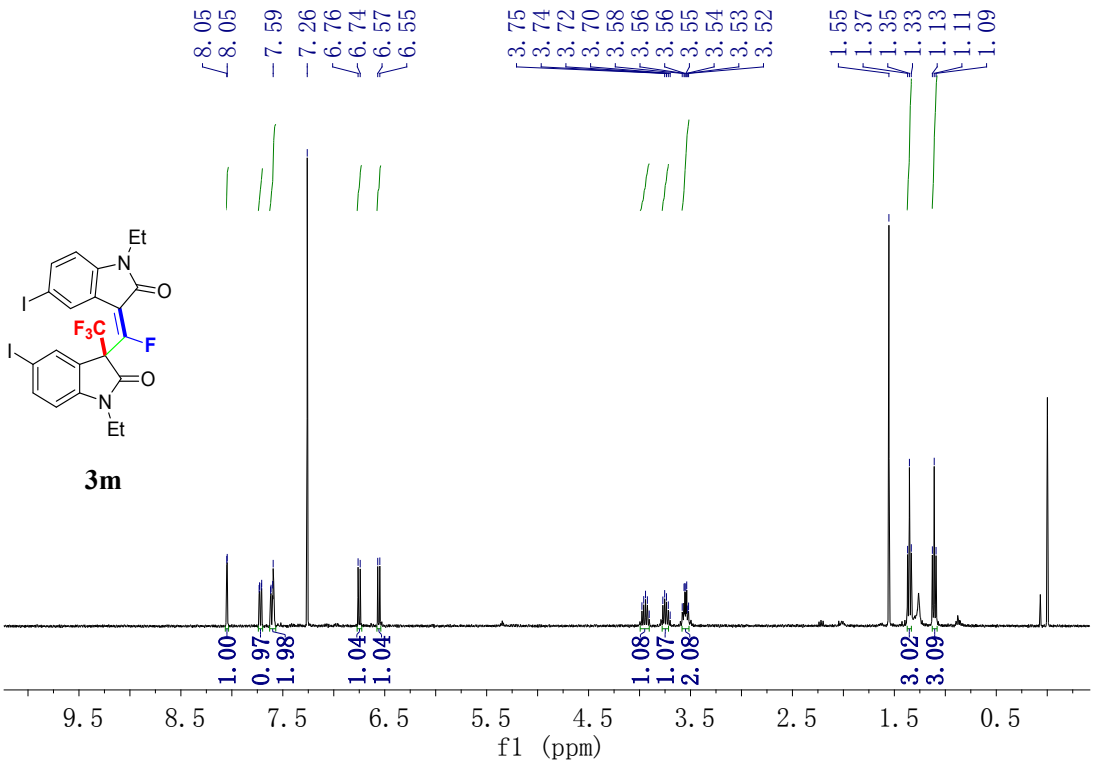


Figure S37: ^{1}H NMR of **3m**

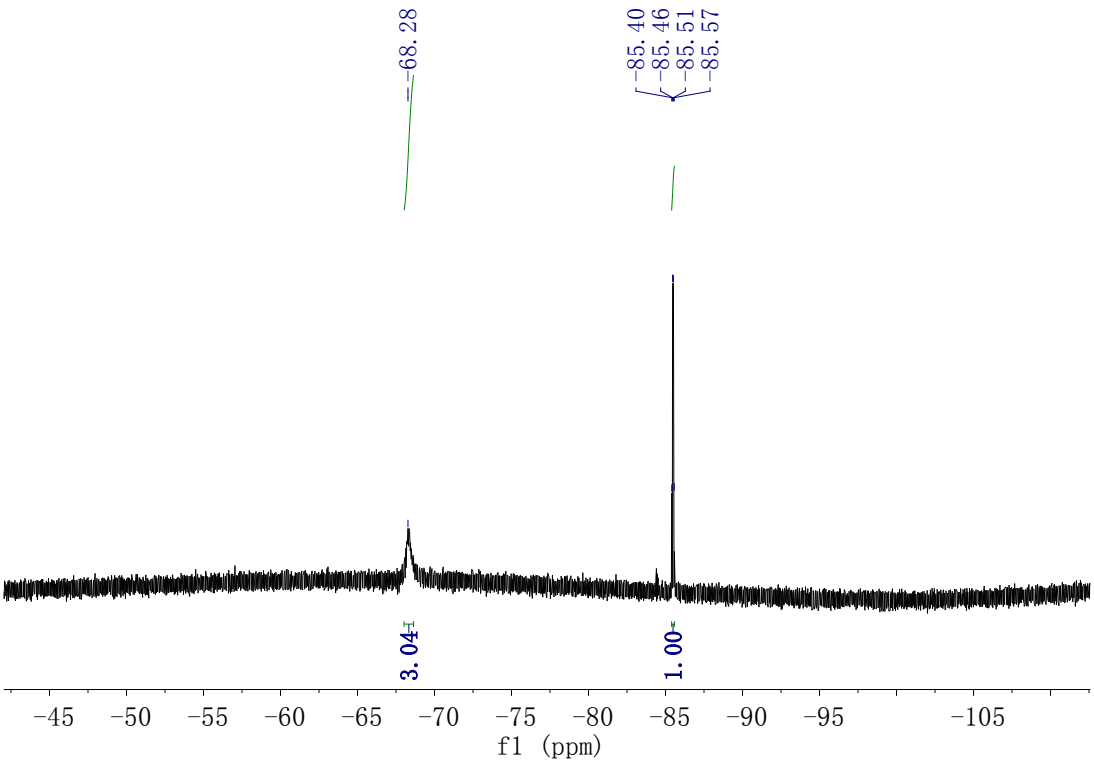


Figure S38: ^{19}F NMR of **3m**

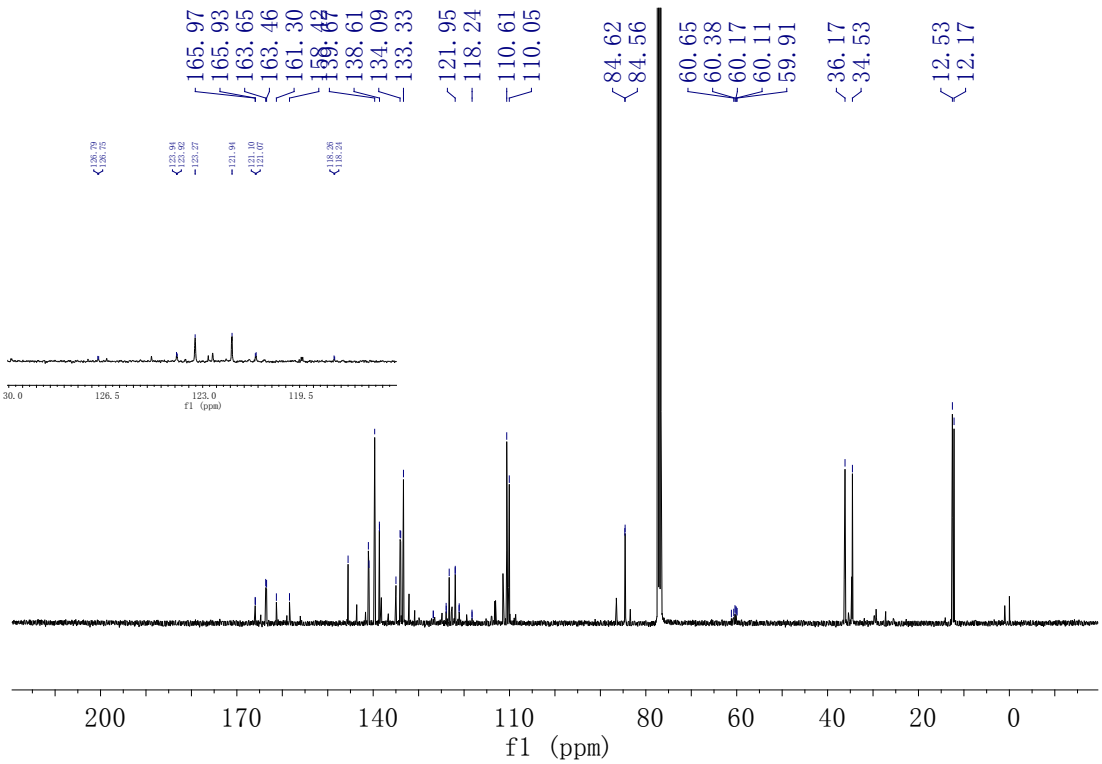


Figure S39: ^{13}C NMR of **3m**

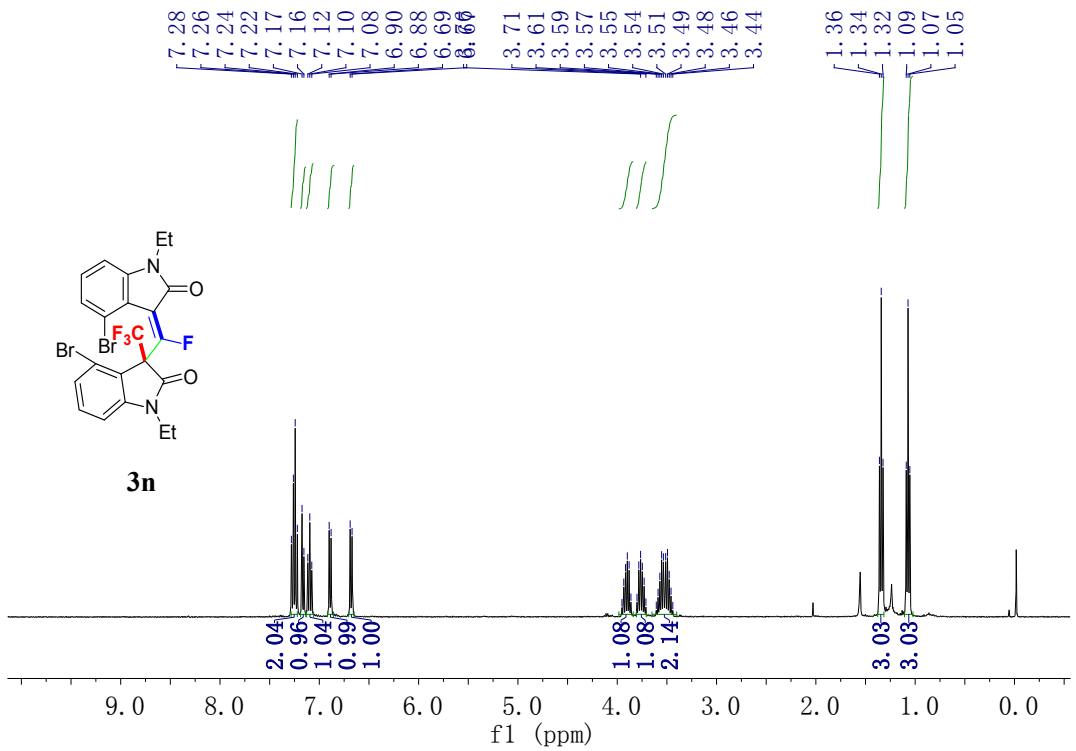


Figure S40: ^{1}H NMR of **3n**

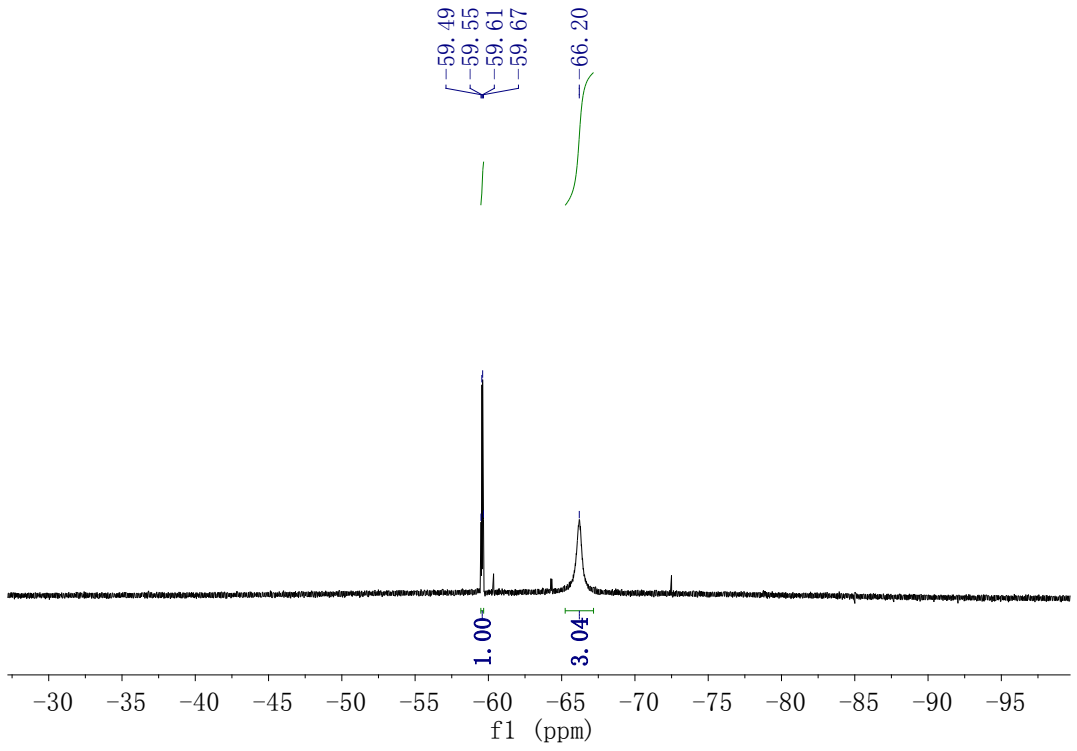


Figure S41: ^{19}F NMR of **3n**

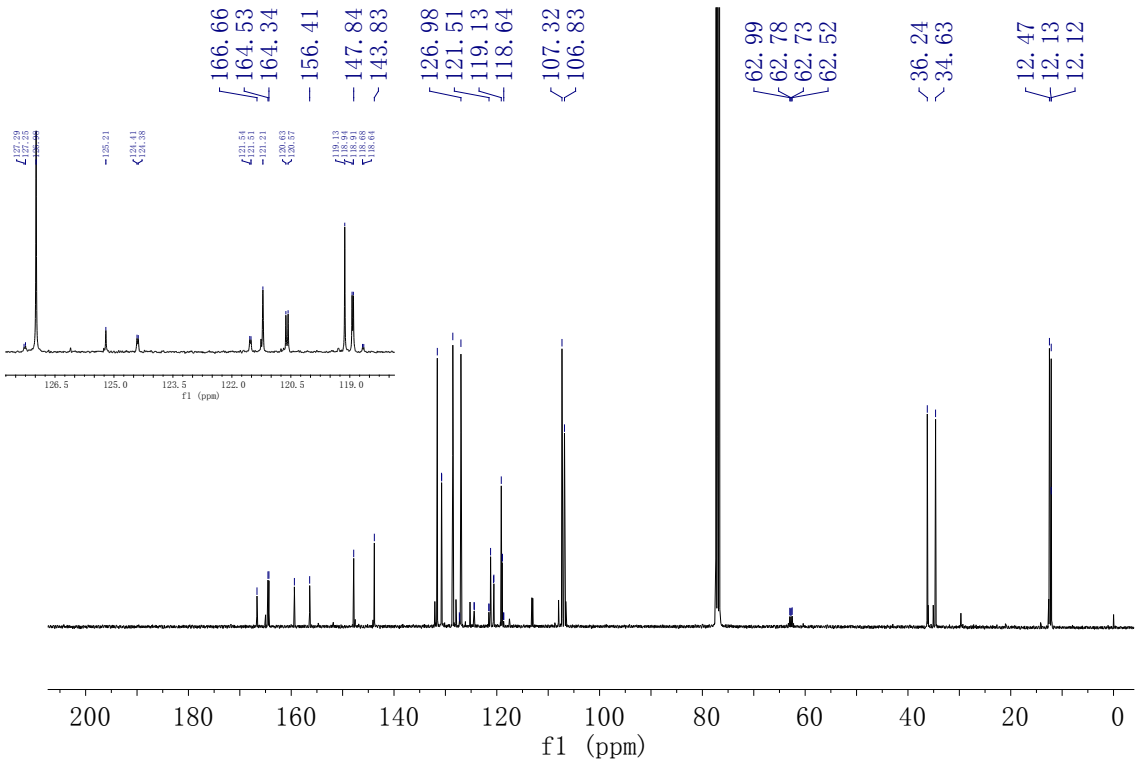


Figure S42: ^{13}C NMR of **3n**

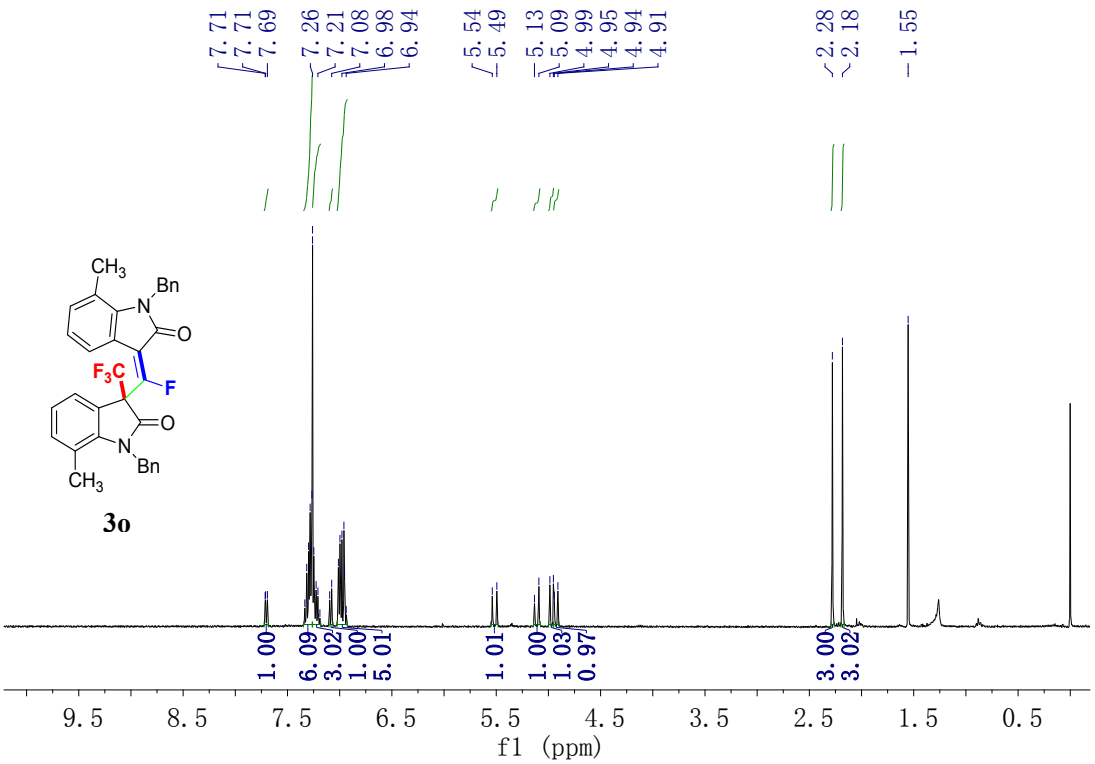


Figure S43: ^{1}H NMR of **3o**

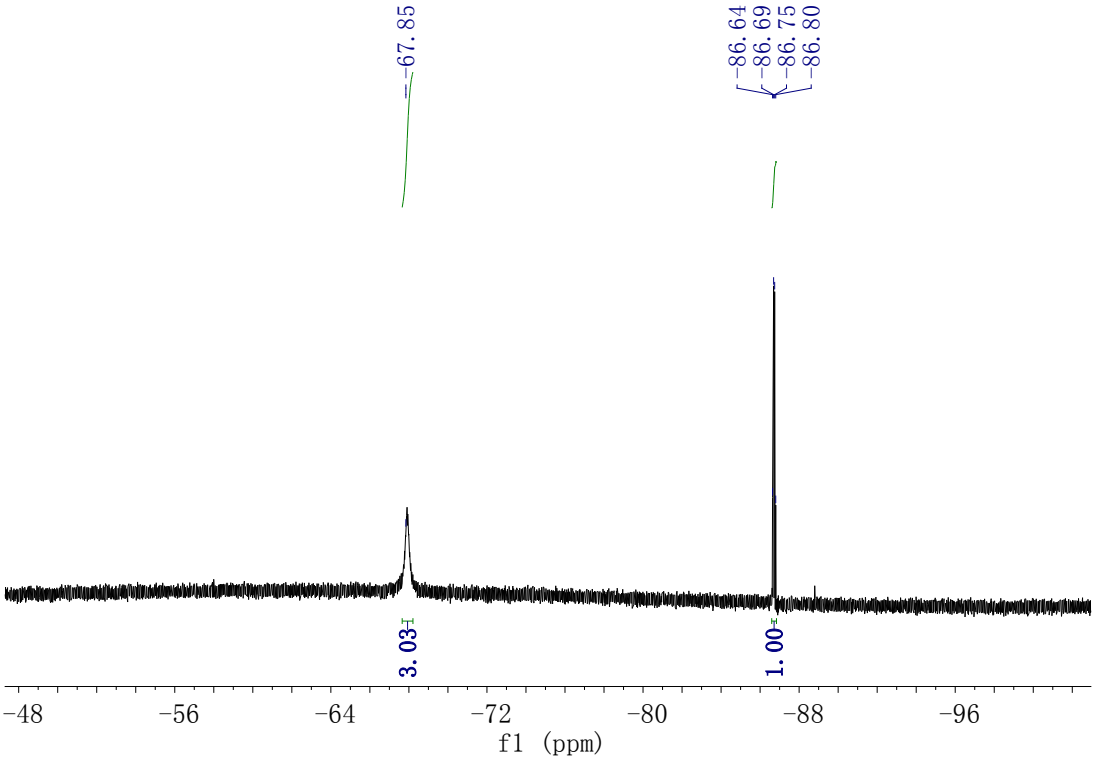


Figure S44: ^{1}H NMR of **3o**

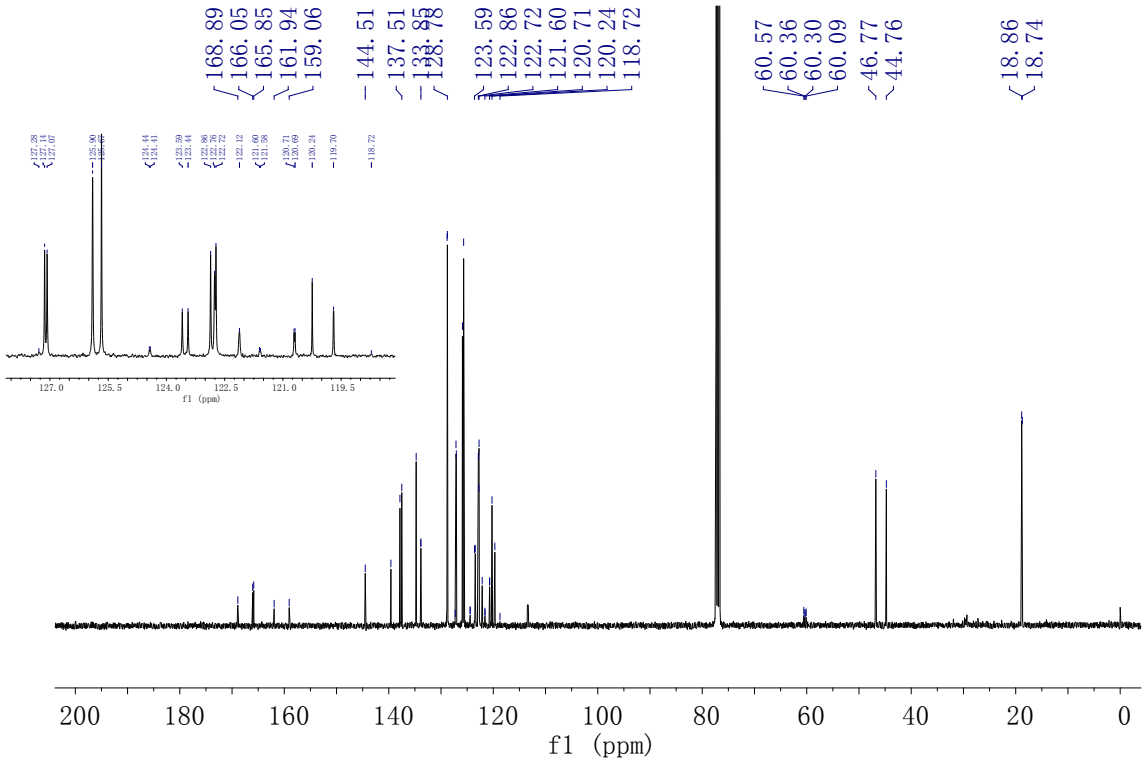


Figure S45: ^{1}H NMR of **3o**

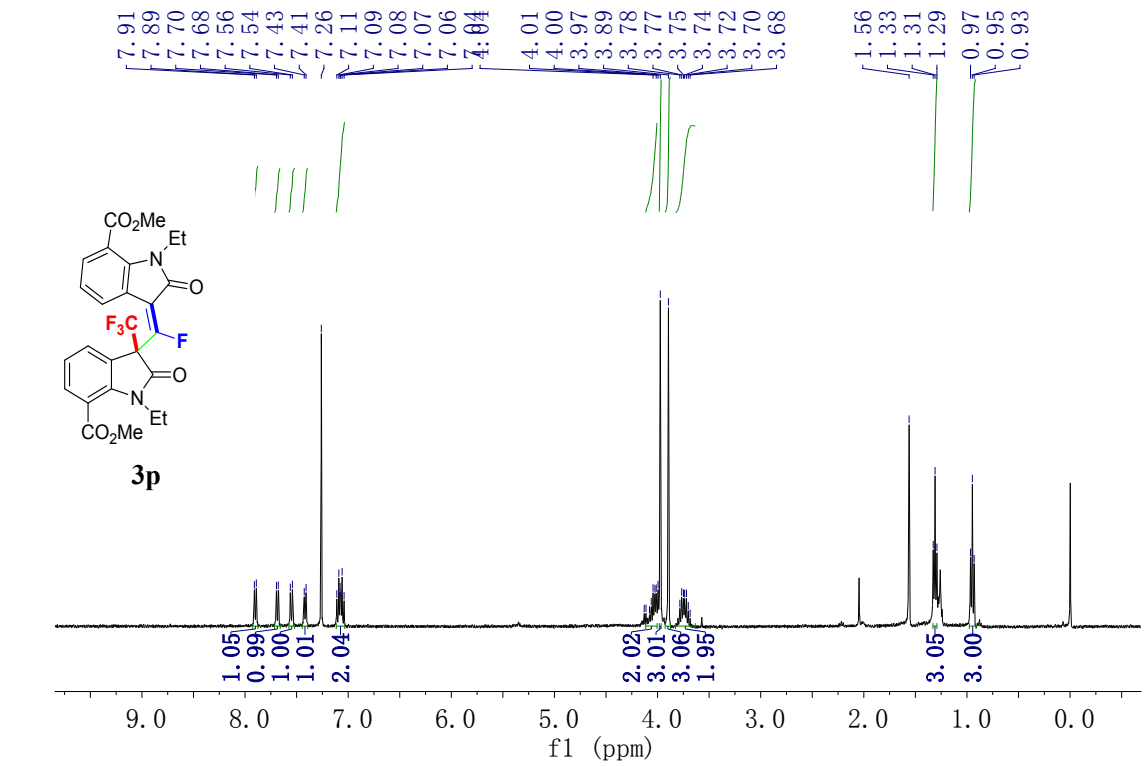


Figure S46: ^{1}H NMR of **3p**

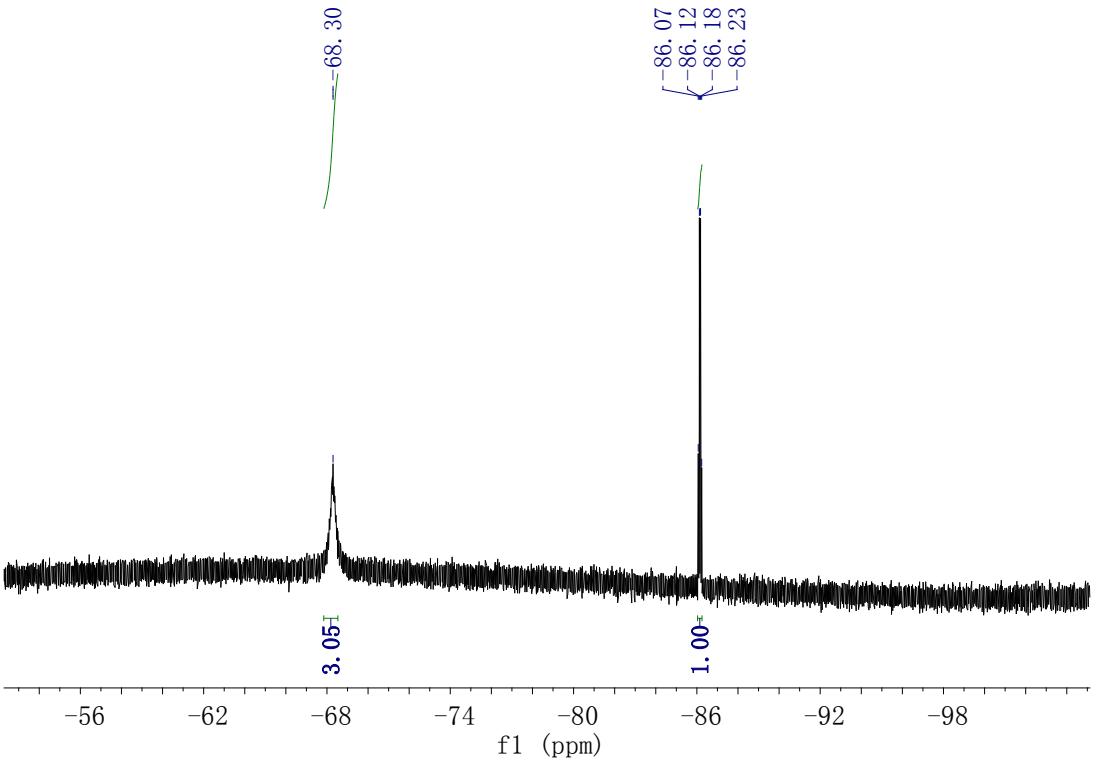


Figure S47: ^{19}F NMR of **3p**

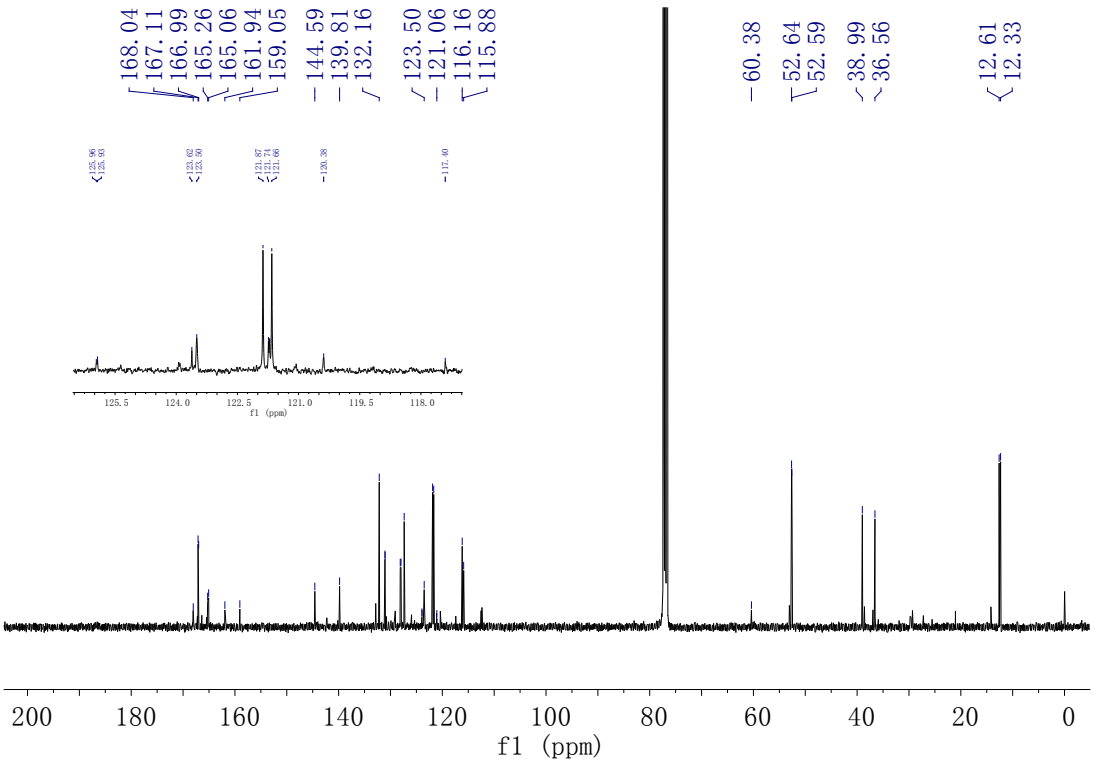


Figure S48: ^{13}C NMR of **3p**

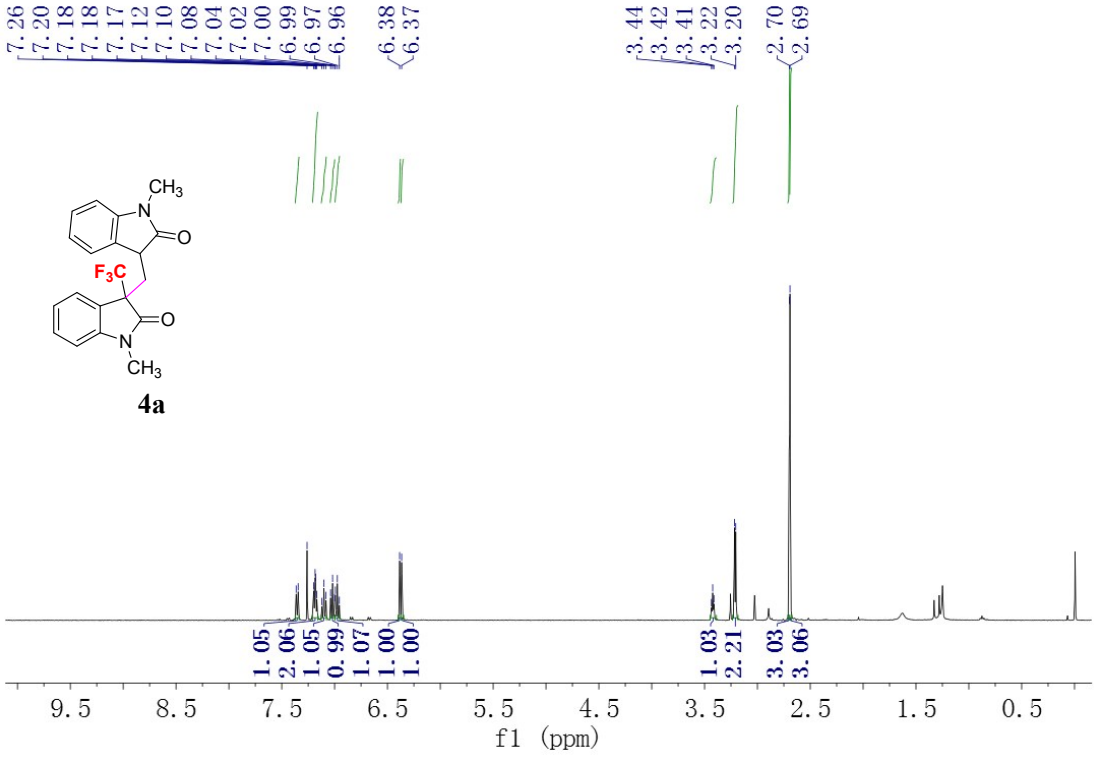


Figure S49: ^{1}H NMR of **4a**

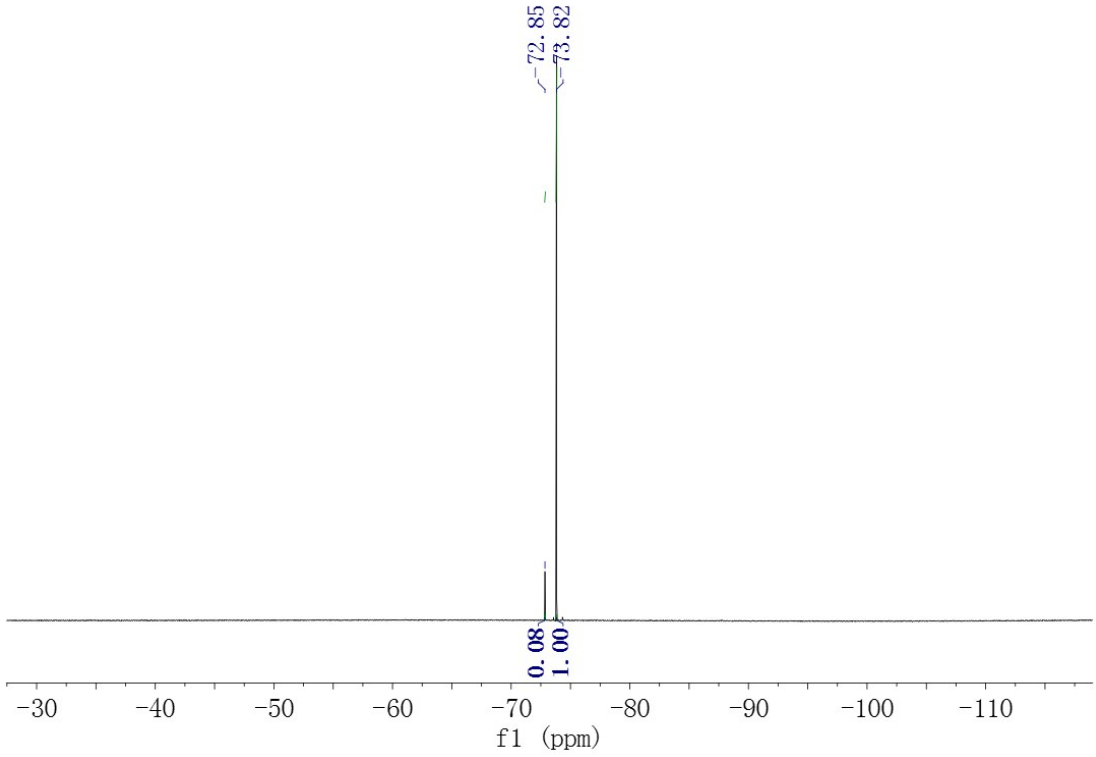


Figure S50: ^{19}F NMR of **4a**

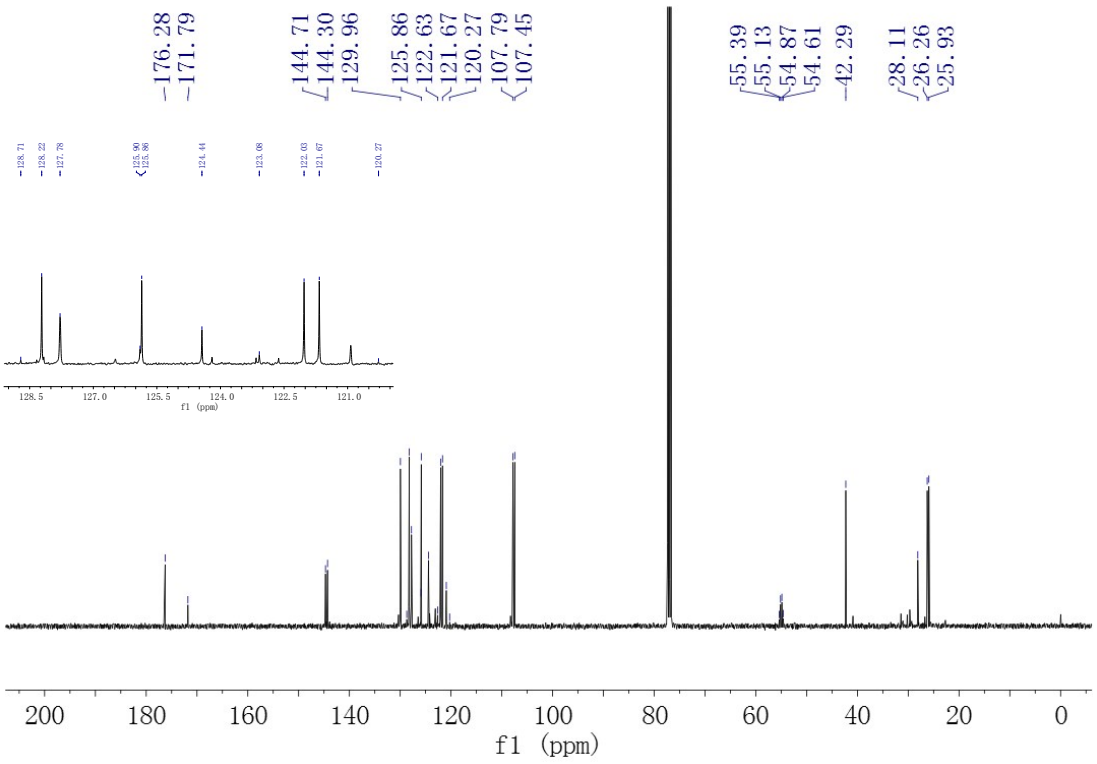
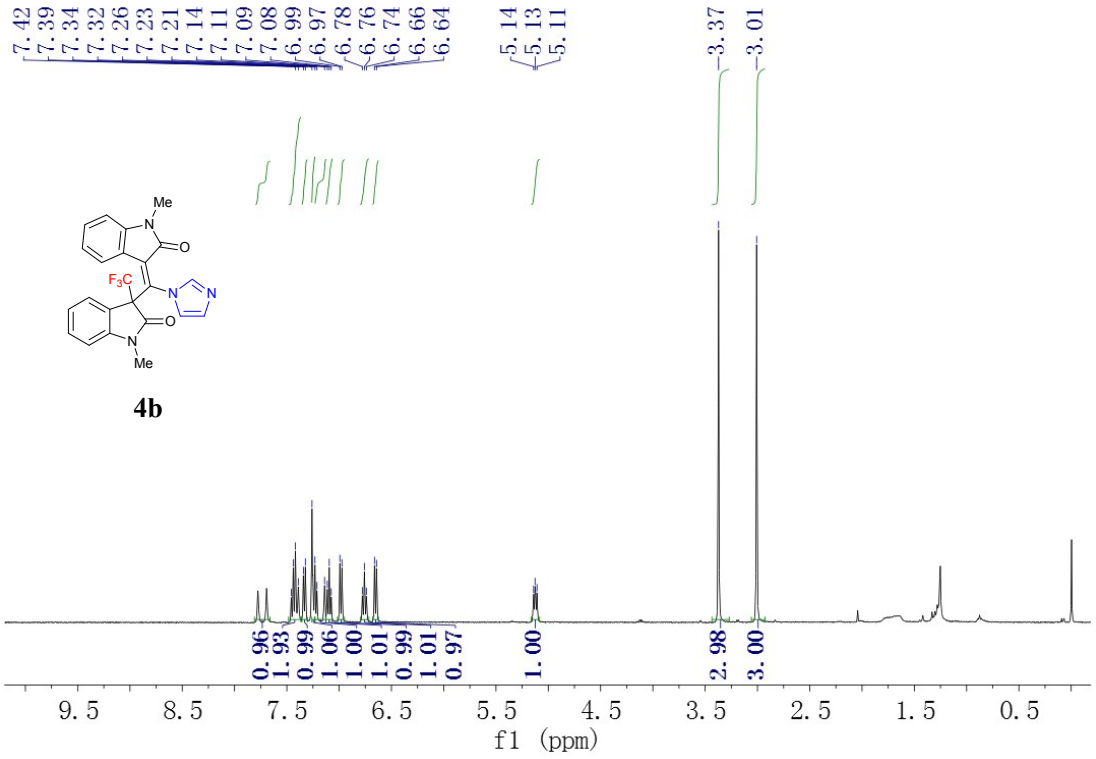


Figure S51: ^{13}C NMR of **4a**



4b

Figure S52: ^{1}H NMR of **4b**

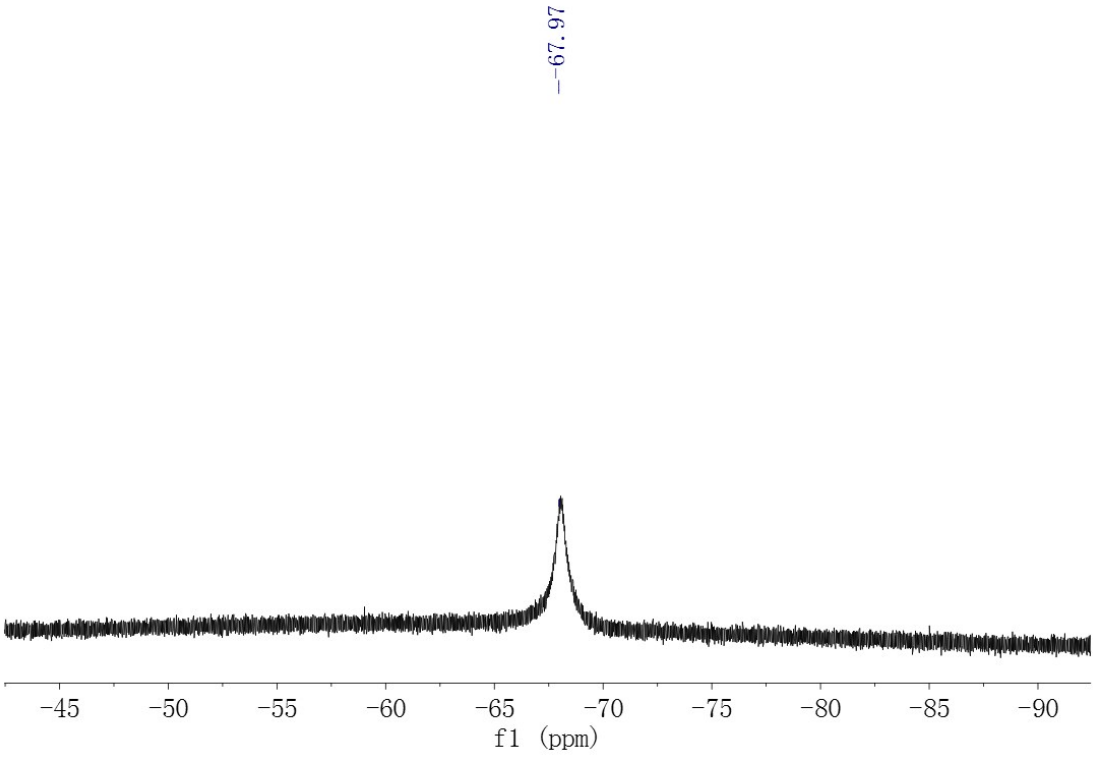


Figure S53: ^{19}F NMR of **4b**

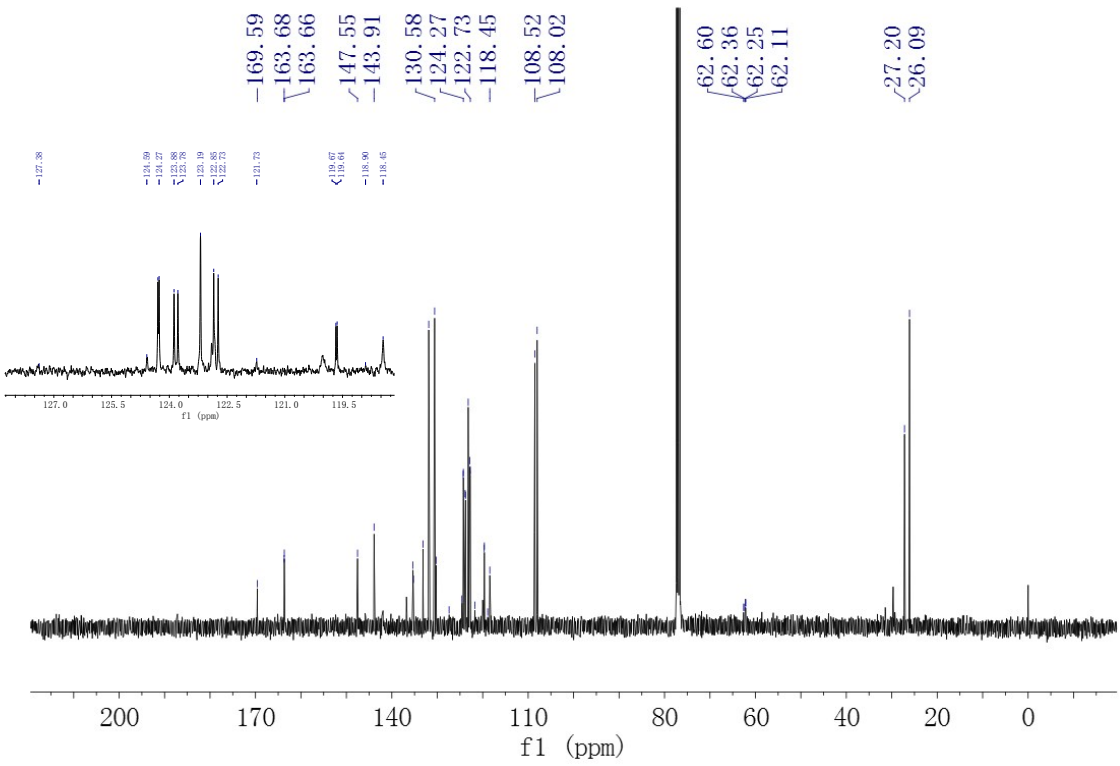
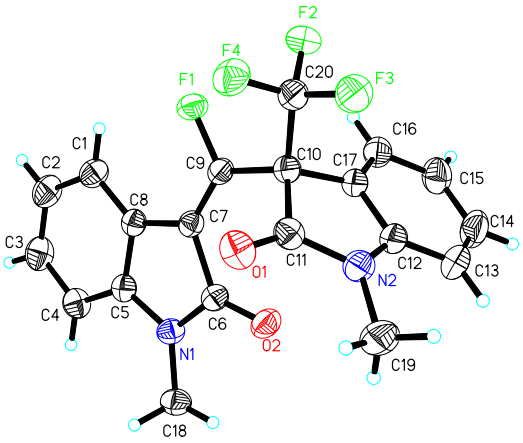
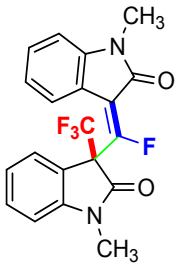


Figure S54: ^{13}C NMR of **4b**

6. ORTEP drawing of the X-ray crystallographic structure of 4a





3a

CCDC 1438186 contains the supplementary crystallographic data for the targe compound **3a**.

This data can be obtained free of charge from the Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.