# Chemoselective Synthesis of Polysubstituted Pyridines via sequential Suzuki Cross Couplings: A SuFEx Approach

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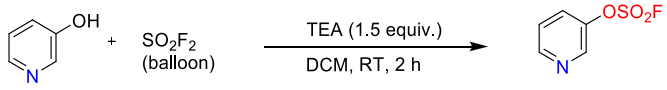
## 1. General information

$^{1}H$ and $^{13}C$ NMR spectra were recorded on Varian Inova 500, Varian Mercury Plus 400, Varian Mercury Plus 300 instruments and the chemical shifts (δ) are expressed in parts per million relative to tetramethylsilane or residual solvent as internal standards. Proton magnetic resonance ($^{1}H$ NMR) spectra were recorded at 500 or 400 MHz. Carbon magnetic resonance ($^{13}C$ NMR) spectra were recorded at 126 or 101 MHz. Fluorine magnetic resonance ($^{19}F$ NMR) spectra were recorded at 376 or 282 MHz and the chemical shifts (δ) are expressed in parts per million relative to $FCCl_3$ as internal standards. NMR acquisitions were performed at 295 K unless otherwise noted. Abbreviations are: s, singlet; d, doublet; t, triplet; q, quartet; br s, broad singlet. Melting points (mp) were determined using a melting point apparatus with capillary method and are uncorrected. GC-MS data were recorded on an Shimadzu GCMS-QP2010 system operating in the electron impact (EI+) mode [Method: T0 = 50 $^{o}$C, t = 2 min; T1 = 260 $^{o}$C, ramp = 20 $^{o}$C/min, then T1 = 260 $^{o}$C, t = 5.5 min]. LC-MS was performed on an Agilent 1260 LC with an Agilent 6230 mass spectrometer (electrospray ionization, ESI) eluting with 0.05% trifluoroacetic acid in $H_2O$ and 0.05% trifluoroacetic acid in $CH_3CN$. All starting materials and solvent were purchased from Alfa Aesar, Aldrich, Acros, TCI chemical companies or from the storehouse of Asychem Laboratories Inc. and used as received.

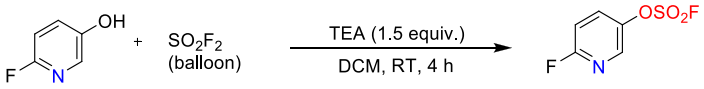
## 2. Preparation of heteroaryl fluorosulfates in **1-1** ~ **1-21** in Table 1.

*General procedure for Preparation of heteroaryl fluorosulfates **1** with TEA in DCM.*

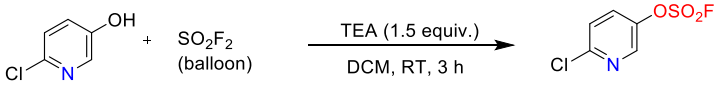
A three-neck round-bottom flask equipped with a thermometer was charged with the corresponding hydroxyheterocycles, DCM (10 mL/g) and TEA (1.5 equiv.). The mixture was stirred at room temperature for 10 min. The reaction flask was then sealed with a septum. The atmosphere above the solution was removed with gentle vacuum, and $SO_2F_2$ gas (sulfuryl fluoride, Vikane) from a balloon was introduced through a three-way valve joint. For large scale reactions, depletion of the sulfuryl fluoride from the balloon was easily observed, and more $SO_2F_2$ gas was introduced with a fresh balloon when required. The reaction mixture was vigorously stirred at room temperature for 2-24 hours, monitoring by TLC. After completion, the reaction mixture washed with saturated sodium bicarbonate and brine, dried over $Na_2SO_4$, filtered and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to give heteroaryl fluorosulfates **1**.



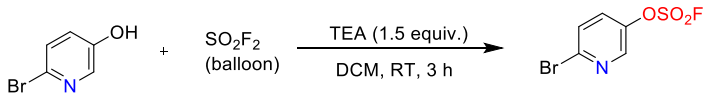
*Pyridin-3-yl fluorosulfate* ***(1-1)*** was prepared from 1.9 g of pyridine-3-ol and isolated as a yellow oil (3.46 g, 98% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.79 – 8.62 (m, 2H), 7.89 – 7.63 (m, 1H), 7.60 – 7.40 (m, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 149.86, 147.06, 142.62 (d, *J* = 0.7 Hz), 128.61, 124.81; $^{19}$F NMR (376 MHz, $CDCl_3$) δ = 37.99; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_5H_5FNO_3S$, 177.9974; found 177.9969.



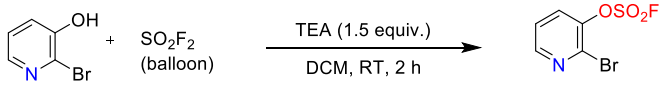

*6-Fluoropyridin-3-yl fluorosulfate* ***(1-2)*** was prepared from 1.13 g of 6-fluoropyridin-3-ol and isolated as a yellow oil (1.76 g, 90% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.31 (d, *J* = 0.6 Hz, 1H), 7.85 (ddd, *J* = 9.0, 6.0, 3.0 Hz, 1H), 7.11 (dd, *J* = 8.9, 3.5 Hz, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 163.15 (d, *J* = 243.2 Hz), 144.69 (d, *J* = 5.2 Hz), 140.71, 134.30 (d, *J* = 9.3 Hz), 111.52 (d, *J* = 40.32 Hz); $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 66.23, -179.71; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for 195.9880, 177.9974; found 195.9878.




*6-Chloropyridin-3-yl fluorosulfate* ***(1-3)*** was prepared from 1.29 g of 6-chloropyridin-3-ol and isolated as a white solid (1.66 g, 78% yield). mp 38-40 °C. $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.48 (d, *J* = 2.8 Hz, 1H), 7.79 – 7.64 (m, 1H), 7.50 (d, *J* = 8.8 Hz, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 151.31, 146.06, 142.58, 131.63, 125.96; $^{19}$F NMR (376 MHz, $CDCl_3$) δ = 38.15; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_5H_4ClFNO_3S$, 211.9584; found 211.9582.

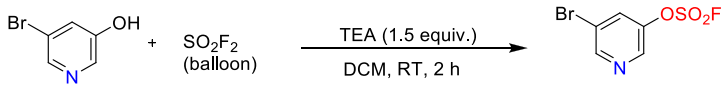



*6-Bromopyridin-3-yl fluorosulfate* ***(1-4)*** was prepared from 1.74 g of 6-bromopyridin-3-ol and isolated as a white solid (2.32 g, 91% yield). mp 51-53 °C. $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.46 (d, J = 2.6 Hz, 1H), 7.65 (d, J = 8.7 Hz, 1H), 7.59 (dd, J = 8.7, 2.9 Hz, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 159.86, 157.75, 146.37 (d, *J* = 4.5 Hz), 138.92 – 138.48 (m), 116.92 (d, *J* = 21.42 Hz); $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 38.23; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_5H_4BrFNO_3S$, 255.9079; found 255.9076.

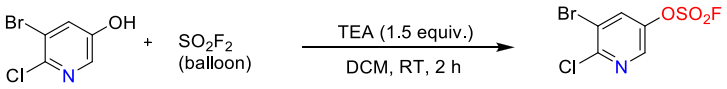



*2-Bromopyridin-3-yl fluorosulfate* ***(1-5)*** was prepared from 1.74 g of 2-bromopyridin-3-ol and isolated as a

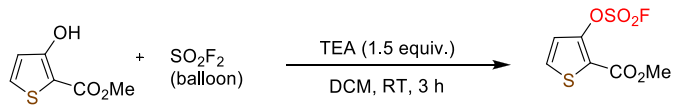
light yellow oil (1.76 g, 68% yield). $^{1}$H NMR (300 MHz, $CDCl_3$) δ = 8.48 (d, *J* = 4.5 Hz, 1H), 7.80 (d, *J* = 8.1 Hz, 1H), 7.47 (dd, *J* = 8.1, 4.5 Hz, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 149.75, 144.86 (d, *J* = 1.2 Hz), 135.59 (d, *J* = 0.9 Hz), 130.72 (d, *J* = 1.0 Hz), 124.20; $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 42.05; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_5H_4BrFNO_3S$, 255.9079; found 255.9080.



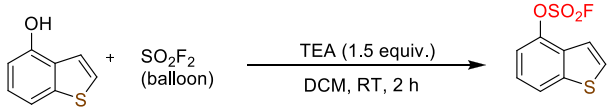

*5-Bromopyridin-3-yl fluorosulfate* ***(1-6)*** was prepared from 0.73 g of 5-bromopyridin-3-ol and isolated as a light yellow oil (0.86 g, 80% yield). $^{1}$H NMR (300 MHz, $CDCl_3$) δ = 8.78 (s, 1H), 8.64 (d, *J* = 1.7 Hz, 1H), 7.93 (s, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 151.26, 146.38, 140.86, 131.68, 120.71; $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 38.71; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_5H_4BrFNO_3S$, 255.9079; found 255.9076.




*5-Bromo-6-chloropyridin-3-yl fluorosulfate* ***(1-7)*** was prepared from 4.17 g of 5-bromo-6-chloropyridin-3-ol and isolated as a yellow oil (4.91 g, 85% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.46 (d, *J* = 2.2 Hz, 1H), 8.06 – 7.99 (m, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 151.07, 144.83, 140.59, 135.00, 121.06; $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 38.82; GC-MS ($t_R$): 8.13 min; EI-MS (m/z): 289 $[M]^+$.




*2-Methoxycarbonyl-thiopen-3-yl fluorosulfate* ***(1-18)*** was prepared from 3.16 g of methyl 3-hydroxythiophene-2-carboxylate and isolated as a yellow oil (4.47 g, 98% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 7.60 (dd, *J* = 5.5, 1.6 Hz, 1H), 7.13 (d, *J* = 5.5 Hz, 1H), 3.93 (d, *J* = 1.6 Hz, 3H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 159.80, 145.61, 130.90 (d, *J* = 7.4 Hz), 122.41, 121.93 (d, *J* = 5.5 Hz), 52.73 (d, *J* = 9.5 Hz); $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 39.63; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_6H_6FO_5S_2$, 240.9641; found 240.9641.

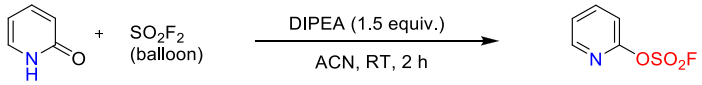



*Benzo[b]thiophen-4-yl fluorosulfate* ***(1-19)*** was prepared from 1.32 g of methyl benzo[*b*]thiophen-4-ol and isolated as a yellow oil (1.42 g, 70% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 7.88 – 7.83 (m, 1H), 7.55 (d, *J* = 5.6 Hz, 1H), 7.45 (d, *J* = 5.6 Hz, 1H), 7.39 – 7.33 (m, 2H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 144.57, 142.73, 132.13, 129.22, 124.79, 123.03, 119.00, 116.29; $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 38.00; GC-MS ($t_R$): 8.97 min; EI-MS

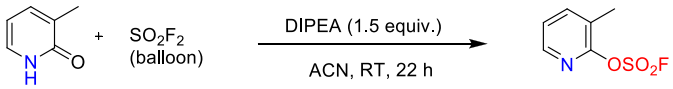
(m/z): 232 $[M]^+$.

*General procedure for Preparation of heteroaryl fluorosulfates **1** with DIPEA in ACN.*

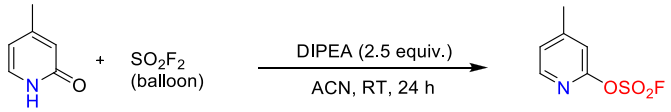
A three-neck round-bottom flask equipped with a thermometer was charged with the corresponding hydroxyheterocycles, ACN (10 mL/g) and DIPEA (1.5 – 3 equiv.). The mixture was stirred at room temperature for 10 min. The reaction flask was then sealed with a septum. The atmosphere above the solution was removed with gentle vacuum, and $SO_2F_2$ gas (sulfuryl fluoride, Vikane) from a balloon was introduced through a three-way valve joint. For large scale reactions, depletion of the sulfuryl fluoride from the balloon was easily observed, and more $SO_2F_2$ gas was introduced with a fresh balloon when required. The reaction mixture was vigorously stirred at room temperature for 2-24 hours, monitoring by TLC. After completion, the solvent was removed by rotary evaporation. The residue was dissolved in EtOAc, washed with saturated sodium bicarbonate and brine, dried over $Na_2SO_4$, filtered and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to give heteroaryl fluorosulfates **1**.



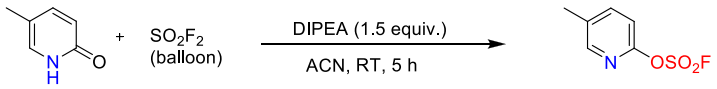

*Pyridin-2-yl fluorosulfate (**1-8**)* was prepared from 95.1 g of 5yridine-2(1*H*)-one and isolated as a yellow oil (154.5 g, 87% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.42 (m, 1H), 7.93 (m, 1H), 7.42 (dd, *J* = 7.4, 4.9 Hz, 1H), 7.20 (d, *J* = 8.2 Hz, 1H); $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 156.24 (d, *J* = 1.3 Hz), 148.50, 141.39, 124.39, 114.10 (d, *J* = 2.5 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ 43.93; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_5H_5FNO_3S$, 177.9974; found 177.9970.



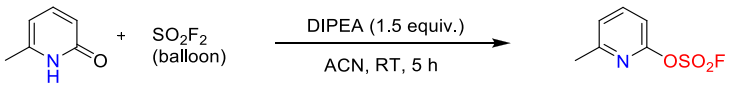

*3-Methylpyridin-2-yl fluorosulfate (**1-9**)* was prepared from 0.55 g of 3-methylpyridin-2(1*H*)-one and isolated as a yellow oil (0.71 g, 74% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.20 (d, *J* = 3.6, 1H), 7.73 (dd, *J* = 7.3, 0.5 Hz, 1H), 7.30 (dt, *J* = 9.8, 4.9 Hz, 1H), 2.36 (s, 3H); $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 155.29 (d, *J* = 1.5 Hz), 145.75, 142.28, 124.45, 124.15 (d, *J* = 2.3 Hz), 15.57; $^{19}$F NMR (376 MHz, $CDCl_3$) δ 45.11; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_6H_7FNO_3S$, 192.0131; found 192.0128.



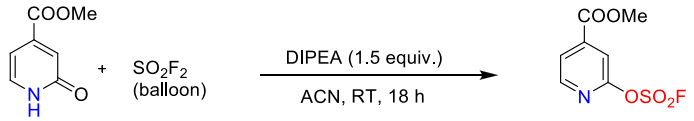
*4-Methylpyridin-2-yl fluorosulfate* ***(1-10)*** was prepared from 1.09 g of 4-methylpyridin-2(1*H*)-one and isolated as a yellow oil (1.36 g, 71% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.24 (d, *J* = 5.1 Hz, 1H), 7.22 (dd, *J* = 5.0, 0.4 Hz, 1H), 7.01 (s, 1H), 2.45 (s, 3H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 156.61 (d, *J* = 1.3 Hz), 153.73, 147.94, 125.46, 114.44 (d, *J*= 2.5 Hz), 21.01; $^{19}$F NMR (377 MHz, $CDCl_3$) δ = 43.63; HRMS (ESI-TOF) (m/z): [M + H]$^{+}$ calcd for $C_6H_7FNO_3S$, 192.0131; found 192.0131.



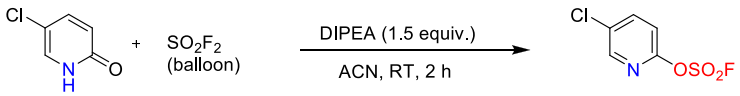

*5-Methylpyridin-2-yl fluorosulfate* ***(1-11)*** was prepared from 1.09 g of 5-methylpyridin-2(1*H*)-one and isolated as a yellow oil (1.86 g, 98% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.28 – 8.12 (m, 1H), 7.72 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.10 (d, *J* = 8.3 Hz, 1H), 2.40 (s, 3H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 154.51 (d, *J* = 1.5 Hz), 148.45, 141.76, 134.66, 113.69 (d, *J* = 2.5 Hz), 17.77 (d, *J* = 4.3 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ = 43.21; HRMS (ESI-TOF) (m/z): [M + H]$^{+}$ calcd for $C_6H_7FNO_3S$, 192.0131; found 192.0130.



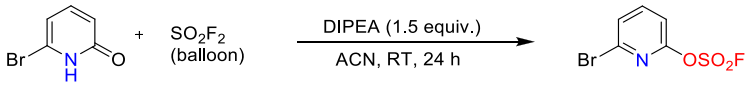

*6-Methylpyridin-2-yl fluorosulfate* ***(1-12)*** was prepared from 1.09 g of 6-methylpyridin-2(1*H*)-one and isolated as a yellow oil (1.75 g, 92% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 7.79 (t, *J* = 7.8 Hz, 1H), 7.27 (dd, *J* = 15.6, 4.1 Hz, 1H), 7.00 (d, *J* = 8.1 Hz, 1H), 2.56 (s, 3H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 159.03, 155.54 (d, *J* = 1.2 Hz, 1H), 141.25, 123.93, 110.82 (d, *J* = 2.4 Hz), 23.85 (q, *J* = 3.2 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ = 43.59; HRMS (ESI-TOF) (m/z): [M + H]$^{+}$ calcd for $C_6H_7FNO_3S$, 192.0131; found 192.0128.



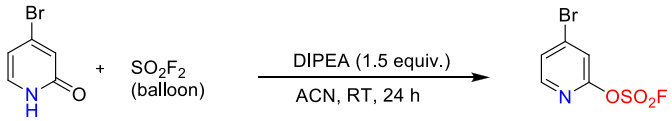

*4-Methoxycarbonyl-pyridin-2-yl fluorosulfate* ***(1-13)*** was prepared from 0.39 g of 4-methoxycarbonyl-pyridin-2(1*H*)-one and isolated as a yellow oil (0.43 g, 72% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.57 (d, *J* = 5.0 Hz, 1H), 7.97 (dd, *J* = 5.0, 1.0 Hz, 1H), 7.75 (s, 1H), 4.01 (s, 3H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 163.61, 156.84, 149.51 (d, *J* = 3.2 Hz), 142.99, 123.76 (d, *J* = 2.8 Hz), 114.12 (d, *J* = 8.7 Hz), 53.36 (d, *J* = 11.6 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ = 44.50; HRMS (ESI-TOF) (m/z): [M + H]$^{+}$ calcd for $C_7H_7FNO_5S$, 236.0029; found 236.0026.



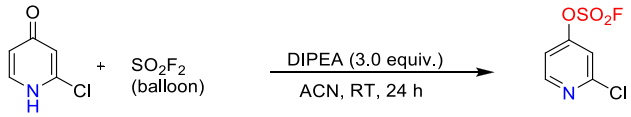

*5-Chloropyridin-2-yl fluorosulfate* ***(1-14)*** was prepared from 0.64 g of 5-chloropyridin-2(1*H*)-one and isolated as a colorless oil (0.95 g, 90% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.36 (s, 1H), 7.89 (dd, *J* = 8.6, 2.5 Hz, 1H), 7.18 (dd, *J* = 8.6, 1.1 Hz, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 154.34 (d, *J* = 1.4 Hz, 1H), 147.33, 140.98, 132.51, 115.29 (d, *J* = 2.6 Hz); $^{19}$F NMR (377 MHz, $CDCl_3$) δ = 43.99; GC-MS ($t_R$): 6.94 min; EI-MS (m/z): 211 $[M]^+$.



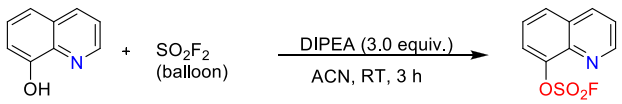

*6-Bromopyridin-2-yl fluorosulfate* ***(1-15)*** was prepared from 1.74 g of 6-bromopyridin-2(1*H*)-one and isolated as a colorless oil (2.17 g, 85% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 7.84 (t, *J* = 7.9 Hz, 1H), 7.70 – 7.57 (m, 1H), 7.29 – 7.16 (m, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 154.43 (d, *J* = 1.3 Hz), 143.04, 139.52, 129.01, 113.04 (d, *J* = 2.4 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ = 44.22; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_5H_4BrFNO_3S$, 255.9079; found 255.9079.



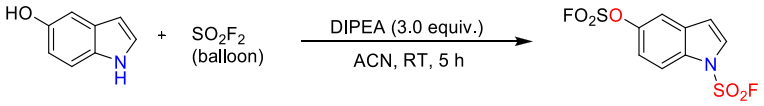

*4-Bromopyridin-2-yl fluorosulfate* ***(1-16)*** was prepared from 0.35 g of 4-bromopyridin-2(1*H*)-one and isolated as a colorless oil (0.41 g, 79% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.26 (d, *J* = 5.3 Hz, 1H), 7.57 (dd, *J* = 5.2, 1.4 Hz, 1H), 7.44 – 7.34 (m, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 156.37 (d, *J* = 1.4 Hz), 148.98, 136.36, 127.84, 117.71 (d, *J* = 2.5 Hz); $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 37.99; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_5H_4BrFNO_3S$, 255.9079; found 255.9079.




*2-Chloropyridin-4-yl fluorosulfate* ***(1-17)*** was prepared from 1.04 g of 2-chloropyridin-4(1*H*)-one and isolated as a colorless oil (0.95 g, 79% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.57 (d, *J* = 5.6 Hz, 1H), 7.40 (d, *J* = 1.3 Hz, 1H), 7.31 (dd, *J* = 5.5, 1.1 Hz, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 157.17, 153.64, 152.10, 116.60, 114.62; $^{19}$F NMR (376 MHz, $CDCl_3$) δ = 40.59; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_5H_4ClFNO_3S$, 211.9584; found 211.9583.

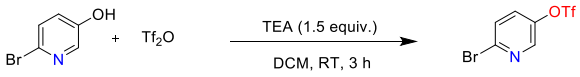



*Quinolin-8-yl fluorosulfate* ***(1-20)*** was prepared from 2.9 g of quinolin-8-ol and isolated as a colorless oil (4.43 g, 97% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 9.01 (d, *J* = 1.4 Hz, 1H), 8.19 (d, *J* = 8.3 Hz, 1H), 7.89 – 7.77 (m, 1H), 7.72 (d, *J* = 7.4 Hz, 1H), 7.60 – 7.53 (m, 1H), 7.51 – 7.48 (m, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 151.87, 145.82, 140.35, 136.02, 129.98, 128.81, 125.91, 122.76, 121.33; $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 40.19; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_9H_7FNO_3S$, 228.0131; found 228.0128.




*1-(Fluorosulfonyl)-1H-indol-5-yl fluorosulfate* ***(1-21)*** was prepared from 0.66 g of 1*H*-indol-5-ol and isolated as a colorless oil (1.43 g, 97% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 7.99 (d, *J* = 9.1 Hz, 1H), 7.65 (s, 1H), 7.57 (d, *J* = 3.8 Hz, 1H), 7.42 (dd, *J* = 9.0, 1.5 Hz, 1H), 6.87 (d, *J* = 3.7 Hz, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 163.18 (d, *J* = 239.4 Hz), 145.91 (d, *J* = 14.9 Hz), 139.84 (d, *J* = 7.9 Hz), 136.77, 134.94 (d, *J* = 4.6 Hz), 128.27, 128.20 (d, *J* = 264.6 Hz), 109.55 (d, *J* = 37.8 Hz); $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 55.31, 36.75; GC-MS ($t_R$): 9.41 min; EI-MS (m/z): 297 $[M]^+$.

3. Preparation of pyridinyl triflates **8** in Figure 3.




To a stirred solution of 0.35 g 6-bromopyridine-3-ol and TEA (1.5 equiv.) in DCM (10 mL/g), $Tf_2O$ (1.25 equiv.) was added dropwise at the speed to keep the temperature of reaction mixture below 10 °C. The resulting mixture was then slowly warmed to room temperature and stirred for 3 h. And the reaction was monitored by TLC. Upon completion, the mixture washed with saturated sodium bicarbonate and brine, dried over $Na_2SO_4$, and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to give pyridinyl triflates **8** as a white solid (0.56 g, 91% yield). mp 50-51 °C. $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.29 (d, *J* = 3.0 Hz, 1H), 7.55 (m, 1H), 7.48 (dd, *J* = 8.7, 3.0 Hz, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 146.37, 143.11, 141.04, 131.74, 129.63, 118.64 (q, *J* = 322.6 Hz); $^{19}$F NMR (377 MHz, $CDCl_3$) δ = -73.78; GC-MS ($t_R$): 5.96 min; EI-MS (m/z): 227 $[M-Br]^+$.

4. General procedures for Pd-catalyzed Suzuki reaction.

*Method A. General Suzuki procedure associate with (aqueous) alcohol solution.*

Het-$OSO_2F$ (1.0 mmol, 1.0 equiv), (hetero)arylboronic acid (1.5 mmol, 1.5 equiv), Pd-catalyst

(1-10 mol%), base (3.0 mmol, 3.0 equiv) were successively added to a 50 mL flask equipped with a stirring bar and a thermometer. The air in the flask was replaced by nitrogen gas by vacuum, and then (aqueous) alcohol solution (with different ratios) (1-20mL) was injected into the flask through a rubber plug. The reaction mixture was placed into an oil bath, heated to the corresponding temperature and stirred for 1-24 hours as monitored by TLC or HPLC. After completion, most of organic solvent was removed by rotary evaporation. The residue was dissolved in EtOAc, washed with saturated brine, dried over $Na_2SO_4$, filtered and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to afford the coupling product.

*Method B. General Suzuki procedure associate with aqueous $NaHCO_3$ solution in 1,4-dioxane at room temperature.*

Het-$OSO_2F$ (1.0 mmol, 1.0 equiv), (hetero)arylboronic acid (1.5 mmol, 1.5 equiv), $Pd(PPh_3)_4$ (10 mol%) were successively added to a 50 mL flask equipped with a stirring bar and a thermometer. The air in the flask was replaced by nitrogen gas by vacuum, and then 1,4-dioxane (10 mL) was injected into the flask through a rubber plug. The reaction mixture was stirred for 10 min and then $NaHCO_3$ (3.0 mmol, 3 equiv) in 10 mL water was injected into the flask. The reaction mixture was stirred at room teperature for 3-24 hours as monitored by HPLC. After completion, the mixture was diluted with EtOAc (20mL), washed with saturated brine, dried over $Na_2SO_4$, filtered and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to afford the coupling product.

*Method C. General Suzuki procedure associate with KF in toluene or 1,4-dioxane at refluxing temperature.*

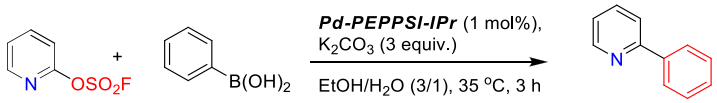
Het-$OSO_2F$ (1.0 mmol, 1.0 equiv), arylboronic acid (1.5 mmol, 1.5 equiv), $Pd(PPh_3)_4$ (10 mol%), KF (3.0 mmol, 3.0 equiv) were successively added to a 50 mL flask equipped with a stirring bar and a thermometer. The air in the flask was replaced by nitrogen gas by vacuum, and then toluene or 1,4-dioxane (10 mL) was injected into the flask through a rubber plug. The reaction mixture was placed into an oil bath, heated to reflux for 3-10 hours as monitored by HPLC. After completion, the mixture was diluted with EtOAc (20mL), washed with saturated brine, dried over $Na_2SO_4$, filtered and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to afford the coupled product.

5. Table 1S Optimization of the Suzuki reaction of pyridin-2-yl fluorosulfate **1-8** with phenylboronic acid **2-1**[a]

| Entry | Conditions | Yield |
|---|---|---|
| 1 | **$Pd(PPh_3)_4$**, $K_2CO_3$, EtOH/$H_2O$(3/1), RT, 18h (10 mol% Cat., 0.05 M) | 92% |
| 2 | **$Pd(PPh_3)_2Cl_2$**, $K_2CO_3$, EtOH/$H_2O$(3/1), RT, 4h (10 mol% Cat., 0.05 M) | 90% |
| 3 | **$Pd(dppf)Cl_2$**, $K_2CO_3$, EtOH/$H_2O$(3/1), RT, 3h (**10 mol**% Cat., 0.05 M) | 97% |
| 4 | $Pd(dppf)Cl_2$, $K_2CO_3$, EtOH/$H_2O$(3/1), RT, 17h (**5 mol %** Cat., 0.05 M) | 81% |
| 5 | $Pd(dppf)Cl_2$, $K_2CO_3$, EtOH/$H_2O$(3/1), RT, 24h (**2 mol%** Cat., 0.05 M) | 46% |
| 6 | **$Pd(OAc)_2$, IPr.HCl**, $K_2CO_3$, EtOH/$H_2O$(3/1), RT, 20h (10 mol% Cat., 0.05 M) | 29% (50%[b]) |
| 7 | ***Pd-PEPPSI-IPr***, $K_2CO_3$, EtOH/$H_2O$(3/1), 35 °C, 3 h (1 mol% Cat., 0.1 M) | 97% |
| 8 | *Pd-PEPPSI-IPr*, $K_2CO_3$, EtOH/$H_2O$(**2/1**), 35 °C, 3.5 h (1% mol% Cat., 0.1 M) | 87% |
| 9 | *Pd-PEPPSI-IPr*, $K_2CO_3$, EtOH/$H_2O$(**4/1**), 35 °C, 3.5 h (1% Cat., 0.1 M) | 96% |
| 10 | *Pd-PEPPSI-IPr*, $K_2CO_3$, **EtOH**, 35 °C, 3.5 h (1 mol% Cat., 0.1 M) | 96% |
| 11 | *Pd-PEPPSI-IPr*, $K_2CO_3$, **MeOH/$H_2O$**(3/1), 35 °C, 3 h (1 mol% Cat., 0.1 M) | 52% |
| 12 | *Pd-PEPPSI-IPr*, $K_2CO_3$, ***i*-PrOH/$H_2O$**(3/1), 35 °C, 3 h (1 mol% Cat., 0.1 M) | 83% |
| 13 | *Pd-PEPPSI-IPr*, **$Na_2CO_3$**, EtOH/$H_2O$(3/1), 35 °C, 5 h (1 mol% Cat., 0.1 M) | 91% |
| 14 | *Pd-PEPPSI-IPr*, **$Cs_2CO_3$**, EtOH/$H_2O$(3/1), 35 °C, 3 h (1 mol% Cat., 0.1 M) | 77% |
| 15 | *Pd-PEPPSI-IPr*, **NaOH**, EtOH/$H_2O$(3/1), 35 °C, 3 h (1 mol% Cat., 0.1 M) | 56% |
| 16 | *Pd-PEPPSI-IPr*, **$K_3PO_4$**3, EtOH/$H_2O$(3/1), 35 °C, 3 h (1% Cat., 0.1 M) | 90% |
| 17 | *Pd-PEPPSI-IPr*, **TEA**, EtOH/$H_2O$(3/1), 35 °C, 6 h (1 mol% Cat., 0.1 M) | 85% |
| 18 | *Pd-PEPPSI-IPr*, **DIPEA**, EtOH/$H_2O$(3/1), 35 °C, 6 h (1 mol% Cat, 0.1 M) | 87% |
| 19 | *Pd-PEPPSI-IPr*,$K_2CO_3$, EtOH/$H_2O$(3/1), **25 °C**, 6 h (1 mol% Cat, 0.1 M) | 83% |
| 20 | *Pd-PEPPSI-IPr*, $K_2CO_3$, EtOH/$H_2O$(3/1), **30 °C**, 6 h (1 mol% Cat, 0.1 M) | 90% |
| 21 | *Pd-PEPPSI-IPr*, $K_2CO_3$, EtOH/$H_2O$(3/1), **40 °C**, 2 h (1 mol% Cat, 0.1 M) | 97% |
| 22 | *Pd-PEPPSI-IPr*, $K_2CO_3$, EtOH/$H_2O$(3/1), 35 °C, 5 h (1 mol% Cat, **0.25 M**) | 96% |
| 23 | *Pd-PEPPSI-IPr*, $K_2CO_3$, EtOH/$H_2O$(3/1), 35 °C, 5 h (1 mol% Cat, **0. 5 M**) | 84% |
| 24 | *Pd-PEPPSI-IPr*, $K_2CO_3$, EtOH/$H_2O$(3/1), 35 °C, 5 h (1 mol% Cat, **1 M**) | 82% |

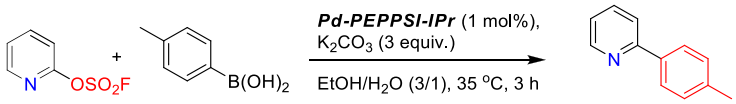
[a] The best conditions for the coupling reaction were as follows: 1 mol% *Pd-PEPPSI-IPr* as catalyst, $K_2CO_3$ (3 equiv.) as base, EtOH/$H_2O$ (3/1) to EtOH as solvent, reaction temperature from 35 °C to 40 °C, and substrate concentration from 0.1 M to 0.25 M. [b] Pd catalyst and ligand was added into EtOH and stirred for 10 min before other substrates were added.

6. Suzuki coupling product **3-1** ~ **3-18** in Table 2.

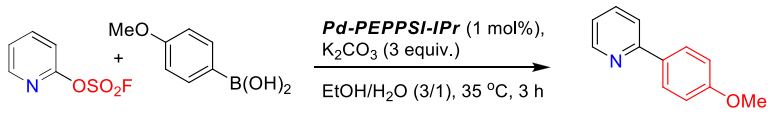



*2-Phenylpyridine (**3-1**)*[3] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and pheylboronic acid (**3-1**) by *method A* and isolated as a light yellow oil (151 mg, 97% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.65 (d, *J* = 4.6 Hz, 1H), 8.03 – 7.91 (m, 2H), 7.67 – 7.54 (m, 2H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.36 (t, *J* = 7.3 Hz, 1H), 7.10

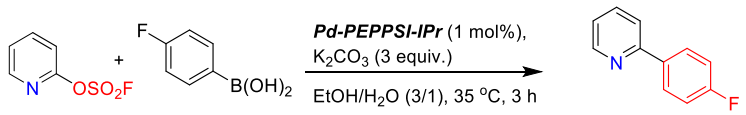
(ddd, $J$ = 6.7, 4.8, 1.6 Hz, 1H).



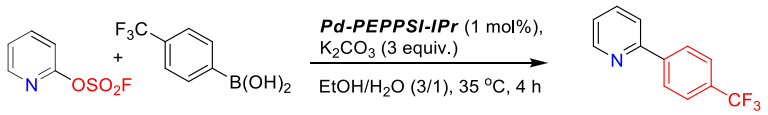

*2-p-Tolylpyridine (**3-2**)*[3] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and *p*-tolylboronic acid (**2-2**) by *method A* and isolated as a light yellow oil (160 mg, 95% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.64 (d, $J$ = 4.6 Hz, 1H), 7.88 (d, $J$ = 8.1 Hz, 2H), 7.69 – 7.49 (m, 2H), 7.23 (d, $J$ = 8.0 Hz, 2H), 7.17 – 6.96 (m, 1H), 2.34 (s, 3H).



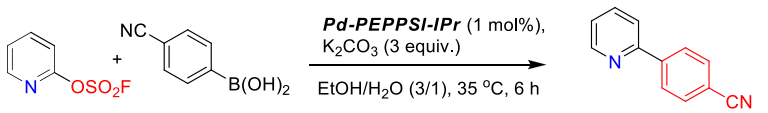

*2-(4-Methoxyphenyl)pyridine (**3-3**)*[3] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 4-methoxyphenylboronic acid (**2-3**) by *method A* and isolated as a white solid (177 mg, 96% yield). mp 55-56 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.65 (ddd, $J$ = 4.8, 1.7, 0.9 Hz, 1H), 8.01 – 7.92 (m, 2H), 7.68 (tdd, $J$ = 7.9, 7.4, 1.4 Hz, 2H), 7.16 (ddd, $J$ = 7.1, 4.8, 1.3 Hz, 1H), 7.03 – 6.95 (m, 2H), 3.85 (s, 3H).




*2-(4-Fluorophenyl)pyridine (**3-4**)*[3] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 4-fluorophenylboronic acid (**2-4**) by *method A* and isolated as a yellow solid (165 mg, 95% yield). mp 40-42 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.64 (s, 1H), 8.06 – 7.87 (m, 2H), 7.78 – 7.55 (m, 2H), 7.22 – 7.02 (m, 3H); $^{19}$F NMR (377 MHz, $CDCl_3$) δ = -113.58.

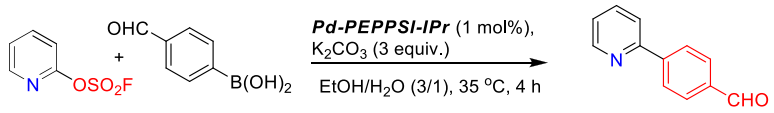



*2-(4-(Trifluoromethyl)phenyl)pyridine (**3-5**)*[3] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 4-(trifluoromethyl)phenylboronic acid (**2-5**) by *method A* and isolated as a white solid (218 mg, 97% yield). mp 79-81 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.70 (d, $J$ = 4.2 Hz, 1H), 8.08 (d, $J$ = 8.2 Hz, 2H), 7.72 (dt, $J$ = 13.3, 7.4 Hz, 4H), 7.32 – 7.17 (m, 1H); $^{19}$F NMR (377 MHz, $CDCl_3$) δ = -62.97.

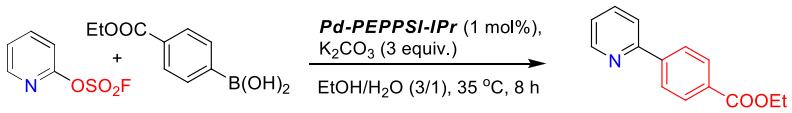



*4-(Pyridin-2-yl)benzonitrile (**3-6**)*[3] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and

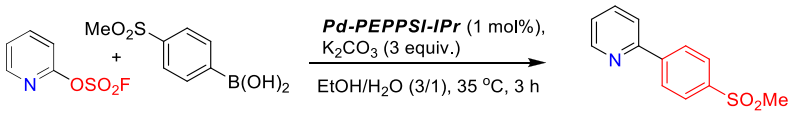
4-cyanophenylboronic acid (**2-6**) by *method A* and isolated as a white solid (169 mg, 94% yield). mp 94-96 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.74 (d, *J* = 4.1 Hz, 1H), 8.12 (d, *J* = 8.4 Hz, 2H), 7.82 (td, *J* = 7.8, 1.7 Hz, 1H), 7.77 (d, *J* = 8.4 Hz, 3H), 7.36 – 7.29 (m, 1H).



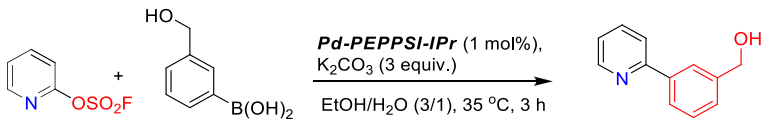

*4-(Pyridin-2-yl)benzaldehyde (**3-7**)*[4] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 4-formylphenylboronic acid (**2-7**) by *method A* and isolated as a white solid (170 mg, 94% yield). mp 45-47 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 10.06 (s, 1H), 8.73 (d, *J* = 4.7 Hz, 1H), 8.16 (d, *J* = 8.3 Hz, 2H), 7.97 (d, *J* = 8.3 Hz, 2H), 7.78 (t, *J* = 6.0 Hz, 2H), 7.29 (dd, *J* = 8.7, 4.6 Hz, 1H).




*Ethyl 4-(pyridin-2-yl)benzoate (**3-8**)*[5] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 4-(ethoxycarbonyl)phenylboronic acid (**2-8**) by *method A* with pure ethanol as the solvent and isolated as a pale yellow solid (209 mg, 92% yield). mp. 55-56°C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.71 (dd, *J* = 3.5, 1.2 Hz, 1H), 8.18 – 8.11 (m, 2H), 8.06 (d, *J* = 8.5 Hz, 2H), 7.78 – 7.74 (m, 2H), 7.28 – 7.21 (m, 1H), 4.40 (q, *J* = 7.1 Hz, 2H), 1.41 (t, *J* = 7.1 Hz, 3H).

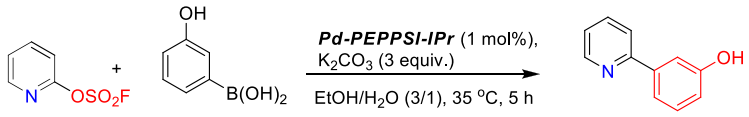



*2-(4-(methylsulfonyl)phenyl)pyridine (**3-9**)*[6] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 4-(methylsulfonyl)phenylboronic acid (**2-9**) by *method A* and isolated as a yellow crystal (220 mg, 94% yield). mp 130-134°C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.73 (d, *J* = 4.4 Hz, 1H), 8.20 (d, *J* = 8.3 Hz, 2H), 8.04 (d, *J* = 8.3 Hz, 2H), 7.91 – 7.76 (m, 2H), 7.33 (t, *J* = 5.1 Hz, 1H), 3.10 (s, 3H).

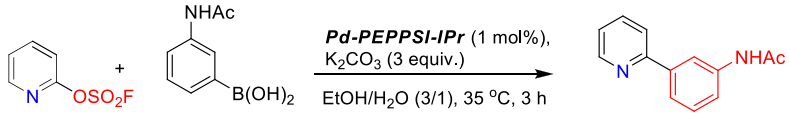



*(3-(Pyridin-2-yl)phenyl)methanol (**3-10**)*[7] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 3-(hydroxymethyl)phenylboronic acid (**2-10**) by *method A*, purified by *n*-hexane and *tert*-butyl methyl ether (MTBE), and isolated as a light yellow oil gummy (183 mg, 99% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.53 (dd, *J* = 2.3, 1.4 Hz, 1H), 7.83 (s, 1H), 7.74 (d, *J* = 7.0 Hz, 1H), 7.65 – 7.58 (m, 1H), 7.58 – 7.50 (m, 1H), 7.36 – 7.22

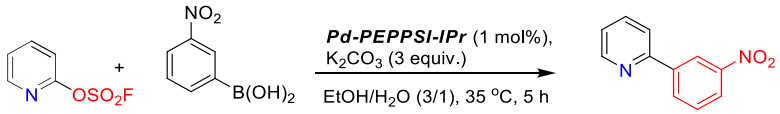
(m, 2H), 7.17 – 7.05 (m, 1H), 5.01 (s, 1H), 4.61 (s, 2H).



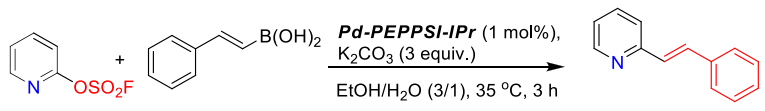

*3-(pyridin-2-yl)phenol* ***(3-11)***[8] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 3-hydroxyphenylboronic acid (**2-11**) by *method A*, purified by *n*-hexane and acetone, and isolated as a white solid (125 mg, 73% yield). mp 100-102 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.64 (dd, *J* = 4.9, 0.8 Hz, 1H), 7.74 (td, *J* = 7.8, 1.7 Hz, 1H), 7.61 (d, *J* = 8.0 Hz, 1H), 7.52 (d, *J* = 1.7 Hz, 1H), 7.37 (d, *J* = 7.7 Hz, 1H), 7.31 – 7.19 (m, 2H), 6.90 – 6.81 (m, 1H).



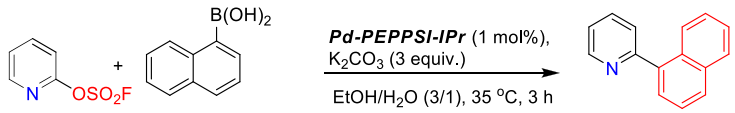

*N-(3-(pyridin-2-yl)phenyl)acetamide* ***(3-12)***[9] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 3-acetamidophenylboronic acid (**2-12**) by *method A*, purified by *n*-hexane and MTBE, and isolated as a white solid (207 mg, 98% yield). mp 134-135 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.63 (d, *J* = 4.3 Hz, 1H), 8.36 (s, 1H), 8.12 (s, 1H), 7.72 – 7.60 (m, 4H), 7.35 (t, *J* = 7.9 Hz, 1H), 7.19 (t, *J* = 5.5 Hz, 1H), 2.10 (s, 3H).



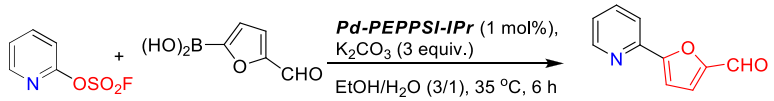

*2-(3-nitrophenyl)pyridine* ***(3-13)***[9, 10] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 3-nitrophenylboronic acid (**2-13**) by *method A*, purified by *n*-hexane and MTBE, and isolated as a white solid (186 mg, 93% yield). mp 71-73 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.87 (t, *J* = 1.8 Hz, 1H), 8.75 (d, *J* = 4.5 Hz, 1H), 8.38 (d, *J* = 7.8 Hz, 1H), 8.32 – 8.23 (m, 1H), 7.88 – 7.78 (m, 2H), 7.66 (t, *J* = 8.0 Hz, 1H), 7.34 (ddd, *J* = 6.7, 4.8, 2.1 Hz, 1H).



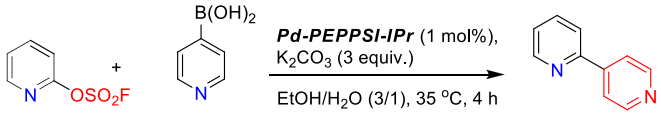

*(E)-2-styrylpyridine* ***(3-14)***[11] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and (E)-styrylboronic acid (**2-14**) by *method A* and isolated as a yellow solid (150 mg, 83% yield). mp 91-93 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.61 (d, *J* = 4.4 Hz, 1H), 7.70 – 7.61 (m, 2H), 7.59 (d, *J* = 7.6 Hz, 2H), 7.38 (t, *J* = 8.0 Hz, 3H), 7.30 (t, *J* = 7.3 Hz, 1H), 7.21 – 7.11 (m, 2H).



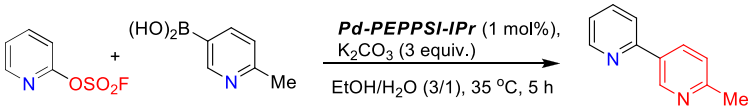

*2-(Naphthalen-1-yl)pyridine* ***(3-15)***[12] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and naphthalen-1-ylboronic acid (**2-15**) by *method A* and isolated as a light yellow oil (188 mg, 92% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.82 – 8.76 (m, 1H), 8.08 (d, *J* = 7.9 Hz, 1H), 7.91 (d, *J* = 7.5 Hz, 2H), 7.82 (td, *J* = 7.7, 1.8 Hz, 1H), 7.57 (ddd, *J* = 16.8, 11.8, 7.7 Hz, 3H), 7.52 – 7.42 (m, 2H), 7.37 – 7.29 (m, 1H).




*5-(Pyridin-2-yl)furan-2-carbaldehyde* ***(3-16)***[13] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 5-formylfuran-2-ylboronic acid (**2-16**) by *method A* and isolated as a yellow solid (132 mg, 77% yield). mp 94-96 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 9.72 (s, 1H), 8.66 (d, *J* = 4.1 Hz, 1H), 7.94 (d, *J* = 8.0 Hz, 1H), 7.80 (t, *J* = 7.8 Hz, 1H), 7.37 (d, *J* = 3.6 Hz, 1H), 7.33 – 7.28 (m, 1H), 7.27 (d, *J* = 3.3 Hz, 1H).

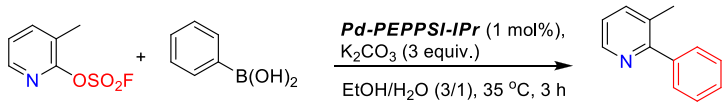



*2,4'-Bipyridine* ***(3-17)*** [14] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and pyridin-4-ylboronic acid (**2-17**) by *method A* using 1,4-dioxane/$H_2O$(3/1) instead of EtOH/$H_2O$(3/1) at refluxing temperature and isolated as a yellow solid (113 mg, 72% yield). mp 64-65 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.74 (ddd, *J* = 8.3, 4.6, 1.2 Hz, 3H), 7.90 (dd, *J* = 4.5, 1.6 Hz, 2H), 7.87 – 7.77 (m, 2H), 7.34 (ddd, *J* = 6.3, 4.8, 2.3 Hz, 1H).

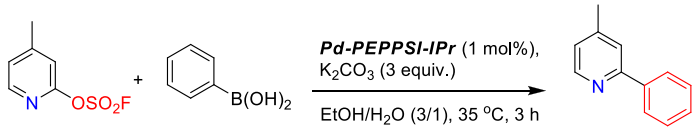



*6'-Methyl-2,3'-bipyridine* ***(3-18)***[15] was prepared from pyridin-2-yl fluorosulfate (**1-8**) and 6-methylpyridin-3-ylboronic acid (**2-18**) by *method A* using 1,4-dioxane/$H_2O$(3/1) instead of EtOH/$H_2O$(3/1) at refluxing temperature and isolated as a white solid (142 mg, 84% yield). mp 101-102 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 9.07 (d, *J* = 1.9 Hz, 1H), 8.70 (ddd, *J* = 4.8, 1.6, 0.9 Hz, 1H), 8.21 (dd, *J* = 8.1, 2.3 Hz, 1H), 7.79 – 7.73 (m, 1H), 7.73 – 7.69 (m, 1H), 7.29 – 7.20 (m, 2H), 2.62 (s, 3H).

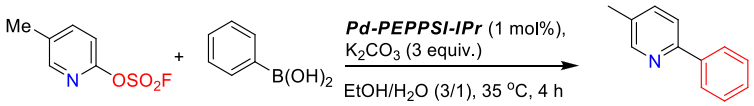
7. Suzuki coupling product **4-1** ~ **4-11** in Table 3.



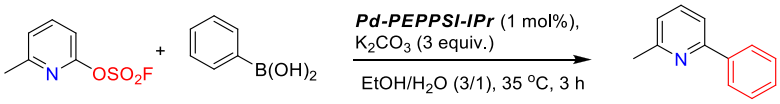

*3-Methyl-2-phenylpyridine (**4-1**)*[16] was prepared from 3-methylpyridin-2-yl fluorosulfate (**1-9**) and phenylboronic acid (**2-1**) by *method A* with 2 mol% Pd-catalyst and isolated as a light yellow oil (113 mg, 67% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.53 (d, *J* = 4.5 Hz, 1H), 7.58 (d, *J* = 7.6 Hz, 1H), 7.55 – 7.48 (m, 2H), 7.45 (dd, *J* = 10.9, 3.7 Hz, 2H), 7.42 – 7.35 (m, 1H), 7.18 (dd, *J* = 6.4, 5.0 Hz, 1H), 2.36 (s, 3H).



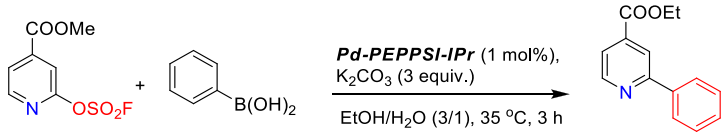

*4-Methyl-2-phenylpyridine (**4-2**)*[3] was prepared from 4-methylpyridin-2-yl fluorosulfate (**1-10**) and phenylboronic acid (**2-1**) by *method A* and isolated as a colorless oil (162 mg, 96% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.55 (d, J = 4.9 Hz, 1H), 7.97 (d, J = 7.3 Hz, 2H), 7.54 (s, 1H), 7.46 (t, J = 7.5 Hz, 2H), 7.40 (t, J = 7.3 Hz, 1H), 7.05 (d, J = 4.5 Hz, 1H), 2.41 (s, 3H).




*5-Methyl-2-phenylpyridine (**4-3**)*[17] was prepared from 5-methylpyridin-2-yl fluorosulfate (**1-11**) and phenylboronic acid (**2-1**) by *method A* and isolated as a light yellow oil (162 mg, 96% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.52 (s, 1H), 8.04 – 7.87 (m, 2H), 7.61 (d, J = 8.1 Hz, 1H), 7.53 (dd, J = 8.1, 1.4 Hz, 1H), 7.45 (t, J = 7.5 Hz, 2H), 7.38 (t, J = 7.3 Hz, 1H), 2.35 (s, 3H).

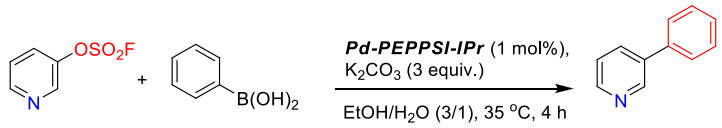



*6-Methyl-2-phenylpyridine (**4-4**)*[16] was prepared from 6-methylpyridin-2-yl fluorosulfate (**1-12**) and phenylboronic acid (**2-1**) by *method A* and isolated as a light yellow oil (167 mg, 99% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.05 (d, *J* = 7.9 Hz, 2H), 7.71 (t, *J* = 7.6 Hz, 1H), 7.59 (d, *J* = 7.9 Hz, 1H), 7.54 (t, *J* = 7.0 Hz, 2H), 7.47 (t, *J* = 7.3 Hz, 1H), 7.17 (d, *J* = 7.5 Hz, 1H), 2.70 (s, 3H).

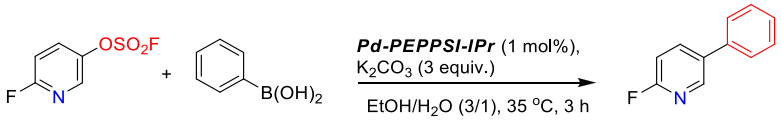



*Ethyl 2-phenylisonicotinate (**4-5**)*[18] was prepared from 4-methoxycarbonyl-pyridin-2-yl fluorosulfate (**1-13**)

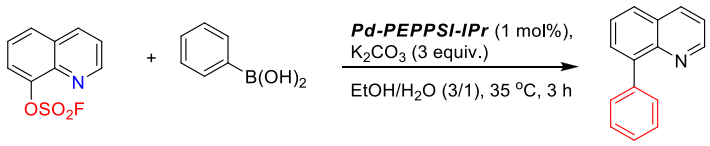
and phenylboronic acid (**2-1**) by *method A* and isolated as a white solid (194 mg, 86% yield). mp 42-44 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.83 (d, *J* = 5.0 Hz, 1H), 8.29 (s, 1H), 8.05 (d, *J* = 7.7 Hz, 2H), 7.77 (d, *J* = 5.0 Hz, 1H), 7.50 (t, *J* = 7.5 Hz, 2H), 7.44 (t, *J* = 7.1 Hz, 1H), 4.44 (q, *J* = 7.1 Hz, 2H), 1.43 (t, *J* = 7.1 Hz, 3H).



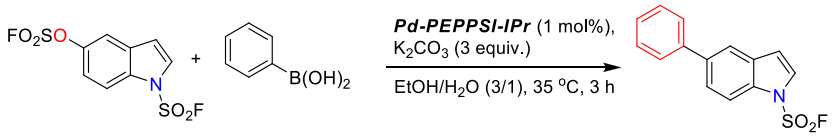

*3-Phenylpyridine (**4-6**)* [12] was prepared from pyridin-3-yl fluorosulfate (**1-1**) and phenylboronic acid (**2-1**) by *method A* and isolated as a yellow oil (152 mg, 98% yield). $^1$H NMR (500 MHz, cdcl$_3$) δ = 8.86 (s, 1H), 8.60 (d, *J* = 4.6 Hz, 1H), 7.88 (d, *J* = 7.9 Hz, 1H), 7.59 (d, *J* = 8.3 Hz, 2H), 7.49 (t, *J* = 7.3 Hz, 2H), 7.41 (t, *J* = 6.8 Hz, 1H), 7.39 – 7.31 (m, 1H).




*2-Fluoro-5-phenylpyridine (**4-7**)*[19] was prepared from 6-fluoropyridin-3-yl fluorosulfate (**1-2**) and phenylboronic acid (**2-1**) by *method A* and isolated as a yellow oil (155 mg, 90% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.41 (s, 1H), 7.95 (td, *J* = 8.3, 2.5 Hz, 1H), 7.52 (d, *J* = 7.2 Hz, 2H), 7.46 (t, *J* = 7.5 Hz, 2H), 7.41 (q, *J* = 7.7 Hz, 1H), 6.99 (dd, *J* = 8.4, 2.8 Hz, 1H).

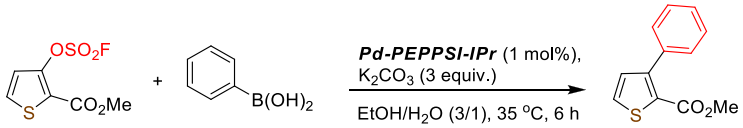



*8-Phenylquinoline (**4-8**)*[20] was prepared from quinolin-8-yl fluorosulfate (**1-20**) and phenylboronic acid (**2-1**) by *method A* and isolated as a yellow oil (189 mg, 92% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.92 (s, 1H), 8.12 (d, *J* = 8.1 Hz, 1H), 7.75 (d, *J* = 7.9 Hz, 1H), 7.69 (d, *J* = 7.0 Hz, 3H), 7.54 (t, *J* = 7.2 Hz, 1H), 7.47 (t, *J* = 7.0 Hz, 2H), 7.39 (t, *J* = 6.9 Hz, 1H), 7.36 – 7.29 (m, 1H).

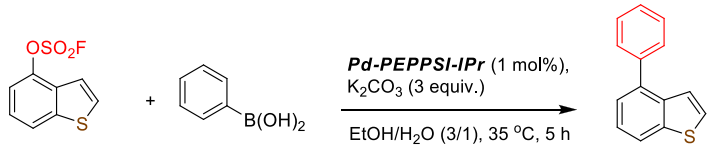



*5-Phenyl-1H-indole-1-sulfonyl fluoride (**4-9**)* was prepared from 1-(Fluorosulfonyl)-1*H*-indol-5-yl fluorosulfate (**1-21**) and phenylboronic acid (**2-1**) by *method A* and isolated as a white solid (251 mg, 87% yield). mp 98-99 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 7.95 (d, *J* = 8.7 Hz, 1H), 7.81 (s, 1H), 7.65 (dd, *J* = 8.6, 1.5

Hz, 1H), 7.61 (d, $J$ = 7.4 Hz, 2H), 7.46 (dd, $J$ = 13.6, 5.6 Hz, 3H), 7.38 (t, $J$ = 7.4 Hz, 1H), 6.84 (d, $J$ = 3.5 Hz, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 140.83, 138.59, 134.27, 131.03, 129.05, 127.59, 126.81, 126.72, 125.54, 120.47 (d, $J$ = 6.0 Hz), 113.87, 111.37; $^{19}$F NMR (377 MHz, $CDCl_3$) δ = 53.96; GC-MS ($t_R$): 12.04 min; EI-MS (m/z): 275 $[M]^+$.

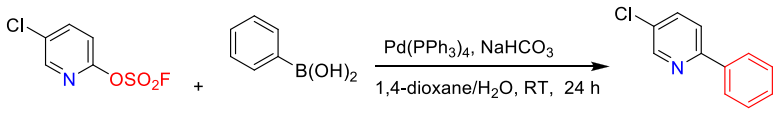



*Methyl 3-phenylthiophene-2-carboxylate* ***(4-10)*** [21] was prepared from 2-methoxycarbonyl-thiopen-3yl fluorosulfate (**1-18**) and phenylboronic acid (**2-1**) by *method A* and isolated as a yellow solid (214 mg, 98% yield). mp 120-122 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 7.49 (d, $J$ = 5.1 Hz, 1H), 7.48 – 7.43 (m, 2H), 7.43 – 7.34 (m, 3H), 7.08 (d, $J$ = 5.1 Hz, 1H), 3.77 (s, 3H).

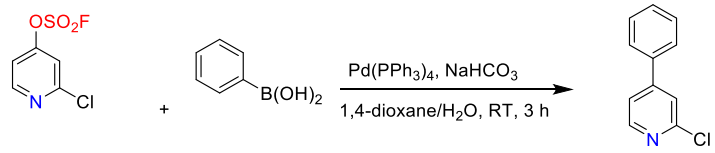



*4-Phenylbenzo[b]thiophene* ***(4-11)*** was prepared from Benzo[*b*]thiophen-4-yl fluorosulfate (**1-19**) and phenylboronic acid (**2-1**) by *method A* and isolated as a white solid (193 mg, 92% yield). mp 37-38 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 7.96 (d, $J$ = 7.7 Hz, 1H), 7.73 – 7.63 (m, 2H), 7.62 – 7.52 (m, 3H), 7.47 (m, 4H). GC-MS ($t_R$): 11.44 min; EI-MS (m/z): 210 $[M]^+$.

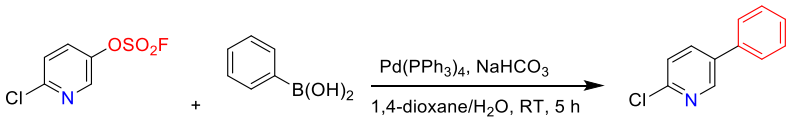
8. Selective Suzuki coupled product **6-1** ~ **6-3** in Figure 3A.




*5-Chloro-2-phenylpyridine* ***(6-1)*** [22] was prepared from 5-chloropyridin-2-yl fluorosulfate (**1-14**) and phenylboronic acid (**2-1**) by *method B* and isolated as a white solid (173 mg, 91% yield). mp 63-64 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.62 (d, $J$ = 2.0 Hz, 1H), 7.93 (d, $J$ = 7.3 Hz, 2H), 7.65 (dd, $J$ = 8.5, 2.4 Hz, 1H), 7.61 (d, $J$ = 8.4 Hz, 1H), 7.45 (t, $J$ = 7.3 Hz, 2H), 7.40 (t, $J$ = 7.2 Hz, 1H).

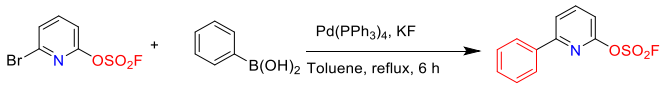


*2-Chloro-4-phenylpyridine (**6-2**)* [23] was prepared from 2-chloropyridin-4-yl fluorosulfate (**1-17**) and phenylboronic acid (**2-1**) by *method B* and isolated as a white solid (177 mg, 93% yield). mp 69-70 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.59 (d, *J* = 2.4 Hz, 1H), 7.82 (dd, *J* = 8.3, 2.6 Hz, 1H), 7.59 – 7.50 (m, 2H), 7.47 (t, *J* = 7.5 Hz, 2H), 7.42 (d, *J* = 7.2 Hz, 1H), 7.39 (dd, *J* = 7.9, 4.8 Hz, 1H).

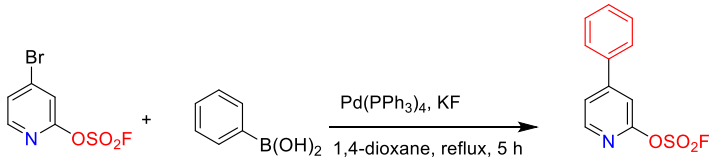



*2-Chloro-5-phenylpyridine (**6-3**)* [24] was prepared from 6-chloropyridin-3-yl fluorosulfate (**1-3**) and phenylboronic acid (**2-1**) by *method B* and isolated as a white solid (182 mg, 96% yield). mp 53-54 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.59 (d, *J* = 2.4 Hz, 1H), 7.82 (dd, *J* = 8.3, 2.6 Hz, 1H), 7.59 – 7.50 (m, 2H), 7.47 (t, *J* = 7.5 Hz, 2H), 7.41 (t, *J* = 7.3 Hz, 1H), 7.39 (t, *J* = 5.7 Hz, 1H).

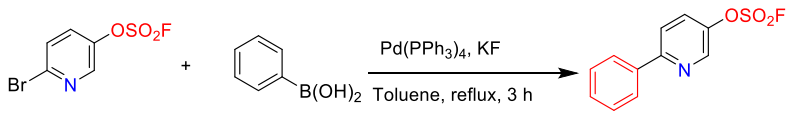
9. Selective Suzuki coupled product **7-1** ~ **7-5** in Figure 3B.



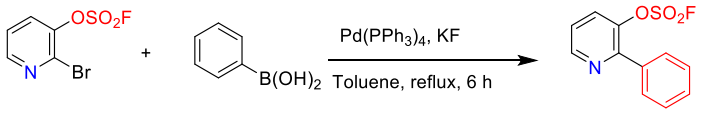

*6-Phenylpyridin-2-yl fluorosulfate (**7-1**)* was prepared from 6-bromopyridin-2-yl fluorosulfate (**1-15**) and phenylboronic acid (**2-1**) by *method C* and isolated as a yellow oil (216 mg, 85% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.04 (d, *J* = 7.3 Hz, 2H), 7.94 (t, *J* = 7.8 Hz, 1H), 7.82 (d, *J* = 7.7 Hz, 1H), 7.57 – 7.42 (m, 3H), 7.08 (d, *J* = 8.0 Hz, 1H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 156.98, 156.15, 141.87, 136.60, 130.34, 129.08, 127.08, 119.98, 111.62; $^{19}$F NMR (377 MHz, $CDCl_3$) δ = 44.60; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{11}H_9FNO_3S$, 254.0287; found 254.0284.



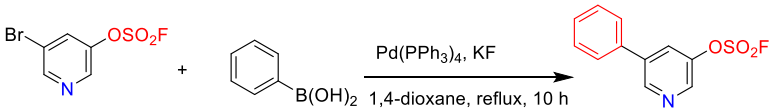

*4-Phenylpyridin-2-yl fluorosulfate (**7-2**)* was prepared from 4-bromopyridin-2-yl fluorosulfate (**1-16**) and phenylboronic acid (**2-1**) by *method C* and isolated as a yellow oil (209 mg, 83% yield). $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.44 (d, *J* = 5.2 Hz, 1H), 7.68 – 7.62 (m, 2H), 7.61 (dd, *J* = 5.2, 0.7 Hz, 1H), 7.53 (dt, *J* = 10.8, 3.9 Hz, 3H), 7.37 (s, 1H); $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 157.27, 154.51, 148.88, 136.35, 130.37, 129.59, 127.25, 122.44, 111.78 (d, *J* = 2.6 Hz); $^{19}$F NMR (377 MHz, $CDCl_3$) δ = 44.03; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{11}H_9FNO_3S$, 254.0287; found 254.0258.




*6-Phenylpyridin-3-yl fluorosulfate (**7-3**)* was prepared from 6-bromopyridin-3-yl fluorosulfate (**1-4**) and phenylboronic acid (**2-1**) by *method C* and isolated as a yellow oil (231 mg, 91% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.72 (d, *J* = 2.8 Hz, 1H), 8.06 – 7.94 (m, 2H), 7.85 (dd, *J* = 8.8, 0.6 Hz, 1H), 7.76 (ddd, *J* = 8.8, 2.8, 0.7 Hz, 1H), 7.57 – 7.40 (m, 3H); $^{13}$C NMR (126 MHz, $CDCl_3$) δ = 157.82, 146.05, 142.23, 137.49, 129.93, 129.31, 129.01, 127.17, 121.43； $^{19}$F NMR (377 MHz, $CDCl_3$) δ = 37.86; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{11}H_9FNO_3S$, 254.0287; found 254.0296.

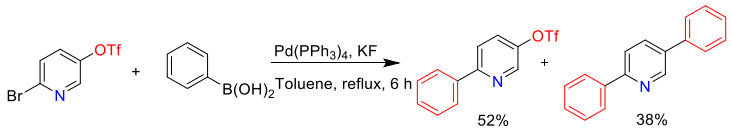



*2-Phenylpyridin-3-yl fluorosulfate (**7-4**)* was prepared from 2-bromopyridin-3-yl fluorosulfate (**1-5**) and phenylboronic acid (**2-1**) by *method C* and isolated as a yellow oil (218 mg, 86% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.75 (d, *J* = 4.6 Hz, 1H), 7.87 – 7.74 (m, 3H), 7.58 – 7.44 (m, 3H), 7.39 (dd, *J* = 8.3, 4.6 Hz, 1H); $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 151.97, 149.73, 144.86, 135.08, 130.11, 129.92, 129.10, 128.81, 123.63; $^{19}$F NMR (377 MHz, $CDCl_3$) δ = 40.73; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{11}H_9FNO_3S$, 254.0287; found 254.0296.




*5-Phenylpyridin-3-yl fluorosulfate (**7-5**)* was prepared from 5-bromopyridin-3-yl fluorosulfate (**1-6**) and phenylboronic acid (**2-1**) by *method C* and isolated as a yellow oil (209 mg, 82% yield). $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.91 (s, 1H), 8.65 (s, 1H), 7.87 (s, 1H), 7.59 (d, *J* = 7.8 Hz, 2H), 7.53 (t, *J* = 7.4 Hz, 2H), 7.50 – 7.44 (m, 1H); $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 148.30, 147.35, 140.81, 138.88, 135.45, 129.52, 129.36, 127.40, 126.82; $^{19}$F NMR (377 MHz, $CDCl_3$) δ = 38.23; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{11}H_9FNO_3S$, 254.0287; found 254.0299.

10. Suzuki coupled product **9** and **10** in Figure 3C.

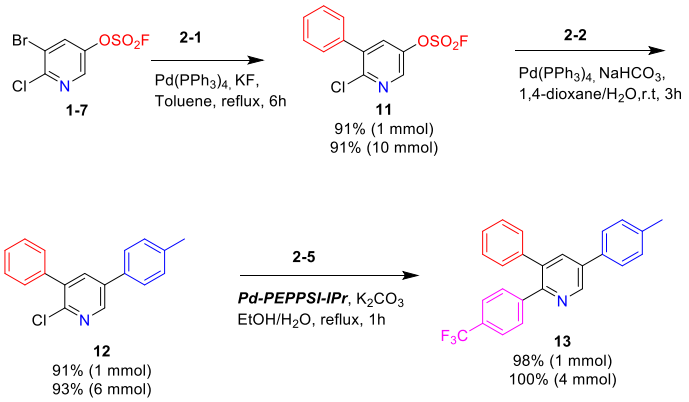



*6-Phenylpyridin-3-yl triflate (**9**)* and *2,5-diphenylpyridine (**10**)* was prepared from 6-bromopyridin-3-yl fluorosulfate (**8**) and phenylboronic acid (**2-1**) by *method C* and isolated as a white solid (161 mg, 52% yield) and a white solid (87 mg, 38% yield).

*6-Phenylpyridin-3-yl triflate (**9**)*:[25] mp 94-95 °C. $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.64 (d, *J* = 2.7 Hz, 1H), 7.97 (d, *J* = 6.9 Hz, 2H), 7.79 (d, *J* = 8.8 Hz, 1H), 7.66 (dd, *J* = 8.8, 2.8 Hz, 1H), 7.53 – 7.41 (m, 3H); $^{19}$F NMR (377 MHz, $CDCl_3$) δ = -72.96.

*2,5-Diphenylpyridine (**10**)*:[3] mp 165-167 °C. $^{1}$H NMR (400 MHz, $CDCl_3$) δ = 8.94 (s, 1H), 8.05 (d, *J* = 7.8 Hz, 2H), 7.95 (d, *J* = 8.2 Hz, 1H), 7.81 (d, *J* = 8.2 Hz, 1H), 7.64 (d, *J* =7.7 Hz, 2H), 7.50 (t, *J* = 7.3 Hz, 4H), 7.42 (dd, *J* = 13.7, 6.6 Hz, 2H).

11. Preparation of tri-substituted pyridine **13** in Figure 4A.



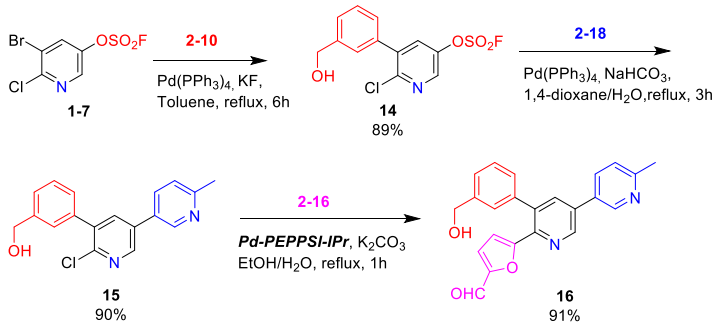

*6-Chloro-5-phenylpyridin-3-yl fluorosulfate (**11**)* was prepared from 5-bromo-6-chloropyridin-3-yl fluorosulfate (**1-7**) and phenylboronic acid (**2-1**) by *method C* and isolated as a yellow oil (263 mg, 91% yield; 10 mmol-scale: 2.60 g, 91%). $^{1}$H NMR (400 MHz, $CDCl_3$) δ = 8.46 (d, *J* = 2.7 Hz, 1H), 7.71 (d, *J* = 2.7 Hz, 1H), 7.57 – 7.36 (m, 5H); $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 149.34, 145.89, 140.61, 138.93, 135.48, 132.03, 129.31, 129.18, 128.71; $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 38.37; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{11}H_8ClFNO_3S$, 287.9897; found 287.9880.

*2-Chloro-3-phenyl-5-p-tolylpyridine (**12**)* was prepared from 6-chloro-5-phenylpyridin-3-yl fluorosulfate (**11**) and *p*-tolylboronic acid (**2-2**) by *method B* and isolated as a white solid (254 mg, 91% yield; 6 mmol-scale: 1.55 g, 93%). mp 100-101 °C. $^{1}$H NMR (500 MHz, $CDCl_3$) δ = 8.59 (d, *J* = 2.4 Hz, 1H), 7.84 (d, *J* = 2.4 Hz, 1H), 7.53 – 7.41 (m, 7H), 7.29 (d, *J* = 7.9 Hz, 2H), 2.41 (s, 3H); $^{13}$C NMR (101 MHz, $CDCl_3$) δ

= 147.86, 146.04, 138.32, 137.55, 137.27, 136.41, 135.60, 133.07, 129.76, 129.16, 128.19, 126.67, 21.03; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{18}H_{15}ClN$, 280.0893; found 280.0879.

*3-Phenyl-5-p-tolyl-2-(4-(trifluoromethyl)phenyl)pyridine* ***(13)*** was prepared from 2-Chloro-3-phenyl-5-p-tolylpyridine (**12**) and 4-(trifluoromethyl)phenylboronic acid (**2-5**) by *method A* and isolated as a white solid (382 mg, 98% yield, 4 mmol-scale: 1.56 g, 100%). mp 54-55 °C. $^1$H NMR (400 MHz, $CDCl_3$) δ = 8.92 (s, 1H), 7.89 (s, 1H), 7.56 – 7.45 (m, 6H), 7.27 (m, 5H), 7.20 (d, *J* = 2.8 Hz, 2H); $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 153.88, 146.78, 143.56, 139.41, 138.43, 136.76, 136.28, 135.61, 134.15, 130.30, 129.97, 129.58, 128.66, 127.71, 127.00, 125.61, 124.88, 124.84, 122.91, 21.20; $^{19}$F NMR (377 MHz, $CDCl_3$) δ = -63.07; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{25}H_{19}F_3N$, 390.1470; found 390.1460.

12. Preparation of tri-substituted pyridine **16** in Figure 4B.



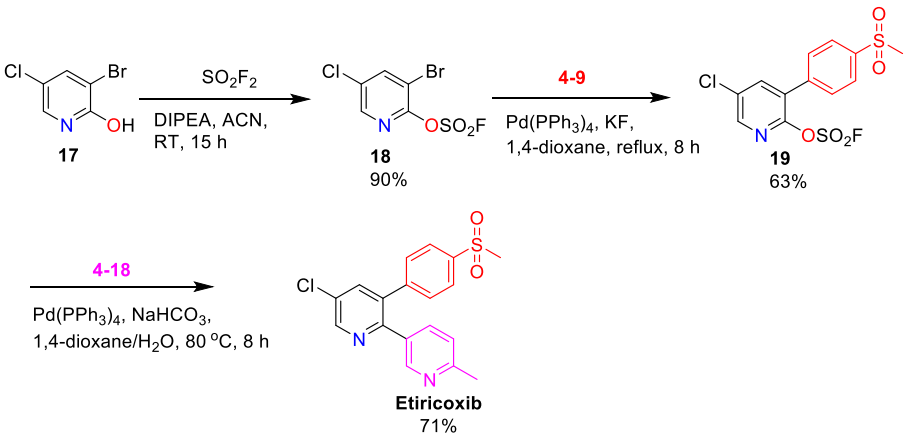

*6-Chloro-5-(3-(hydroxymethyl)phenyl)pyridin-3-yl fluorosulfate* ***(14)*** was prepared from 5-bromo-6-chloropyridin-3-yl fluorosulfate (**1-7**) and 3-(hydroxymethyl)phenylboronic acid (**2-10**) by *method C* with 1.05 equiv. **2-10** and isolated as a light yellow solid (282 mg, 89% yield). mp 54-55 °C. $^1$H NMR (500 MHz, $CDCl_3$) δ = 8.46 (d, *J* = 2.7 Hz, 1H), 7.71 (d, *J* = 2.8 Hz, 1H), 7.49 (dd, *J* = 13.9, 7.5 Hz, 3H), 7.44 – 7.36 (m, 1H), 4.79 (s, 2H), 2.14 (s, 1H); $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 149.08, 145.79, 141.68, 140.48, 138.78, 135.43, 132.11, 128.70, 128.10, 127.60, 127.37, 64.24; $^{19}$F NMR (282 MHz, $CDCl_3$) δ = 38.52; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{12}H_{10}ClFNO_4S$, 318.0003; found 317.9986.

*(3-(6-Chloro-6'-methyl-3,3'-bipyridin-5-yl)phenyl)methanol* ***(15)*** was prepared from 6-chloro-5-(3-(hydroxymethyl)phenyl)pyridin-3-yl fluorosulfate (**14**) and 6-methylpyridin-3-ylboronic acid (**2-18**) by *method B* at refluxing temperature and isolated as a white solid (279 mg, 90% yield). mp124-127 °C. $^1$H NMR (500 MHz, $CD_3OD$) δ = 8.75 (d, *J* = 2.0 Hz, 1H), 8.65 (d, *J* = 2.5 Hz, 1H), 8.07 (dd, *J* = 7.3, 2.4 Hz, 2H), 7.52 (s, 1H), 7.50 – 7.40 (m, 4H), 4.69 (s, 2H), 2.59 (s, 3H); $^{13}$C NMR (101 MHz, $CD_3OD$) δ = 159.58, 147.57, 147.19, 143.28, 139.56, 138.70, 138.46, 137.20, 134.18 , 131.05, 129.52,

129.34, 128.90, 128.14, 125.39, 64.88, 23.53; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{18}H_{16}ClN_2O$, 311.0951; found 311.0936.

*5-(5-(3-(Hydroxymethyl)phenyl)-6'-methyl-3,3'-bipyridin-6-yl)furan-2-carbaldehyde* (***16***) was prepared from (3-(6-chloro-6'-methyl-3,3'-bipyridin-5-yl)phenyl)methanol (**15**) and 5-formylfuran-2-ylboronic acid (**2-16**) by *method A* and isolated as a white solid (338 mg, 91% yield). mp151-152 $^oC$. $^1H$ NMR (500 MHz, $CDCl_3$) δ = 9.54 (s, 1H), 8.92 (d, *J* = 2.2 Hz, 1H), 8.77 (d, *J* = 2.0 Hz, 1H), 7.85 (dt, *J* = 4.3, 2.3 Hz, 2H), 7.52 – 7.42 (m, 3H), 7.30 (d, *J* = 8.0 Hz, 0H), 7.23 (d, *J* = 7.3 Hz, 0H), 7.15 (d, *J* = 3.7 Hz, 1H), 6.56 (d, *J* = 3.6 Hz, 1H), 4.78 (s, 2H), 2.83 (s, 1H), 2.63 (s, 3H); $^{13}C$ NMR (101 MHz, $CDCl_3$) δ = 178.23, 158.80, 157.08, 152.33, 147.14, 146.72, 144.47, 142.05, 138.49, 136.89, 136.66, 134.80, 132.85, 129.49, 128.79, 127.85, 127.72, 127.08, 123.72, 121.05, 114.22, 64.66, 24.17; HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{23}H_{19}N_2O_3$, 371.1396; found 371.1379.

13. Preparation of Etoricoxib in Scheme 2B.




*3-Bromo-5-chloropyridin-2-yl fluorosulfate* (**18**) was prepared from 0.76 g 3-bromo-5-chloropyridin-2-ol by *General procedure for Preparation of heteroaryl fluorosulfates **1** with DIPEA in ACN* and isolated as a white solid (0.95 g, 90% yield). mp 29-30 $^0C$. $^1H$ NMR (400 MHz, $CDCl_3$) δ = 8.29 (d, *J* = 2.3 Hz, 1H), 8.10 (d, *J* = 2.3 Hz, 1H); $^{13}C$ NMR (101 MHz, $CDCl_3$) δ = 151.36, 145.42, 143.69, 132.52, 110.26 (d, *J* = 3.3 Hz); $^{19}F$ NMR (377 MHz, $CDCl_3$) δ = 46.62; GC-MS ($t_R$): 8.30 min; EI-MS (m/z): 289 $[M]^+$.

*5-chloro-3-(4-(methylsulfonyl)phenyl)pyridin-2-yl fluorosulfate* (**19**) was prepared from 290 mg 3-Bromo-5-chloropyridin-2-yl fluorosulfate (**18**) and 4-(methylsulfonyl)phenylboronic acid (**2-9**) by *method C* with 1.5 equiv. **2-9** and 5 equiv. KF, and isolated as a white solid (230 mg, 63% yield). mp141-143 $^0C$. $^1H$ NMR (400 MHz, $CDCl_3$) δ = 8.40 (d, *J* = 2.3 Hz, 1H), 8.10 (d, *J* = 8.3 Hz, 2H), 7.94 (d, *J* = 2.3 Hz, 1H), 7.70 (d, *J* = 8.3 Hz, 2H), 3.14 (s, 3H); $^{13}C$ NMR (101 MHz, $CDCl_3$) δ = 151.05, 146.59, 141.58, 141.16, 137.70, 132.64, 130.10, 128.26, 127.47 (d, *J* = 2.3 Hz), 44.52; $^{19}F$ NMR (377 MHz, $CDCl_3$) δ = 46.93; HRMS (ESI-TOF) (m/z):

$[M + H]^+$ calcd for $C_{12}H_{10}ClFNO_5S_2$, 365.9673; found 365.9667.

*5-chloro-6'-methyl-3-(4-(methylsulfonyl)phenyl)-2,3'-bipyridine*[26] (**Etoricoxib**) was prepared from 183 mg 5-chloro-3-(4-(methylsulfonyl)phenyl)pyridin-2-yl fluorosulfate (**19**) and 6-methylpyridin-3-ylboronic acid (**2-18**) by *method B* with 1.5 equiv. **2-18** at 80 $^oC$ and isolated as a white solid (127 mg, 71% yield). mp132-134 $^0C$. $^1H$ NMR (400 MHz, $CDCl_3$) δ = 8.72 (d, *J* = 2.2 Hz, 1H), 8.39 (s, 1H), 7.91 (d, *J* = 8.3 Hz, 2H), 7.74 (d, *J* = 2.2 Hz, 1H), 7.57 (d, *J* = 8.0 Hz, 1H), 7.41 (d, *J* = 8.3 Hz, 2H), 7.10 (d, *J* = 8.1 Hz, 1H), 3.09 (s, 3H), 2.55 (s, 3H); HRMS (ESI-TOF) (m/z): $[M + H]^+$ calcd for $C_{18}H_{16}ClN_2O_2S$, 359.0621; found 359.0622.

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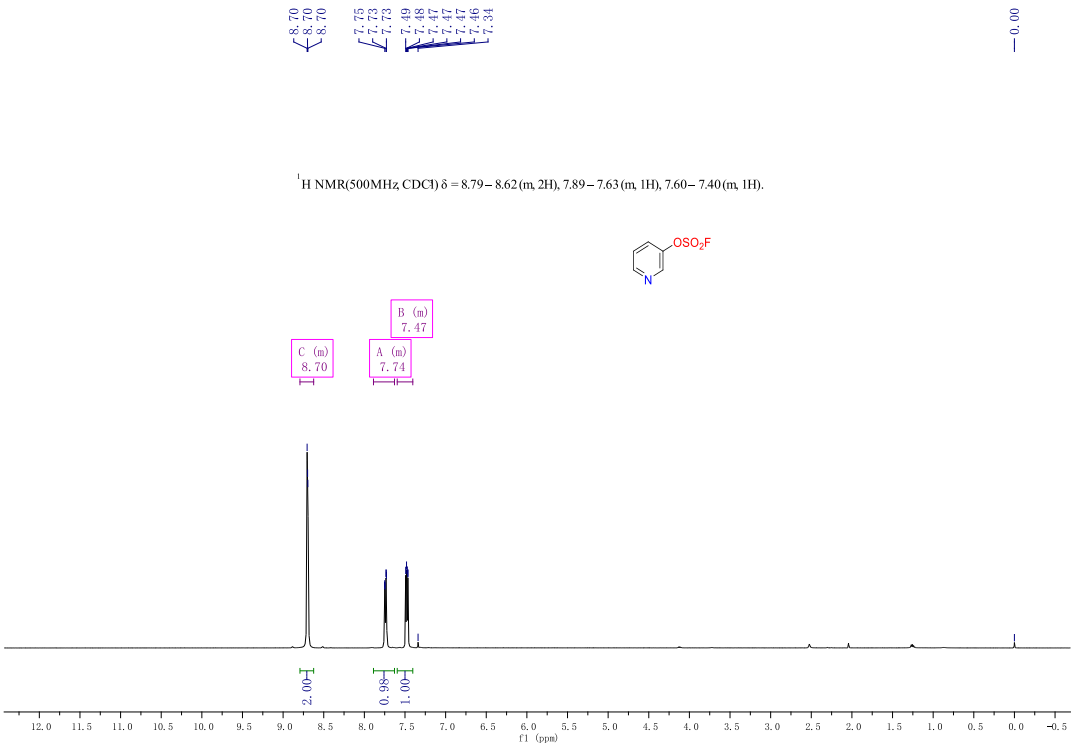
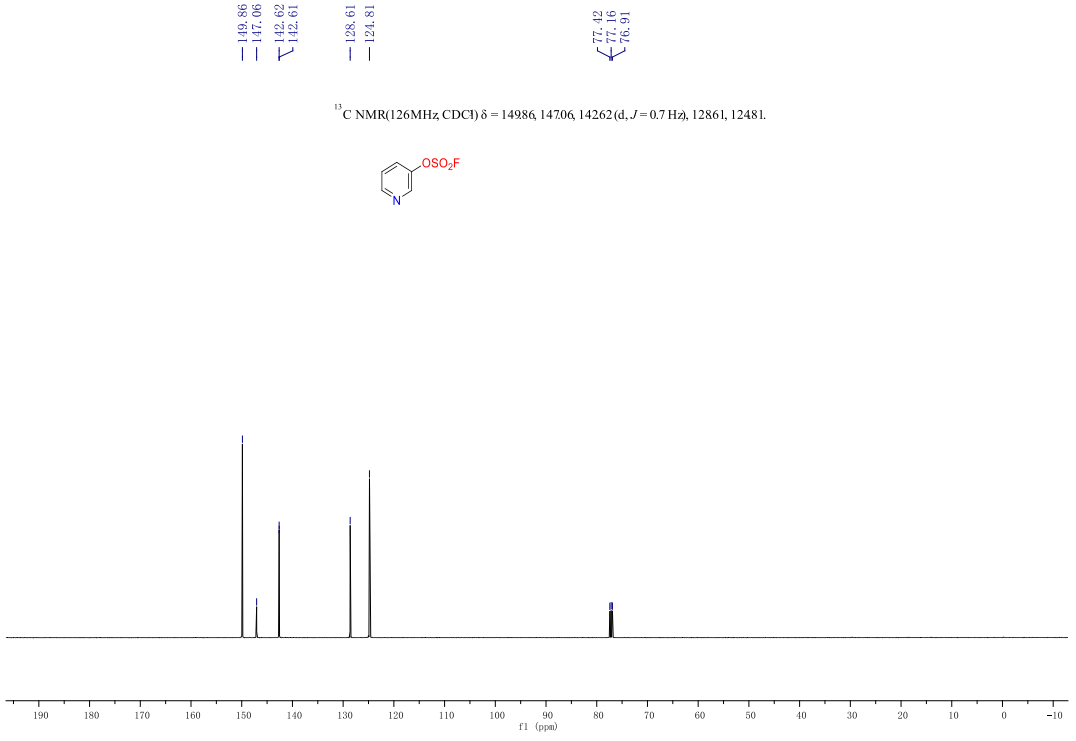
14. Copies of $^{1}H$, $^{13}C$ NMR and $^{19}F$ NMR Spectra for the compounds **1** ~ **19** and **Etoricoxib.**

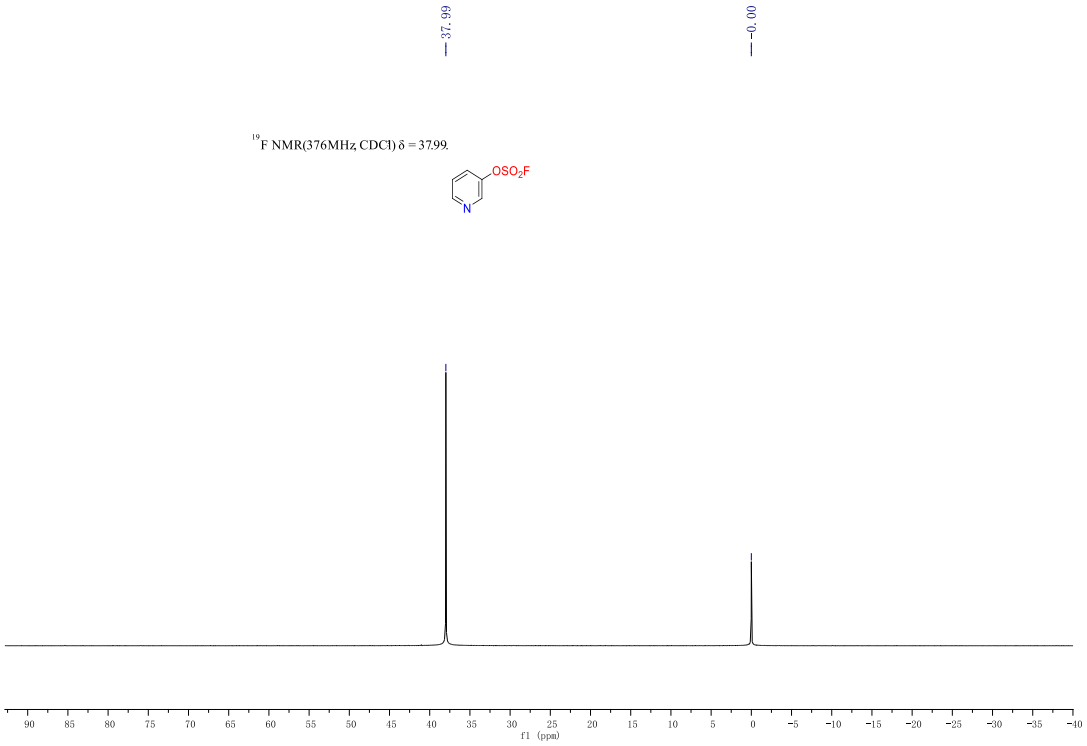
Compound **1-1**. *Pyridin-3-yl fluorosulfate*



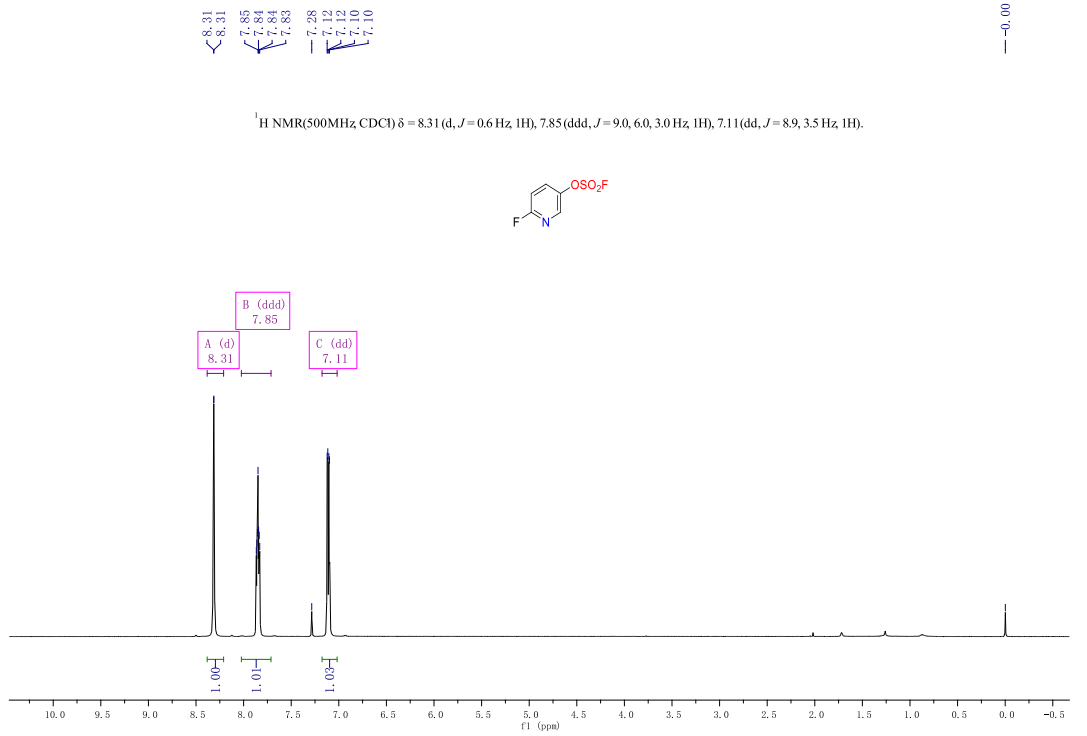

$^{1}H$ NMR(500MHz, CDCl) δ = 8.79 – 8.62 (m, 2H), 7.89 – 7.63 (m, 1H), 7.60 – 7.40 (m, 1H).

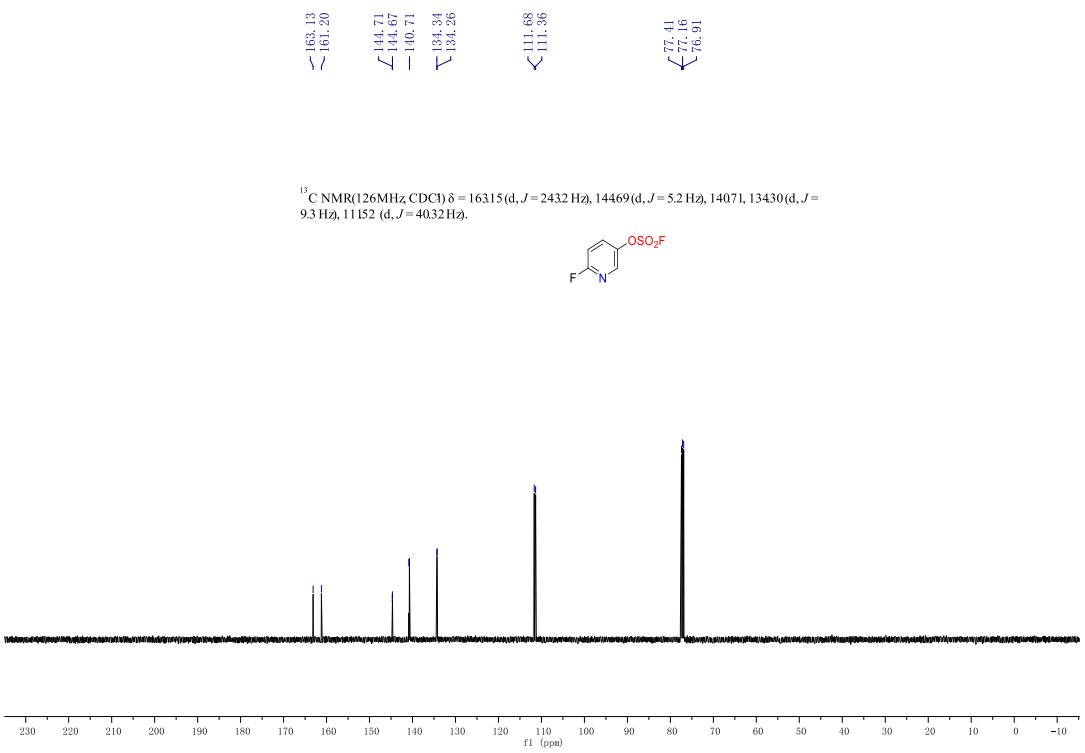



$^{13}C$ NMR(126MHz, CDCl) δ = 149.86, 147.06, 142.62 (d, *J* = 0.7 Hz), 128.61, 124.81.

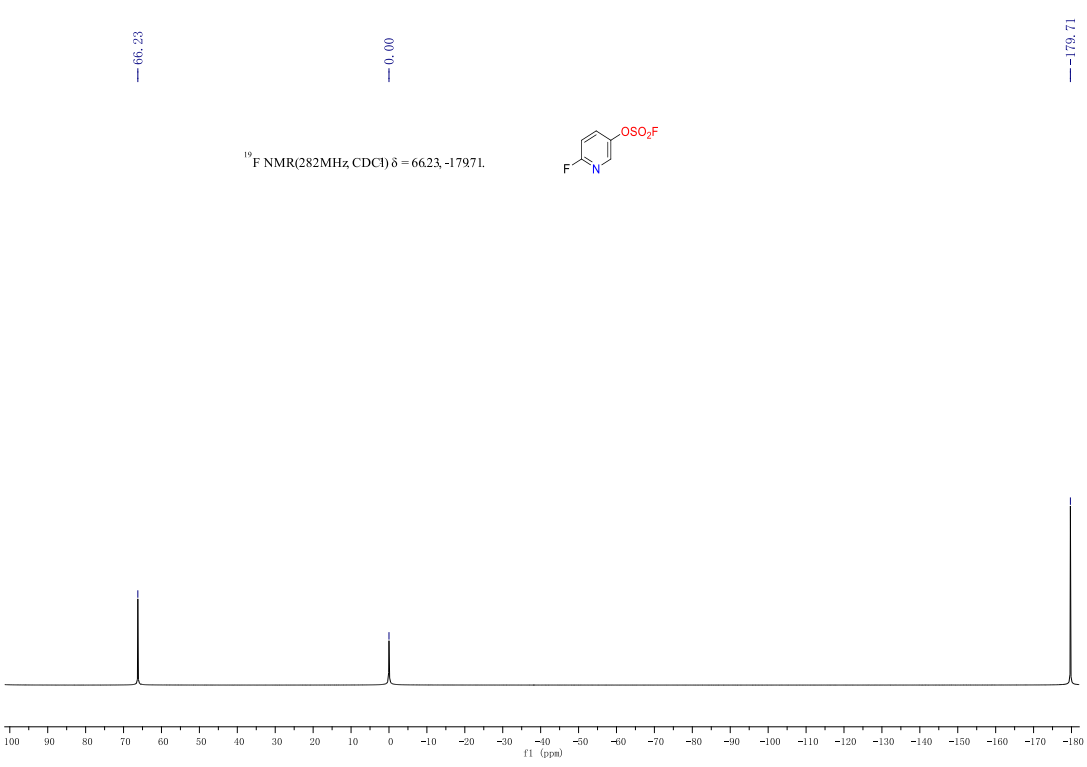



Compound **1-2**. *6-Fluoropyridin-3-yl fluorosulfate*



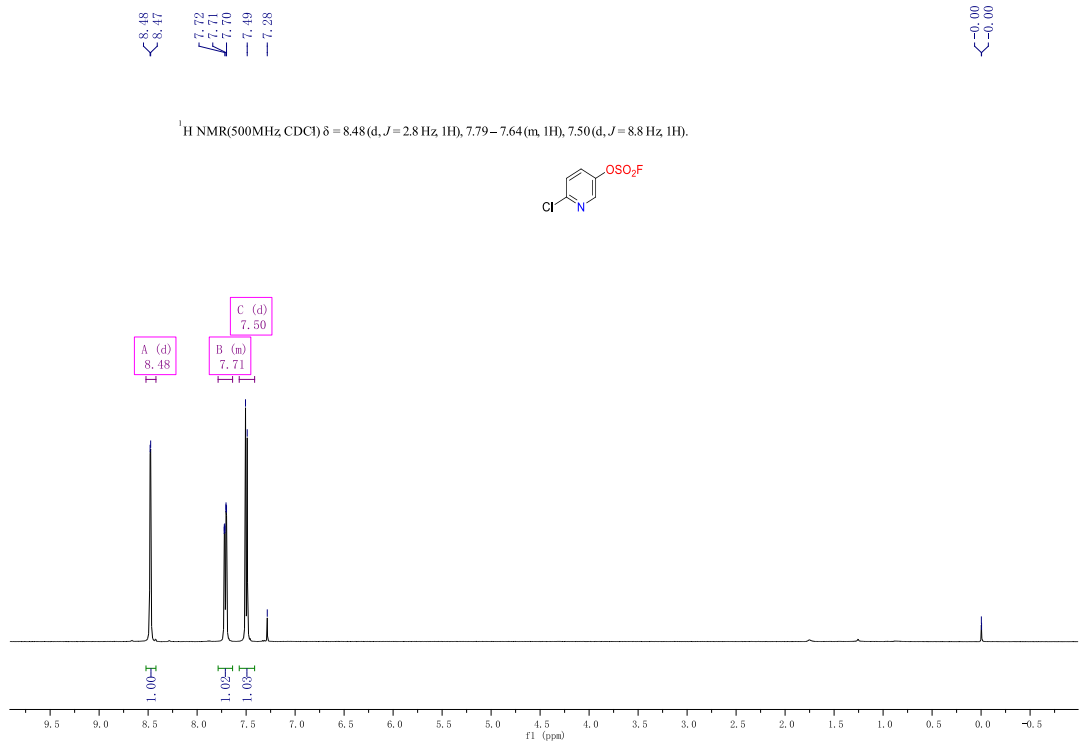



$^{13}$C NMR(126MHz, CDCl) δ = 163.15 (d, *J* = 243.2 Hz), 144.69 (d, *J* = 5.2 Hz), 140.71, 134.30 (d, *J* = 9.3 Hz), 111.52 (d, *J* = 40.32 Hz).

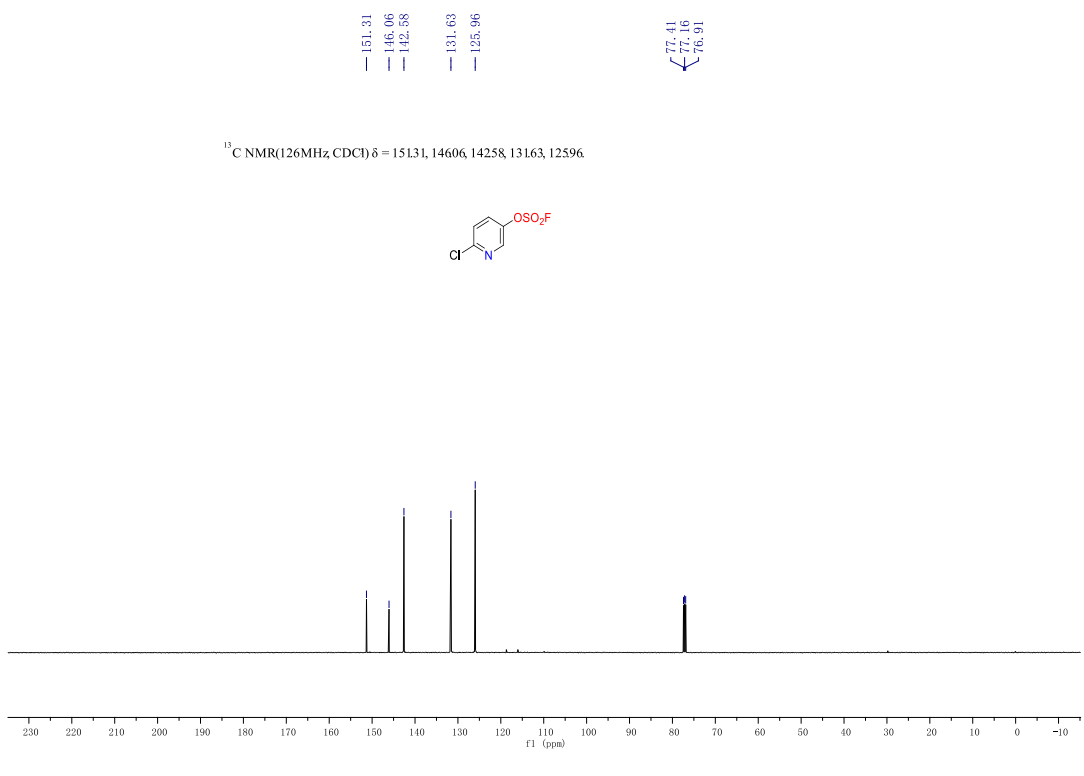



$^{19}$F NMR(282MHz, CDCl) δ = 66.23, -179.71.

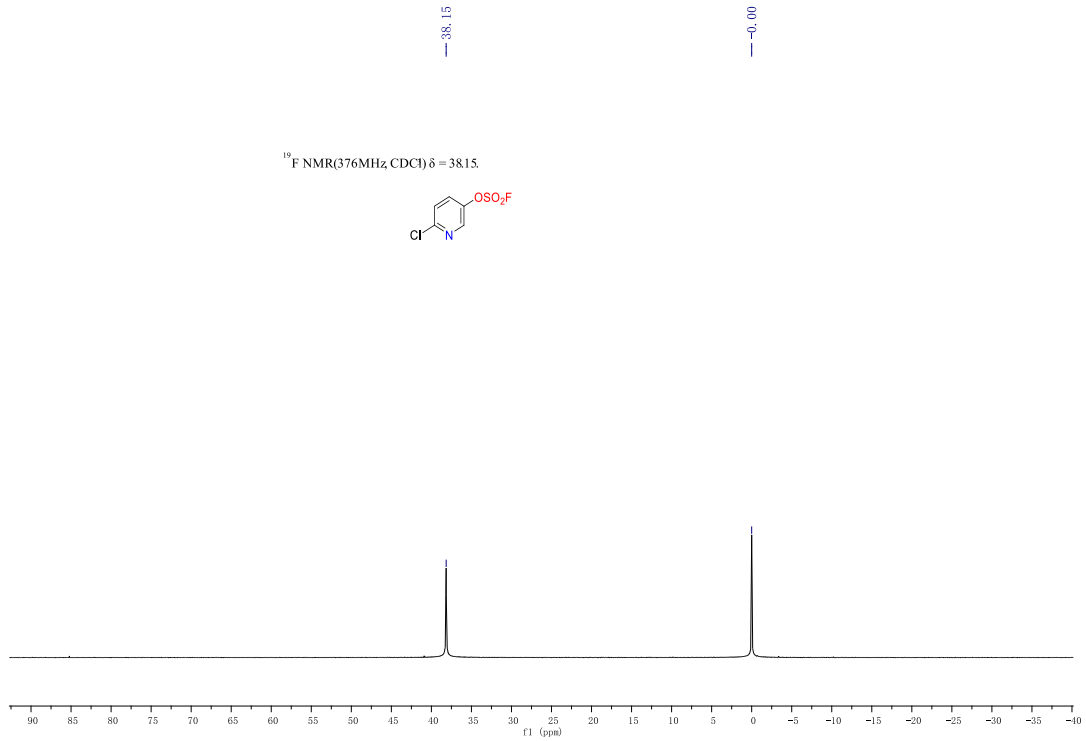
Compound **1-3**. *6-Chloropyridin-3-yl fluorosulfate*



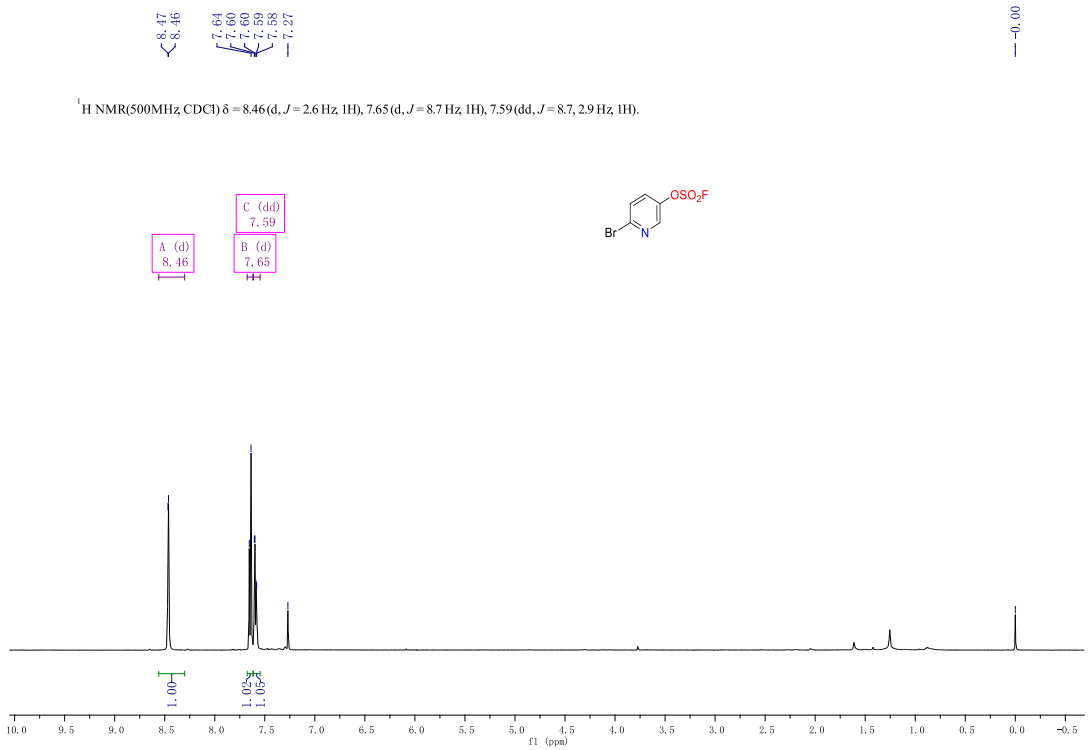

$^{1}$H NMR(500MHz, CDCl) δ = 8.48 (d, *J* = 2.8 Hz, 1H), 7.79 – 7.64 (m, 1H), 7.50 (d, *J* = 8.8 Hz, 1H).



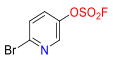

$^{13}$C NMR(126MHz, CDCl) δ = 151.31, 146.06, 142.58, 131.63, 125.96.

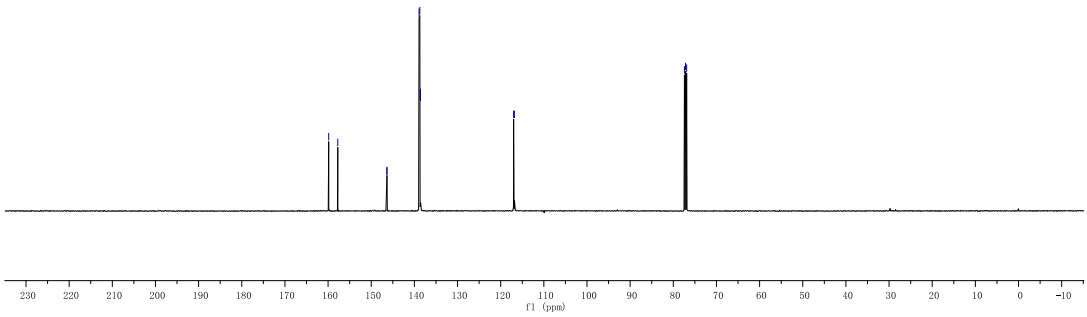



Compound **1-4**. *6-Bromopyridin-3-yl fluorosulfate*



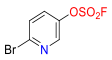

$^{13}$C NMR(126MHz, CDCl) δ = 159.86, 157.75, 146.37 (d, $J$ = 4.5 Hz), 138.92 – 138.48 (m), 116.92 (d, $J$ = 21.42 Hz).

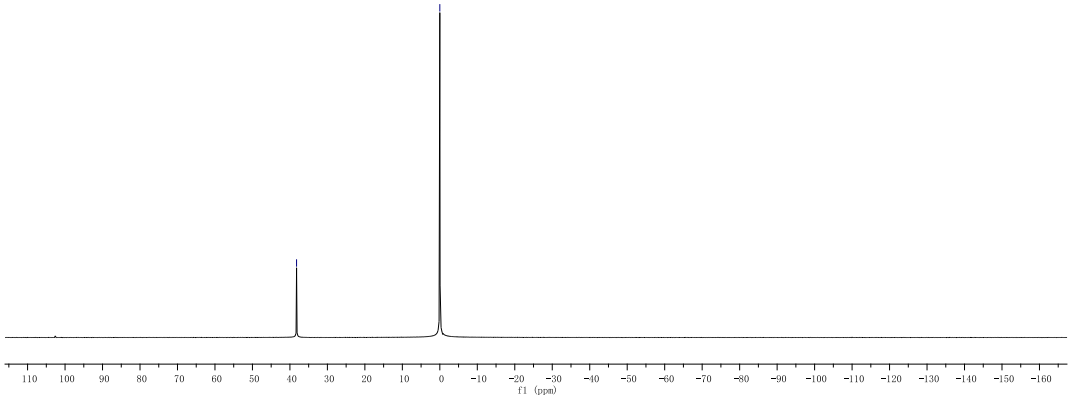


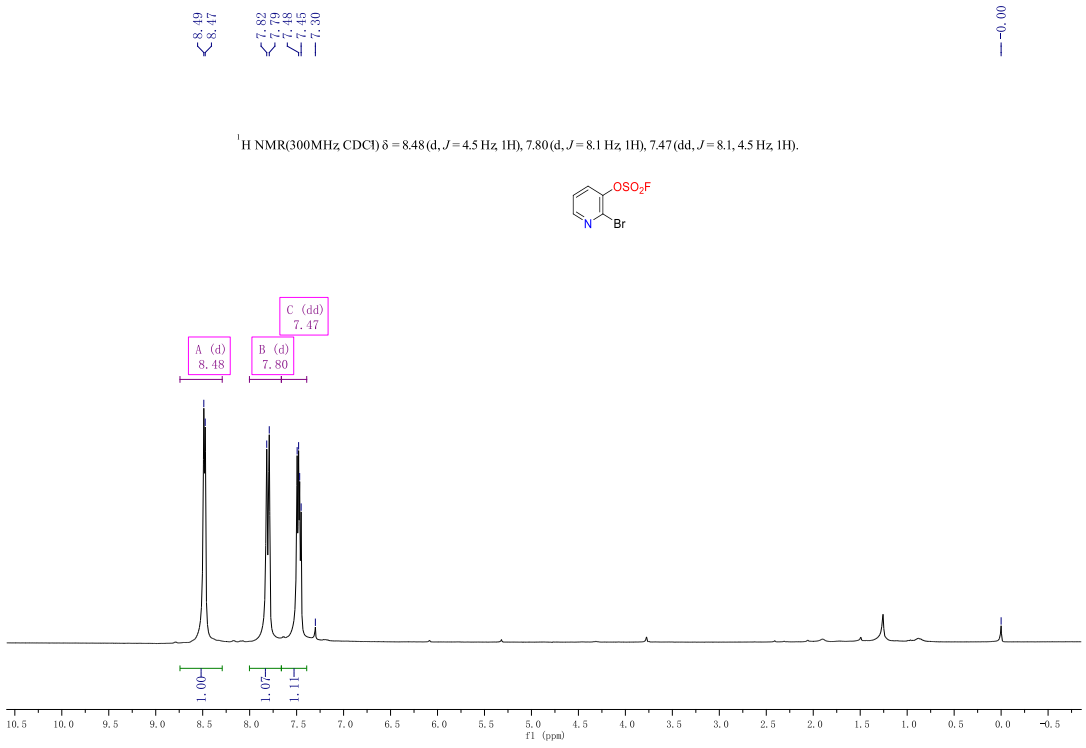


$^{19}$F NMR(282MHz, CDCl) δ = 38.23.

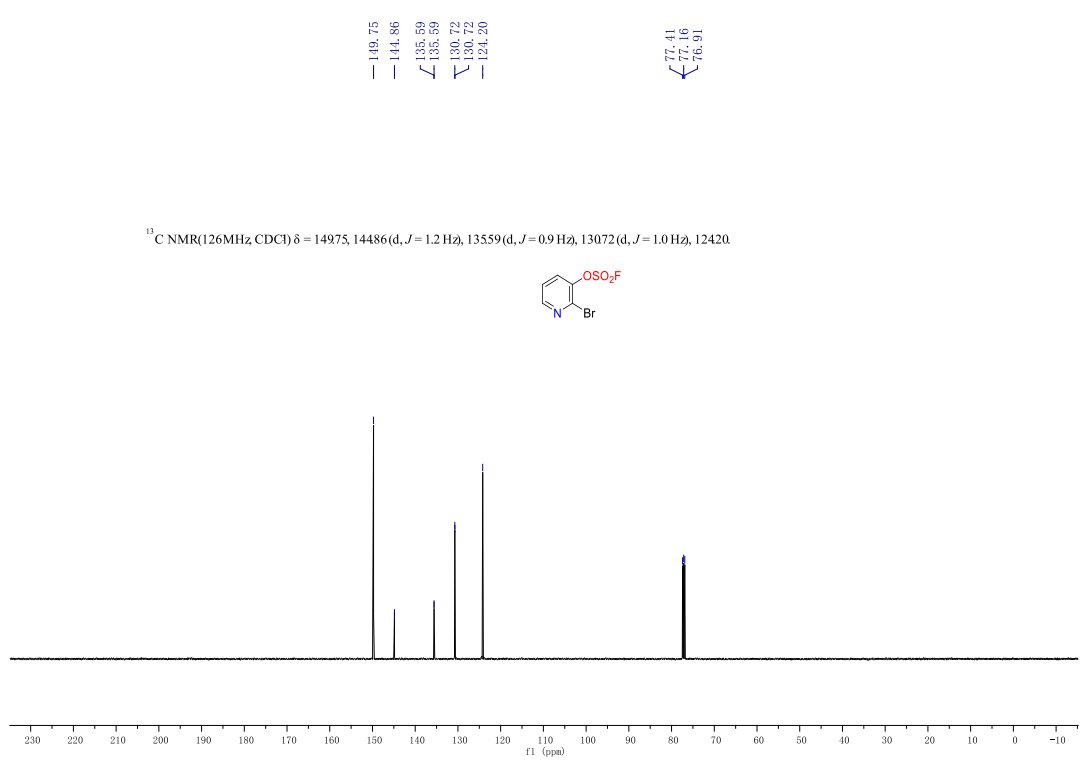


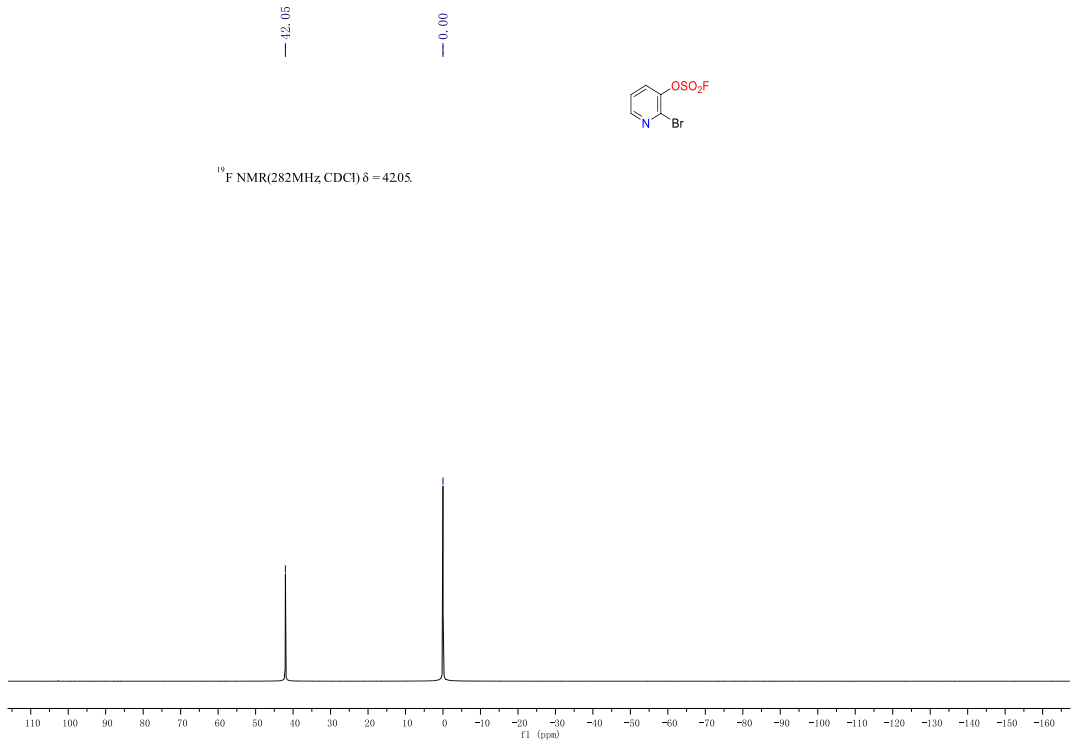
Compound **1-5**. *2-Bromopyridin-3-yl fluorosulfate*



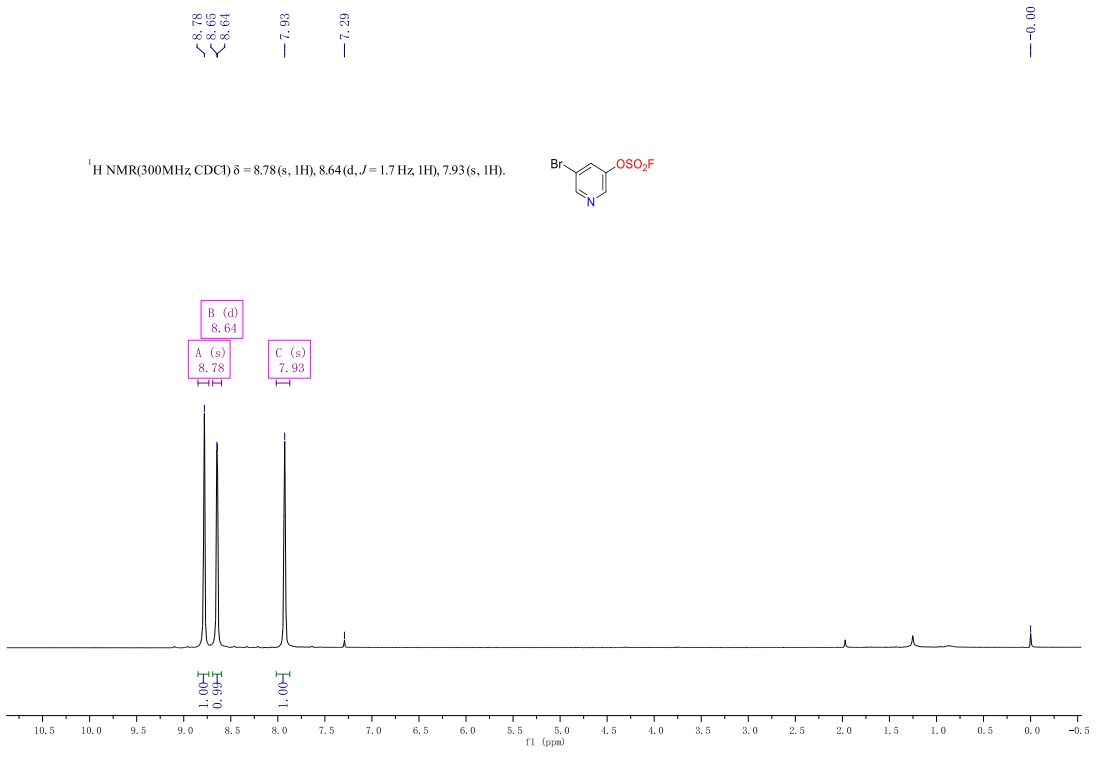

$^{1}$H NMR(300MHz, CDCl) δ = 8.48 (d, *J* = 4.5 Hz, 1H), 7.80 (d, *J* = 8.1 Hz, 1H), 7.47 (dd, *J* = 8.1, 4.5 Hz, 1H).



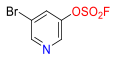

$^{13}$C NMR(126MHz, CDCl) δ = 149.75, 144.86 (d, *J* = 1.2 Hz), 135.59 (d, *J* = 0.9 Hz), 130.72 (d, *J* = 1.0 Hz), 124.20.

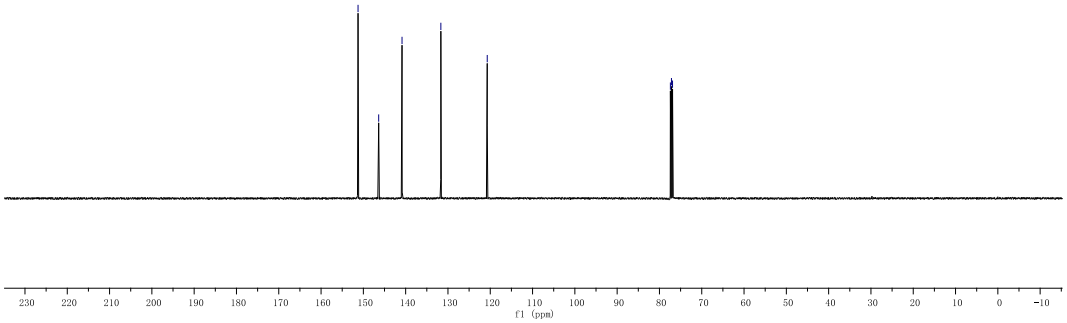



Compound **1-6**. *5-Bromopyridin-3-yl fluorosulfate*



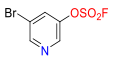

$^{13}$C NMR(126MHz, CDCl) δ = 151.26, 146.38, 140.86, 131.68, 120.71.



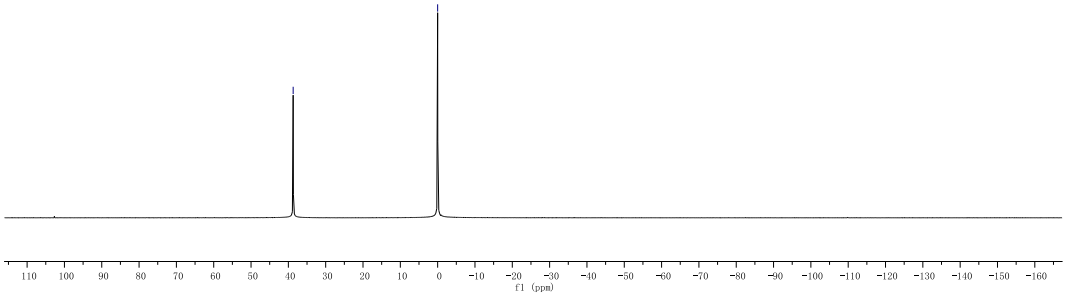





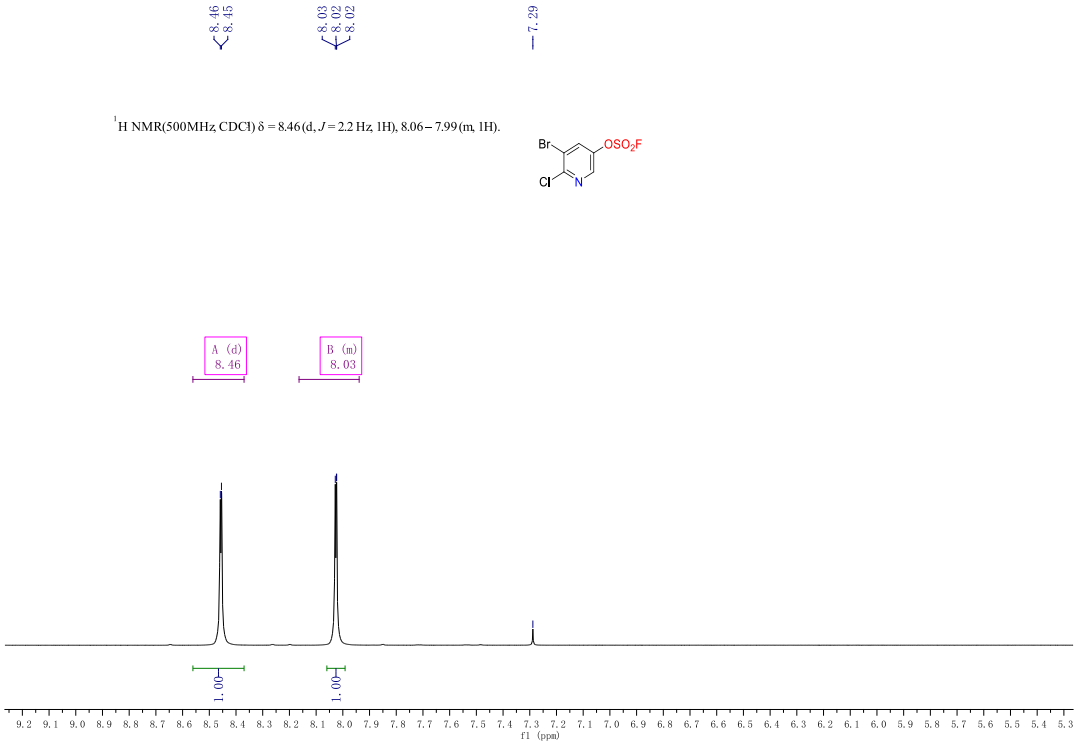





$^{19}$F NMR(282MHz, CDCl) δ = 38.71.

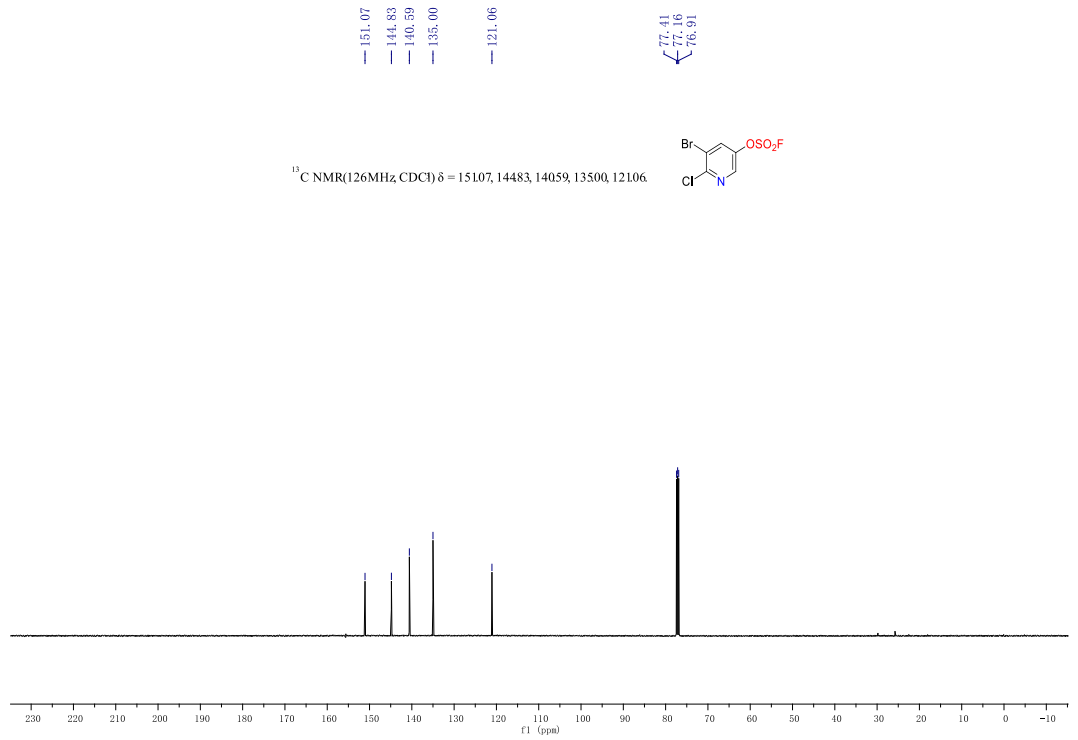


Compound **1-7**. *5-Bromo-6-chloropyridin-3-yl fluorosulfate*

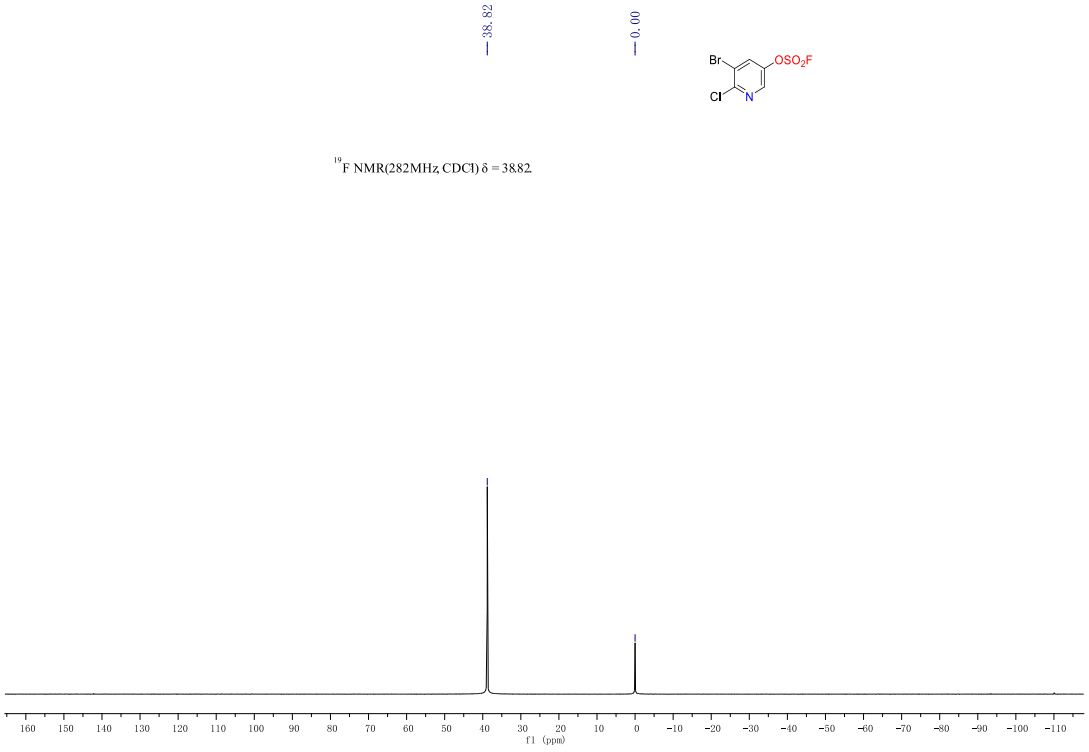



$^{1}$H NMR(500MHz, CDCl) δ = 8.46 (d, *J* = 2.2 Hz, 1H), 8.06 – 7.99 (m, 1H).

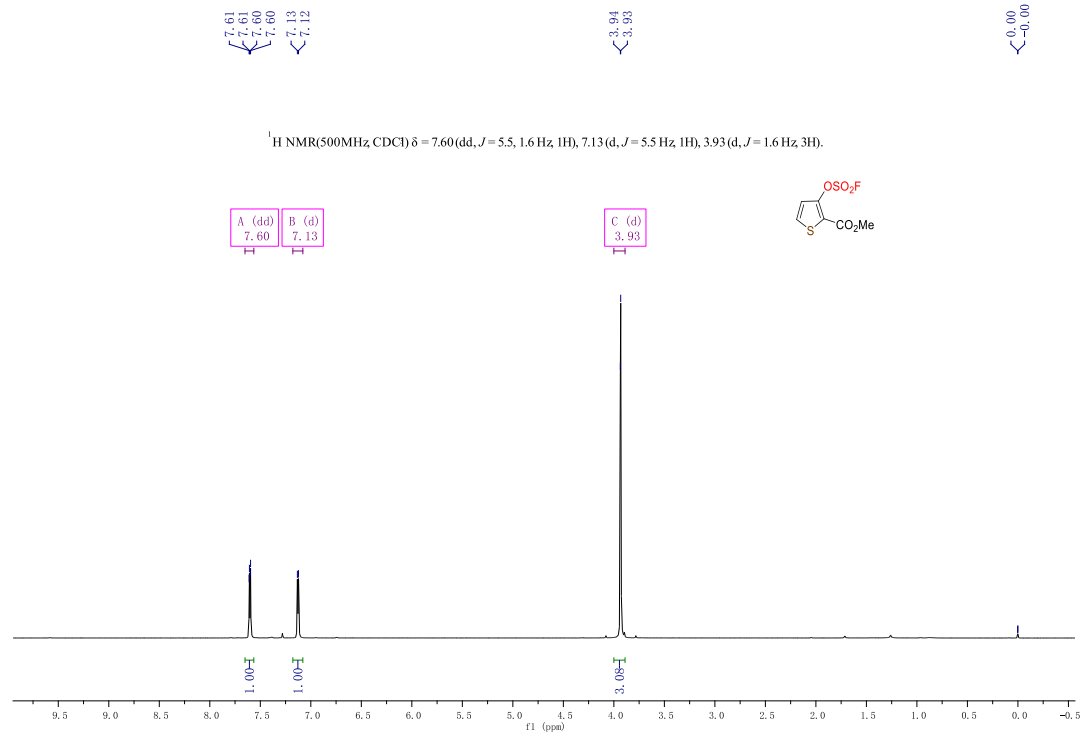



$^{13}$C NMR(126MHz, CDCl) δ = 151.07, 144.83, 140.59, 135.00, 121.06.

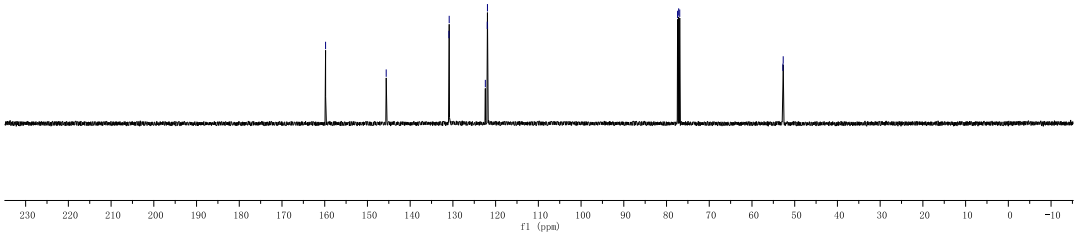



Compound **1-18**. *2-Methoxycarbonyl-thiopen-3-yl fluorosulfate*



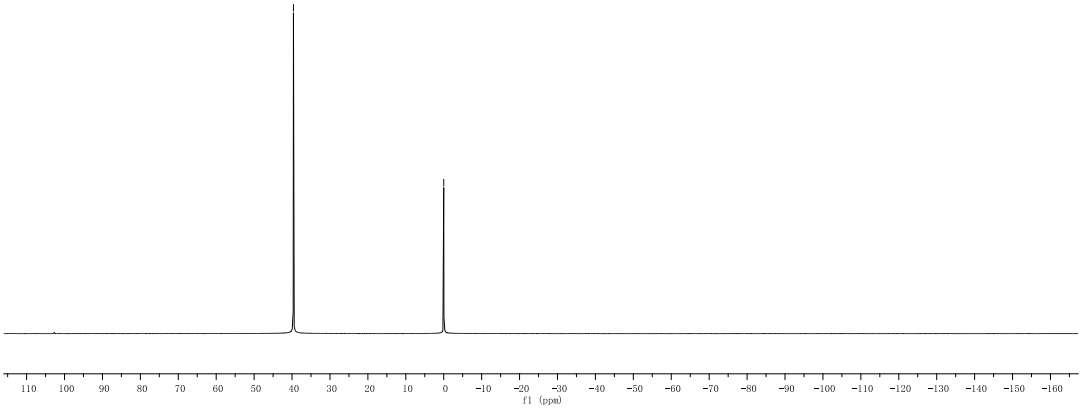
159.80
145.61
130.92
130.87
122.41
121.95
121.91
77.41
77.16
76.91
52.77
52.69

$^{13}$C NMR(126MHz, CDCl) δ = 159.80, 145.61, 130.90 (d, $J$ = 7.4 Hz), 122.41, 121.93 (d, $J$ = 5.5 Hz), 52.73 (d, $J$ = 9.5 Hz).

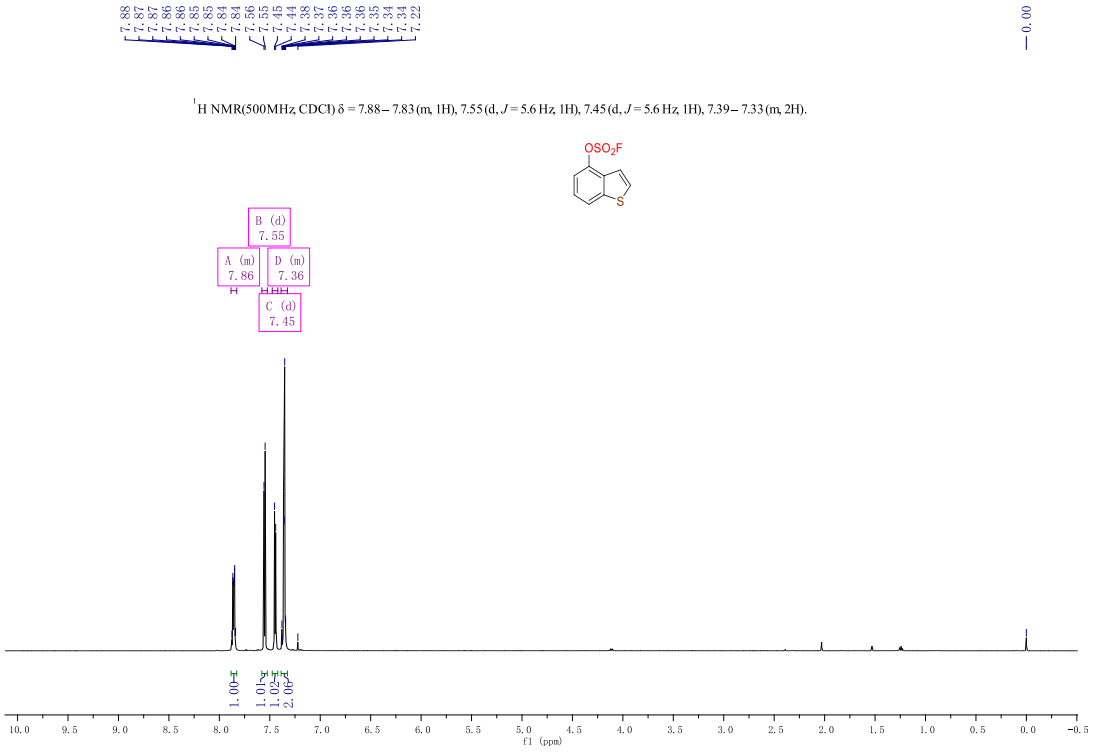




39.63
−0.00

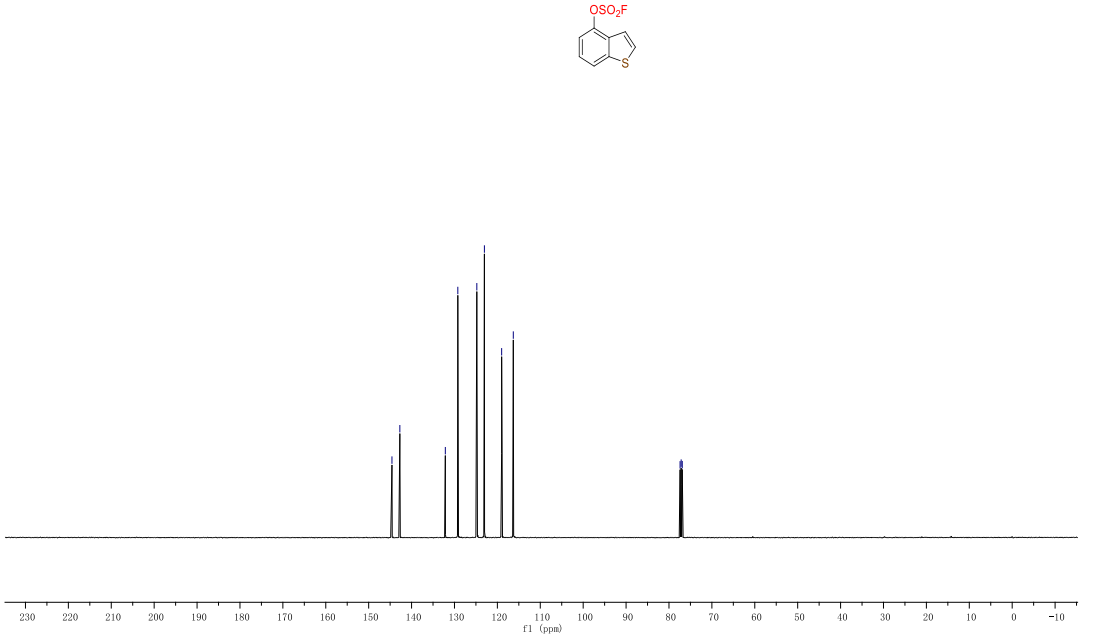
$^{19}$F NMR(282MHz, CDCl) δ = 39.63.

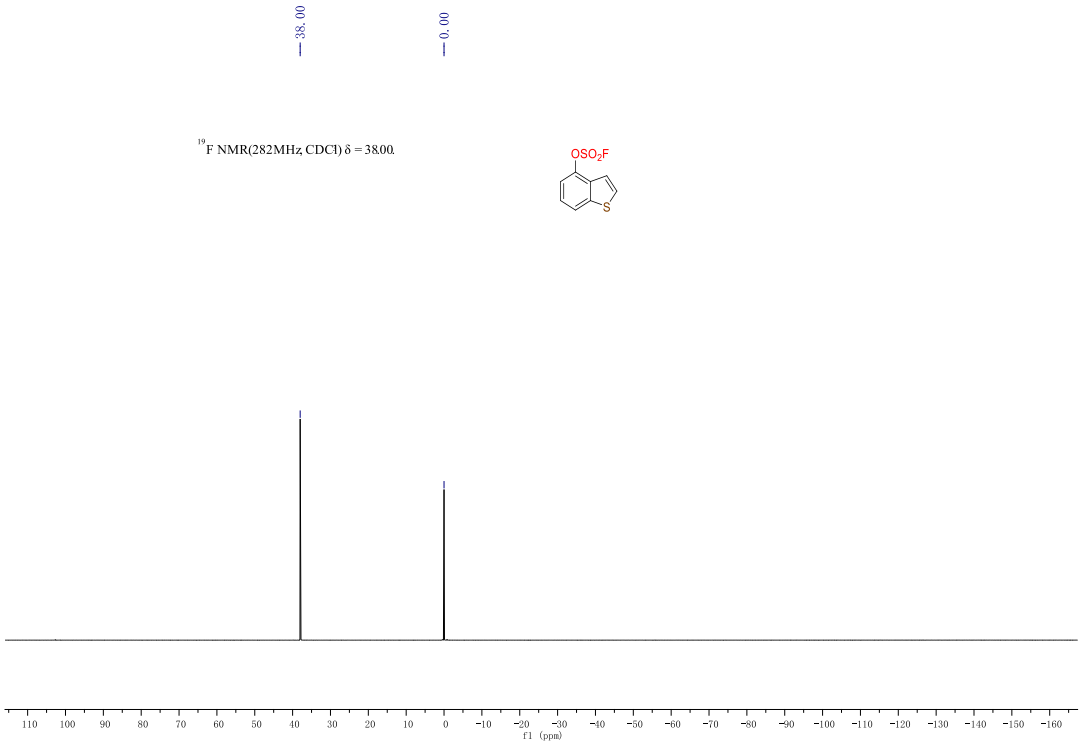
Compound **1-19**. *Benzo[b]thiophen-4-yl fluorosulfate*




$^{1}$H NMR(500MHz, CDCl) δ = 7.88 – 7.83 (m, 1H), 7.55 (d, *J* = 5.6 Hz, 1H), 7.45 (d, *J* = 5.6 Hz, 1H), 7.39 – 7.33 (m, 2H).

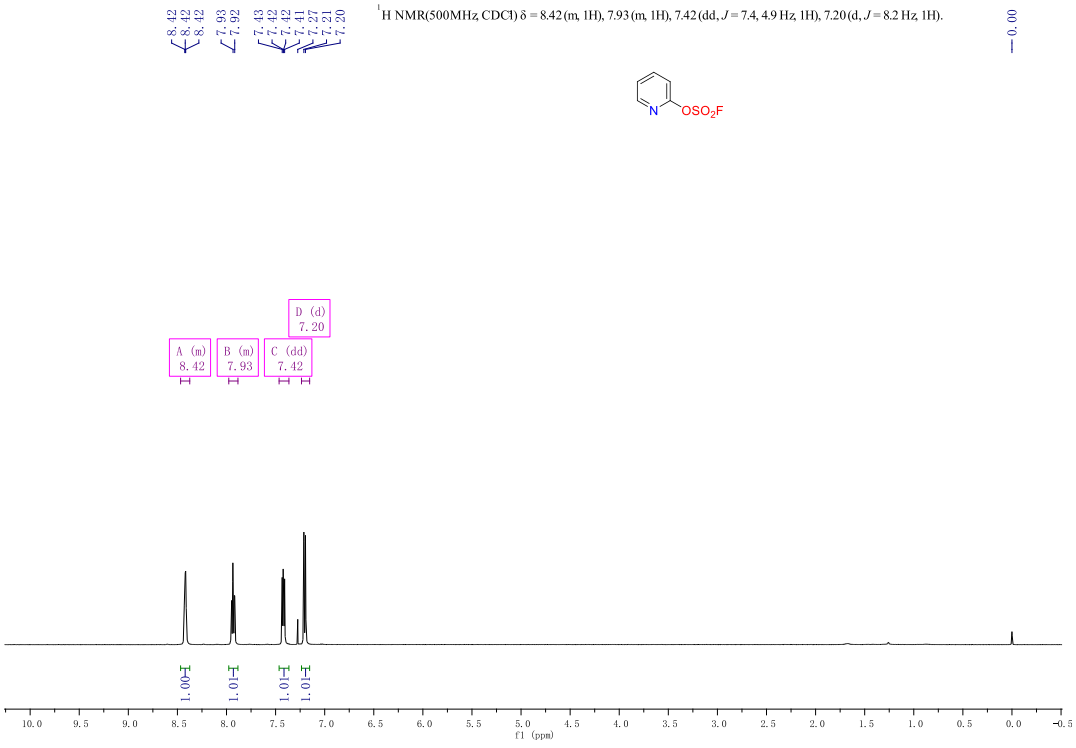



$^{13}$C NMR(126MHz, CDCl) δ = 144.57, 142.73, 132.13, 129.22, 124.79, 123.03, 119.00, 116.29.



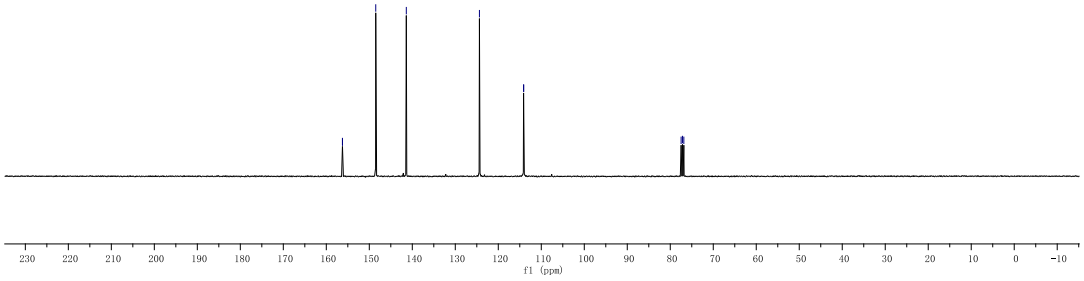

$^{19}$F NMR(282MHz, CDCl) δ = 38.00.

Compound **1-8**. *Pyridin-2-yl fluorosulfate*

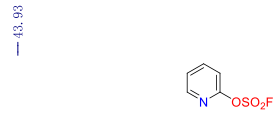


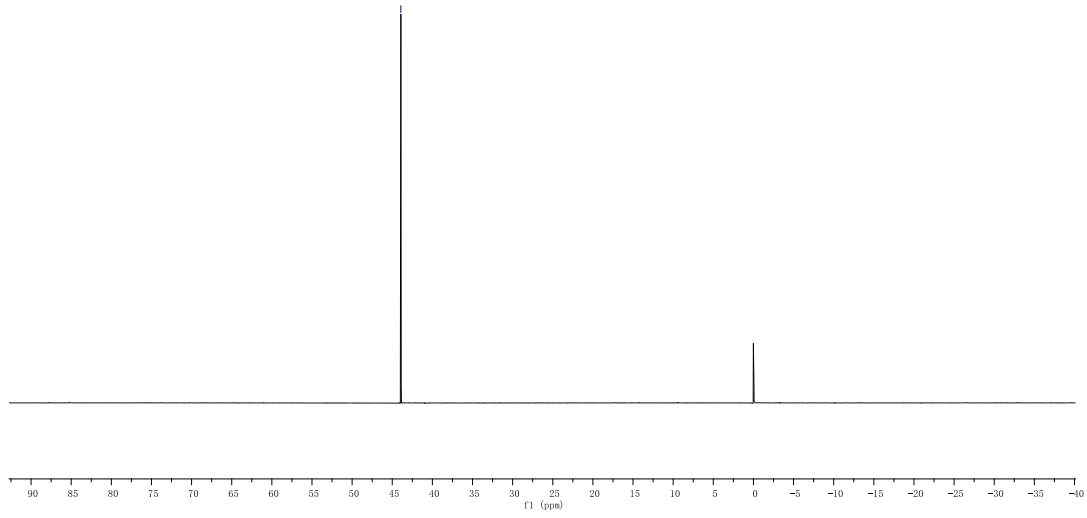

$^{1}$H NMR(500MHz, CDCl) δ = 8.42 (m, 1H), 7.93 (m, 1H), 7.42 (dd, *J* = 7.4, 4.9 Hz, 1H), 7.20 (d, *J* = 8.2 Hz, 1H).


$^{13}$C NMR(101MHz, CDCl) δ = 156.24 (d, *J* = 1.3 Hz), 148.50, 141.39, 124.39, 114.10 (d, *J* = 2.5 Hz).

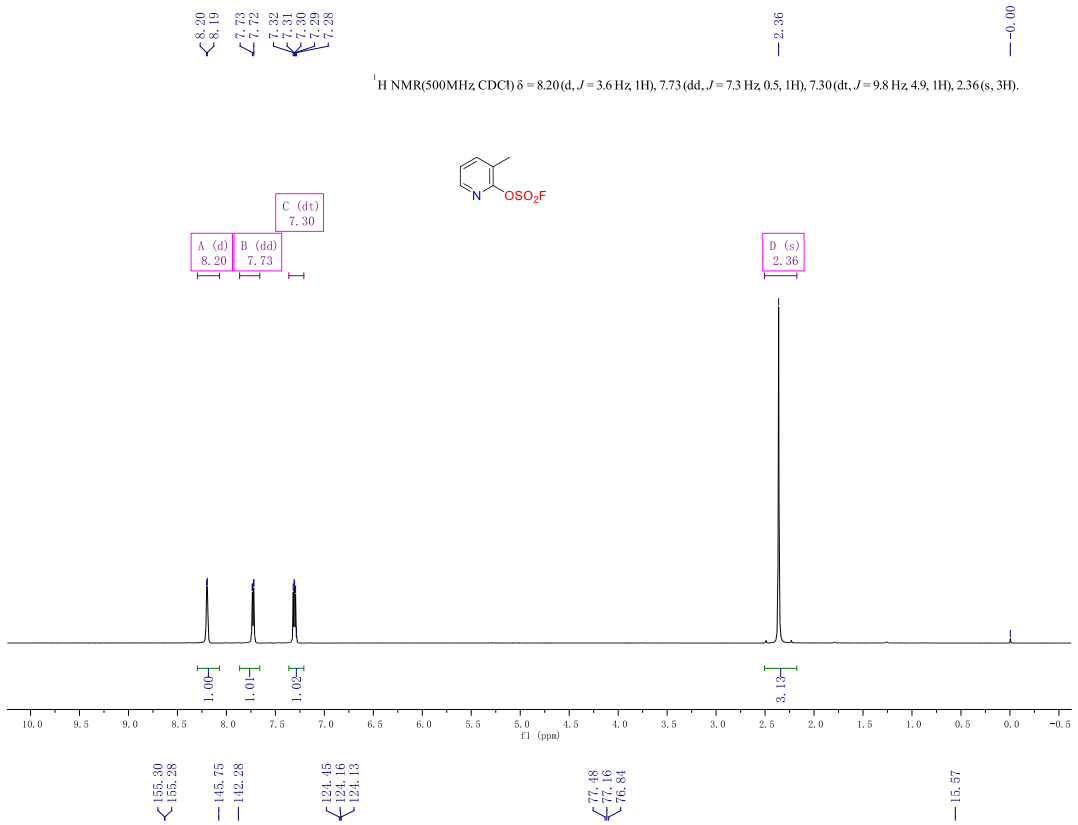




$^{19}$F NMR(376MHz, CDCl) δ 43.93

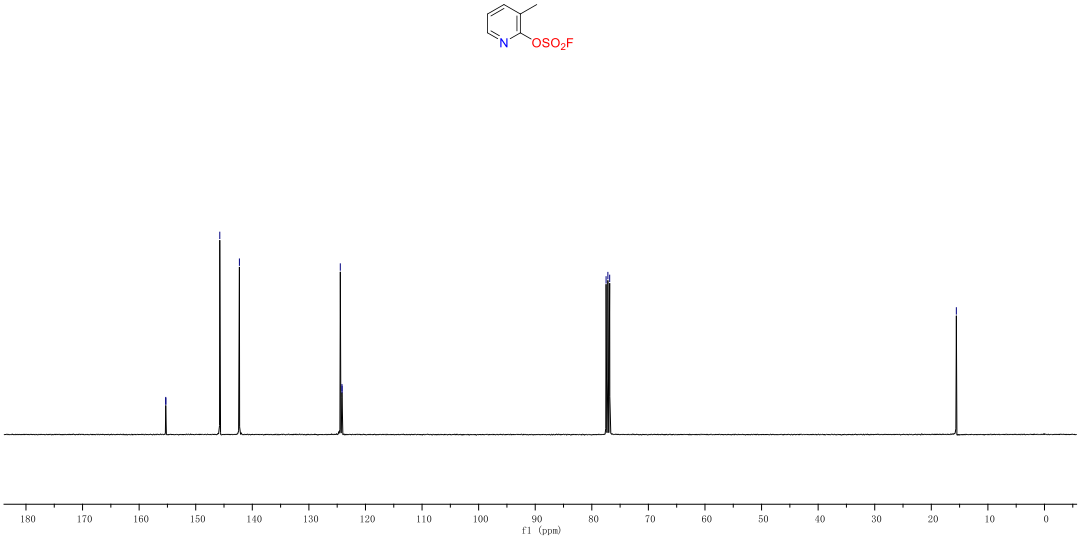


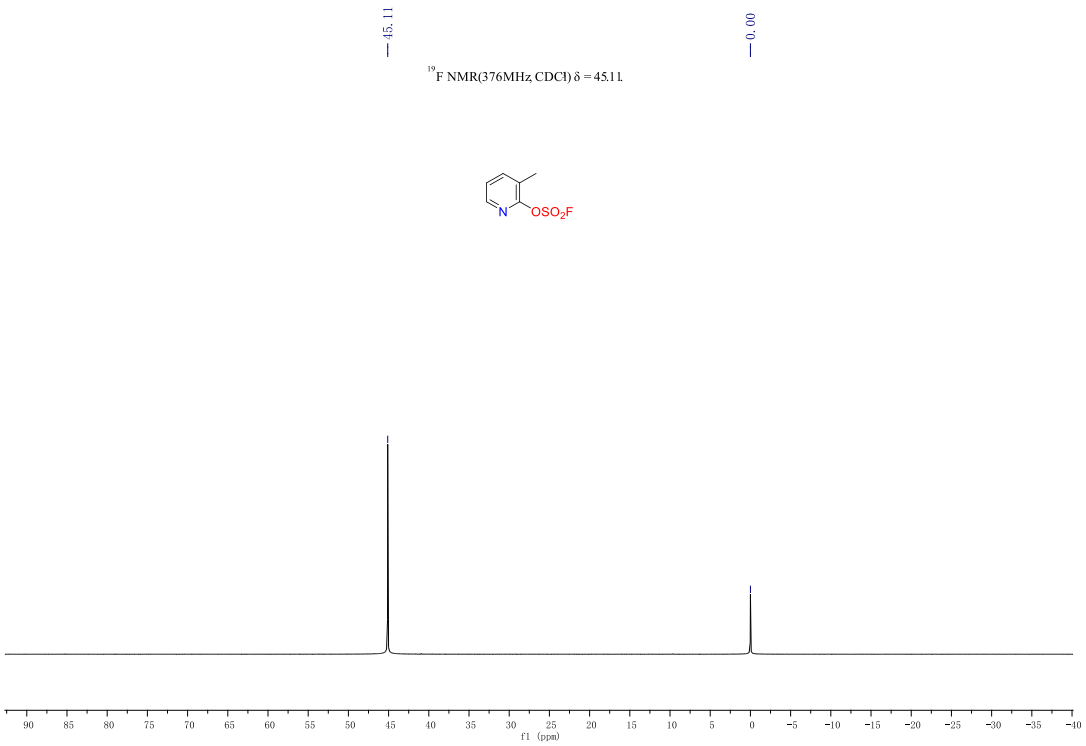
Compound **1-9**. *3-Methylpyridin-2-yl fluorosulfate*




$^{1}$H NMR(500MHz, CDCl) δ = 8.20 (d, *J* = 3.6 Hz, 1H), 7.73 (dd, *J* = 7.3 Hz, 0.5, 1H), 7.30 (dt, *J* = 9.8 Hz, 4.9, 1H), 2.36 (s, 3H).

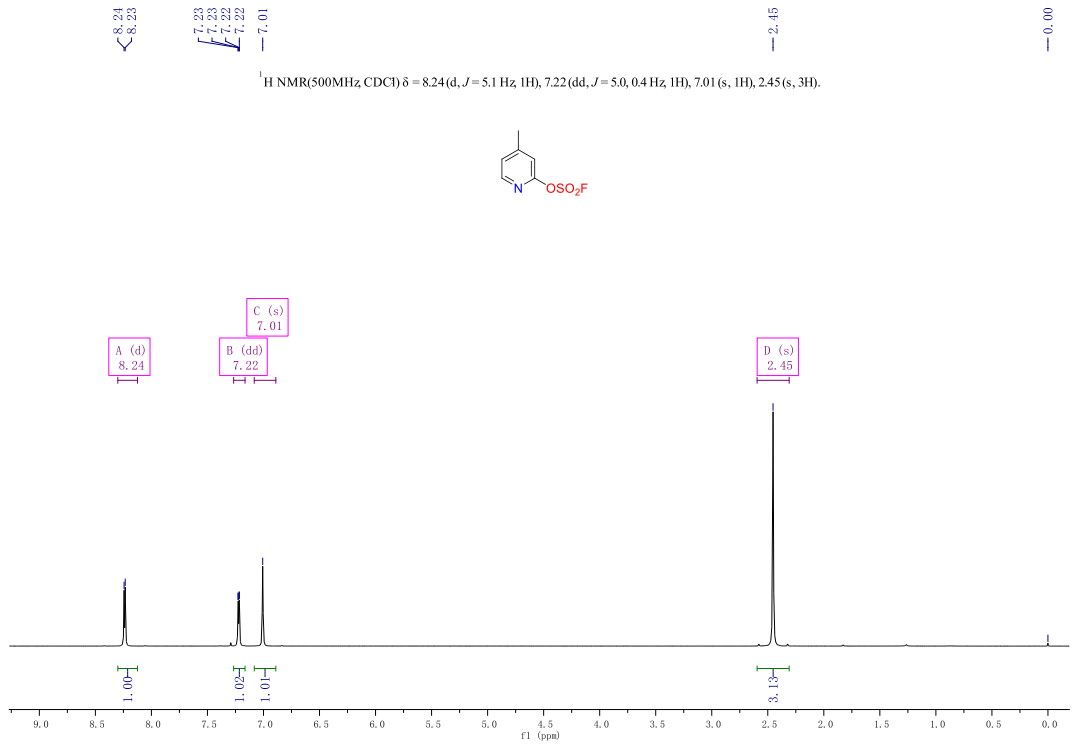



$^{13}$C NMR(101MHz, CDCl) δ = 155.29 (d, *J* = 1.5 Hz), 145.75, 142.28, 124.45, 124.15 (d, *J* = 2.3 Hz), 15.57.



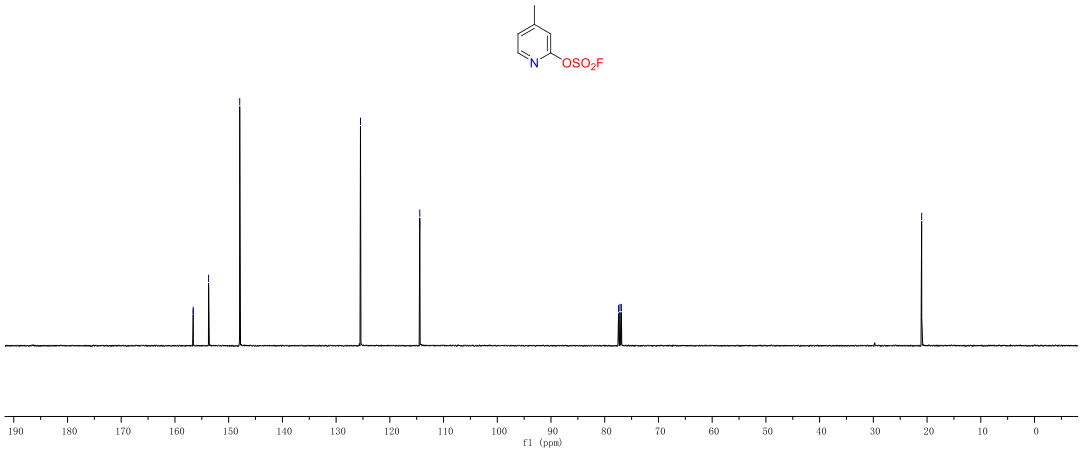

$^{19}$F NMR(376MHz, CDCl) $\delta$ = 45.11.

Compound **1-10**. *4-Methylpyridin-2-yl fluorosulfate*



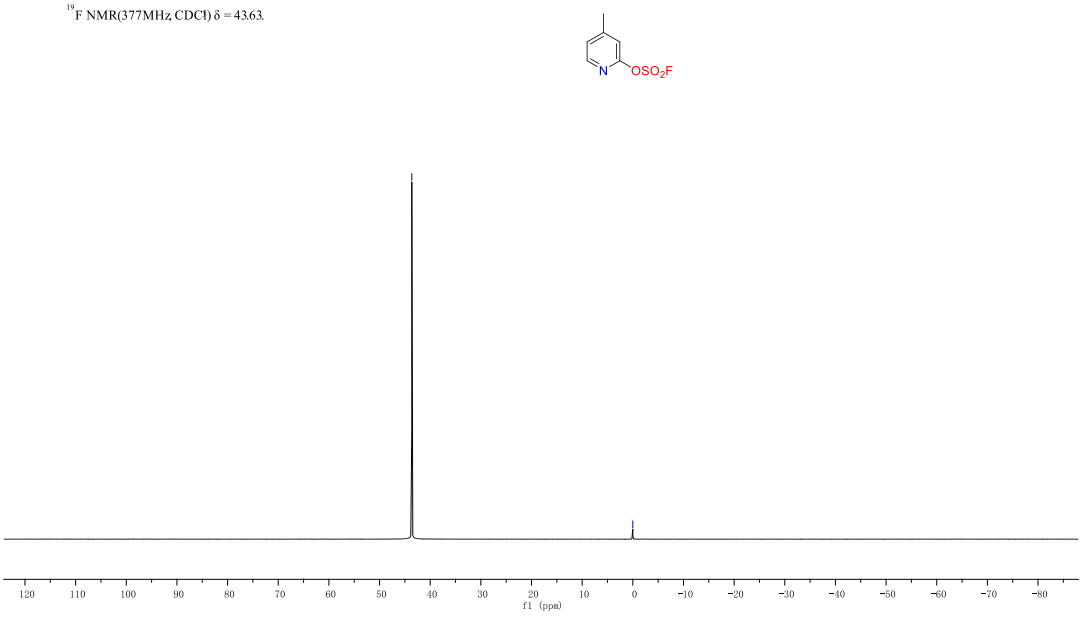

$^{1}$H NMR(500MHz, CDCl) $\delta$ = 8.24 (d, $J$ = 5.1 Hz, 1H), 7.22 (dd, $J$ = 5.0, 0.4 Hz, 1H), 7.01 (s, 1H), 2.45 (s, 3H).


$^{13}$C NMR(126MHz, CDCl) δ = 156.61 (d, *J* = 1.3 Hz), 153.73, 147.94, 125.46, 114.44 (d, *J*= 2.5 Hz), 21.01.



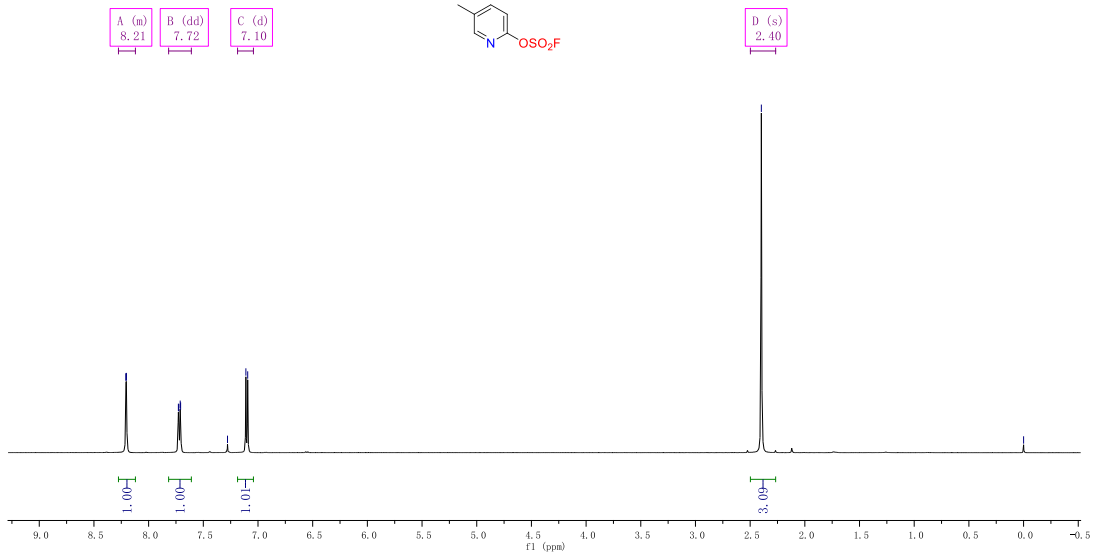


$^{19}$F NMR(377MHz, CDCl) δ = 43.63.



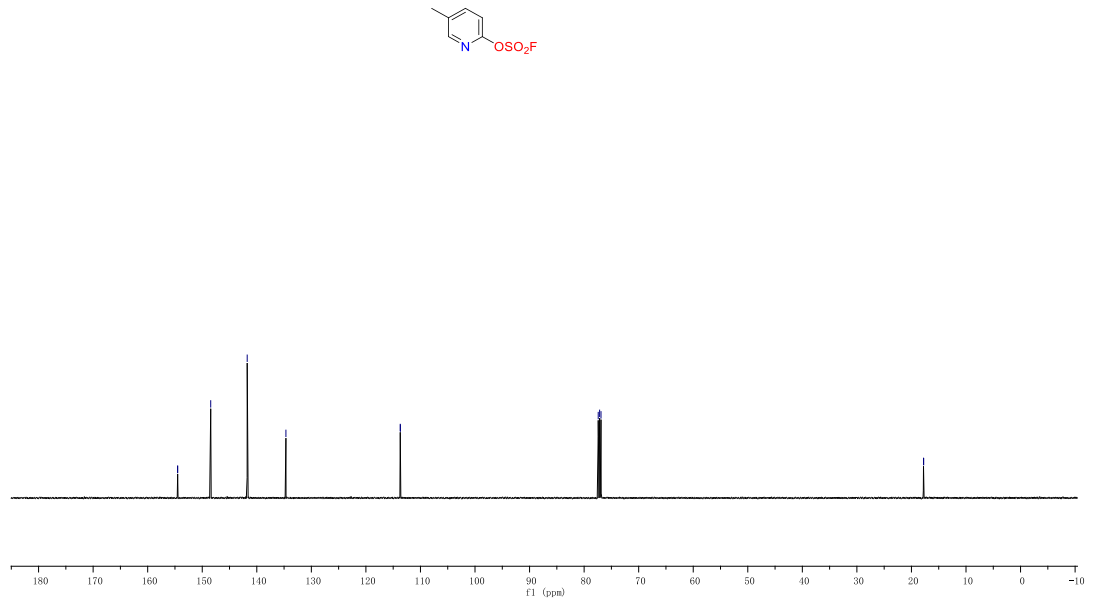
Compound **1-11**. *5-Methylpyridin-2-yl fluorosulfate*

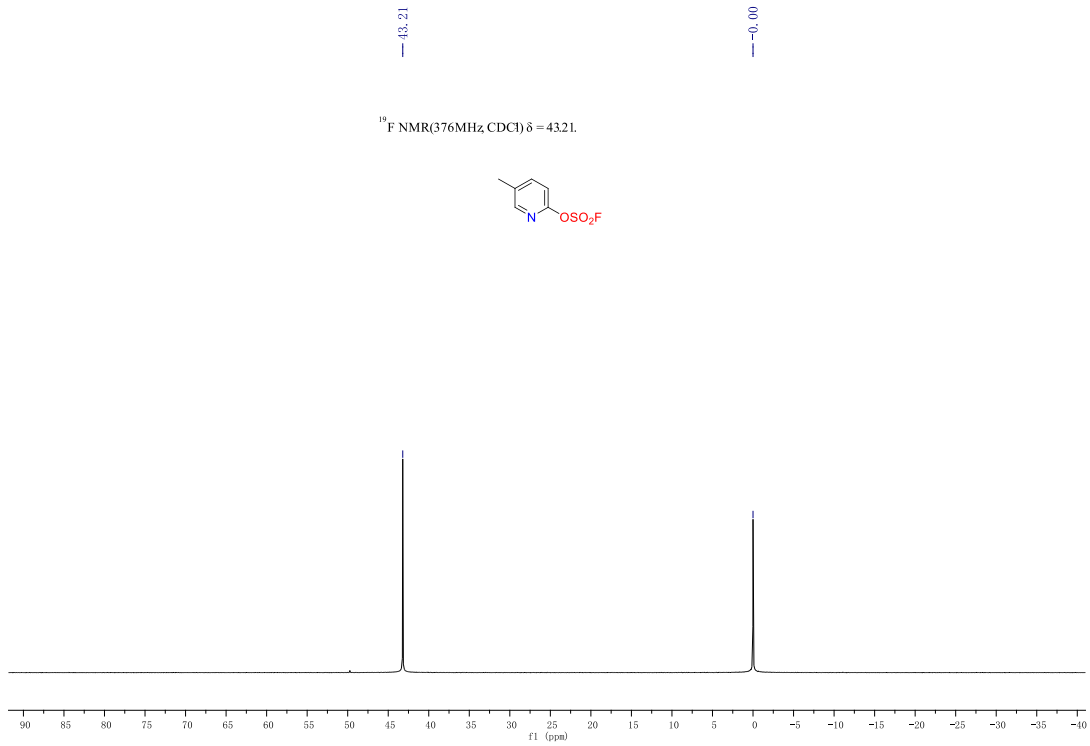

$^{1}$H NMR(500MHz, CDCl) δ = 8.28 – 8.12 (m, 1H), 7.72 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.10 (d, *J* = 8.3 Hz, 1H), 2.40 (s, 3H).





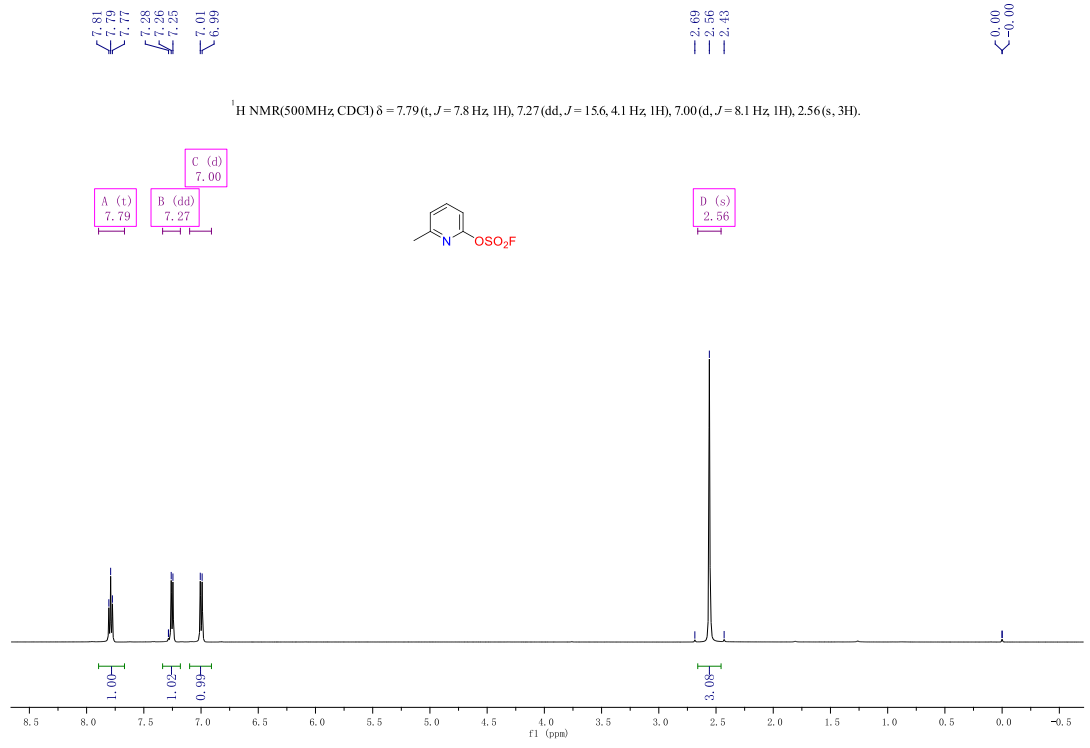
$^{13}$C NMR(126MHz, CDCl) δ = 154.51 (d, *J* = 1.5 Hz), 148.45, 141.76, 134.66, 113.69 (d, *J* = 2.5 Hz), 17.77 (d, *J* = 4.3 Hz).





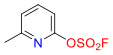

$^{19}$F NMR(376MHz, CDCl) δ = 43.21.

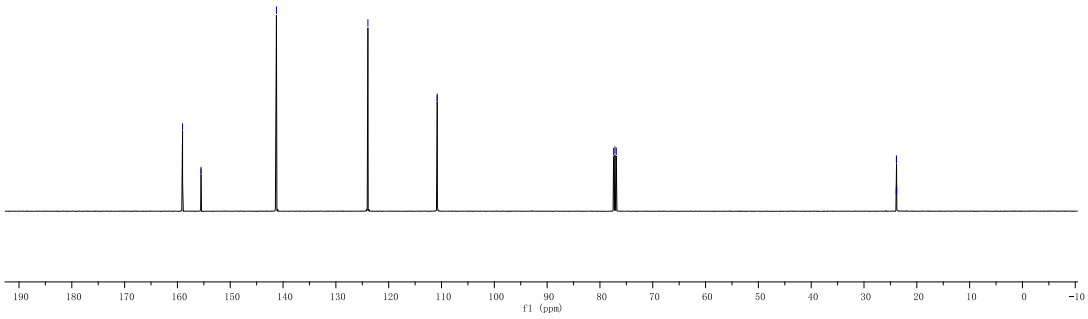
Compound **1-12**. *6-Methylpyridin-2-yl fluorosulfate*




$^{1}$H NMR(500MHz, CDCl) δ = 7.79 (t, *J* = 7.8 Hz, 1H), 7.27 (dd, *J* = 15.6, 4.1 Hz, 1H), 7.00 (d, *J* = 8.1 Hz, 1H), 2.56 (s, 3H).


$^{13}$C NMR(126MHz, CDCl$_3$) δ = 159.03, 155.54 (d, *J* = 1.2 Hz, 1H), 141.25, 123.93, 110.82 (d, *J* = 2.4 Hz), 23.85 (q, *J* = 3.2 Hz).

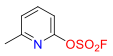


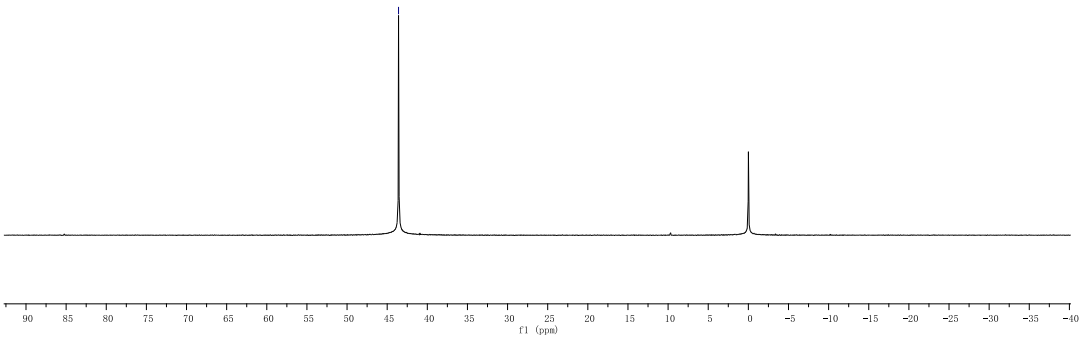





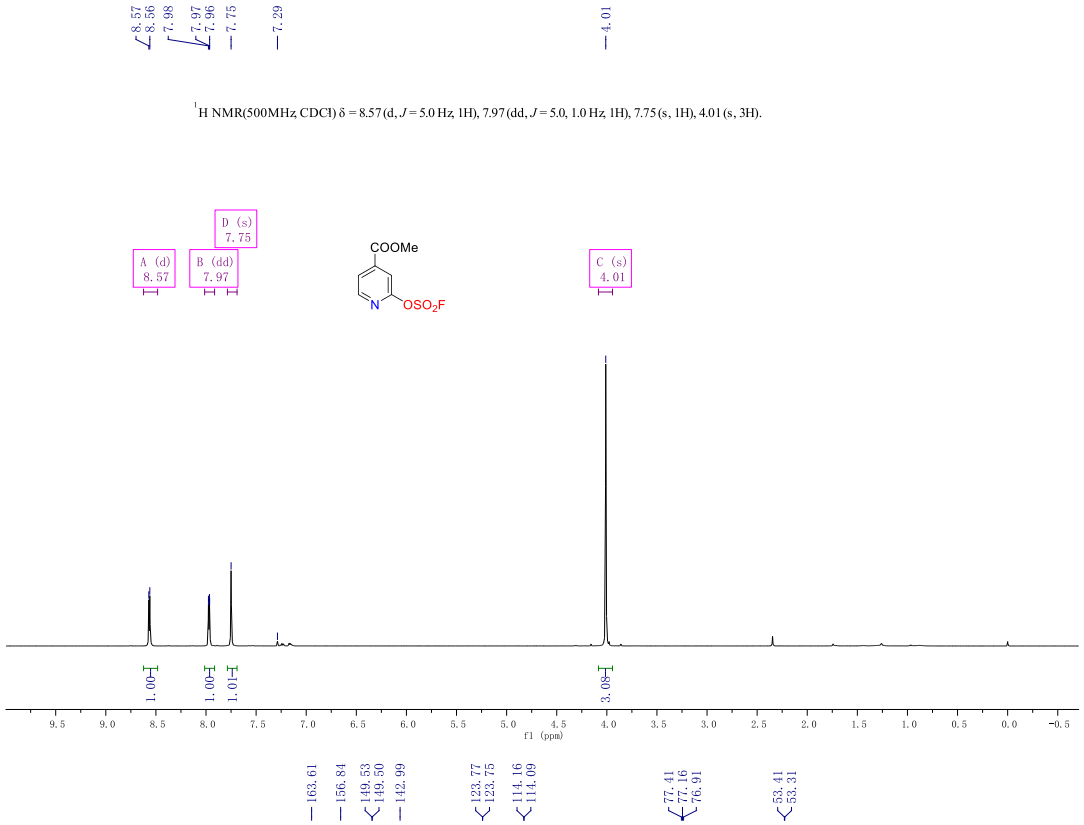


$^{19}$F NMR(376MHz, CDCl$_3$) δ = 43.59.



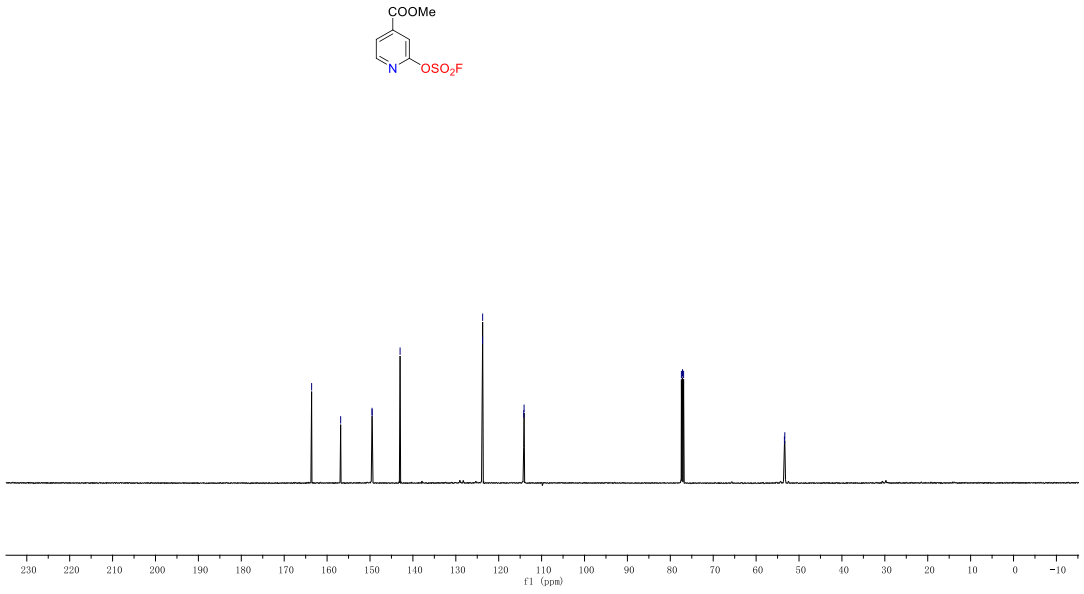



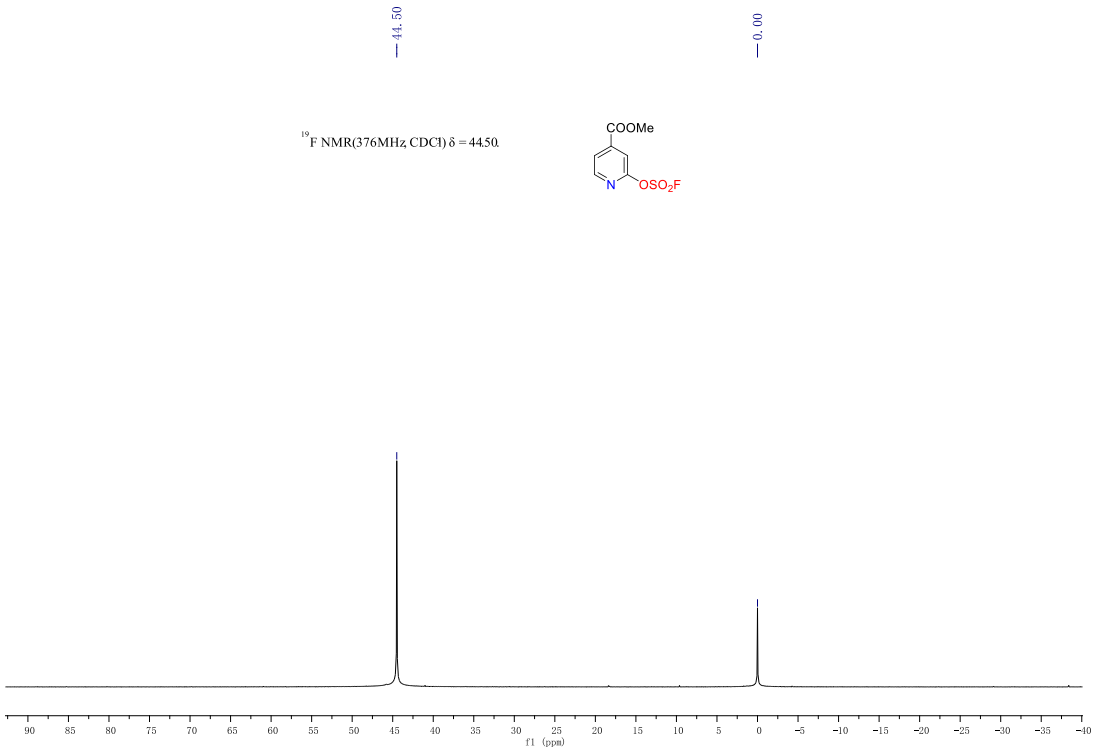
Compound **1-13**. *4-Methoxycarbonyl-pyridin-2-yl fluorosulfate*



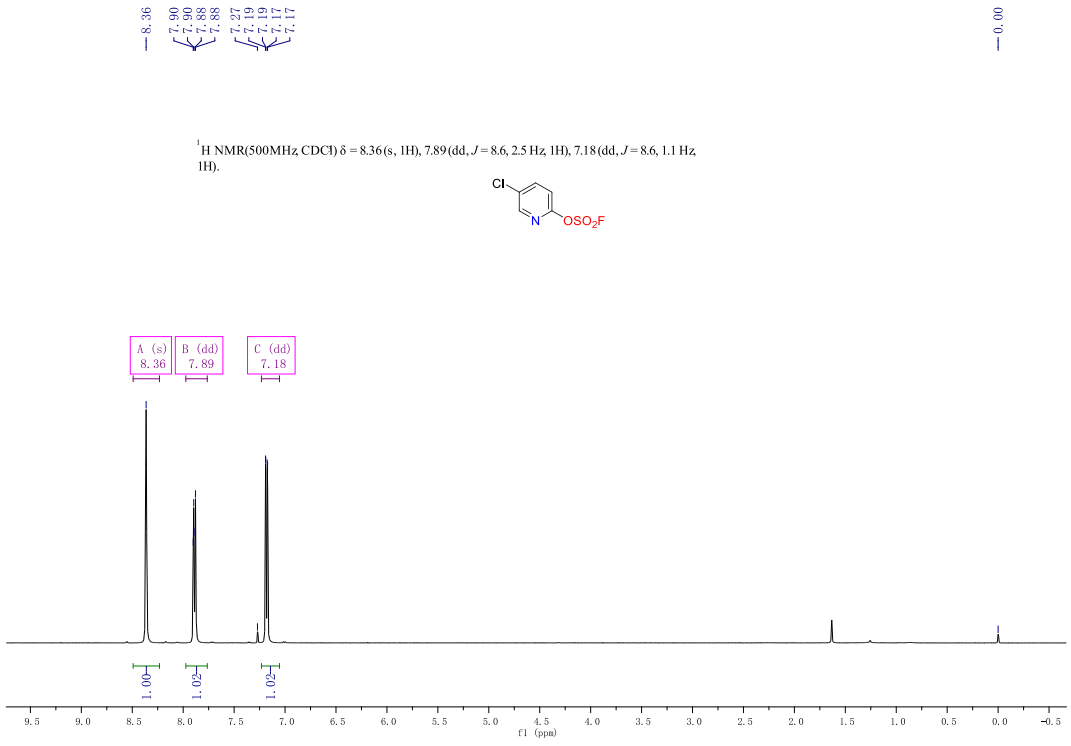

$^{1}$H NMR(500MHz, CDCl) δ = 8.57 (d, *J* = 5.0 Hz, 1H), 7.97 (dd, *J* = 5.0, 1.0 Hz, 1H), 7.75 (s, 1H), 4.01 (s, 3H).

$^{13}$C NMR(126MHz, CDCl) δ = 163.61, 156.84, 149.51 (d, *J* = 3.2 Hz), 142.99, 123.76 (d, *J* = 2.8 Hz), 114.12 (d, *J* = 8.7 Hz), 53.36 (d, *J* = 11.6 Hz).

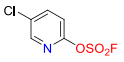


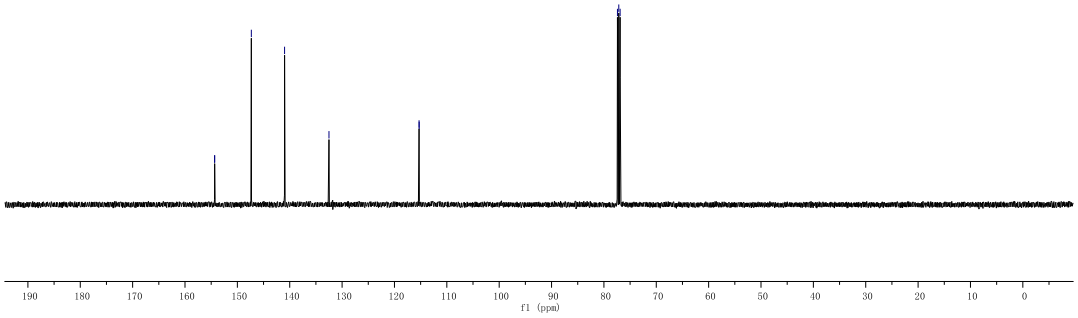



Compound **1-14**. *5-Chloropyridin-2-yl fluorosulfate*



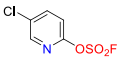

$^{13}$C NMR(126MHz, CDCl) δ = 154.34 (d, *J* = 1.4 Hz, 1H), 147.33, 140.98, 132.51, 115.29 (d, *J* = 2.6 Hz).

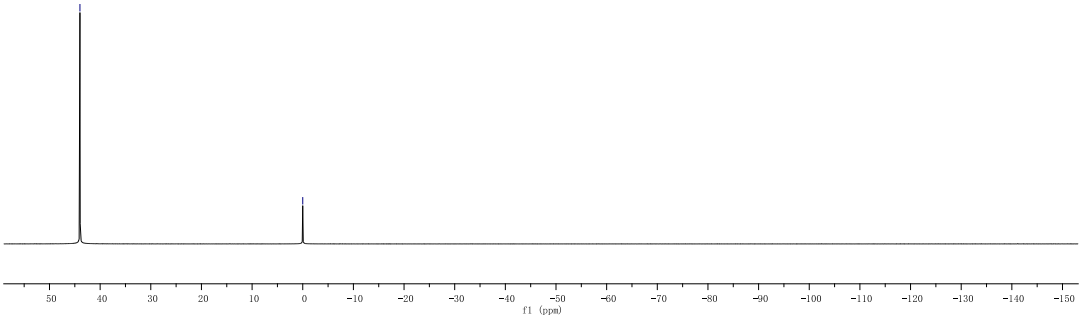


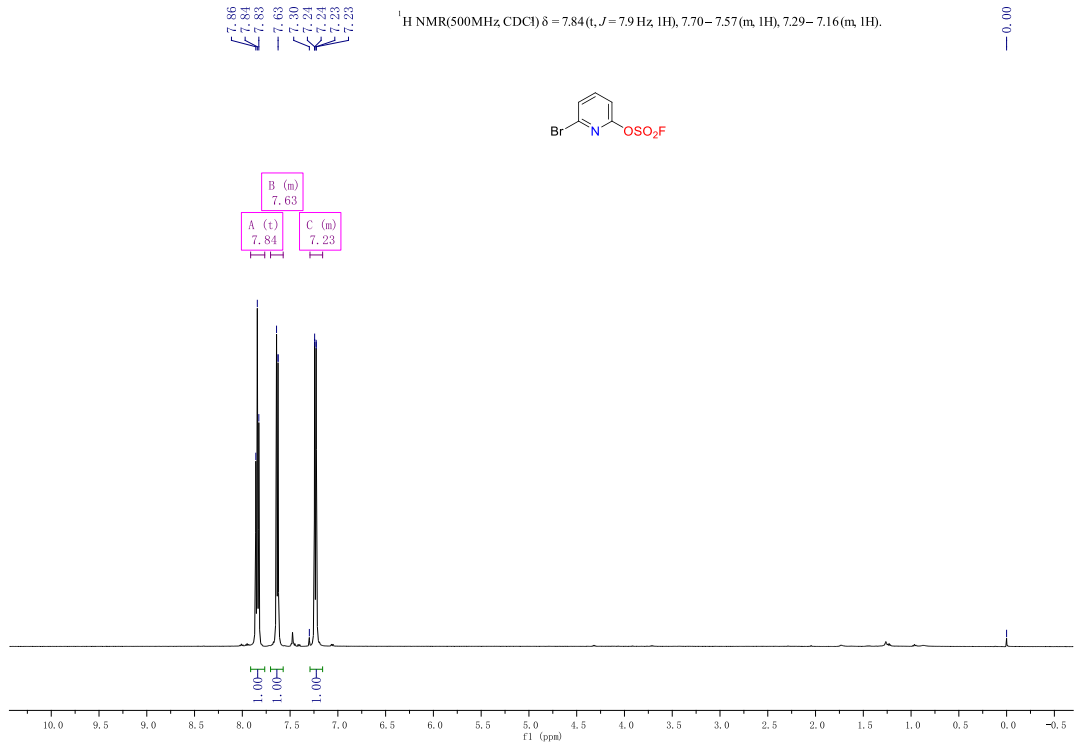


$^{19}$F NMR(377MHz, CDCl) δ = 43.99.

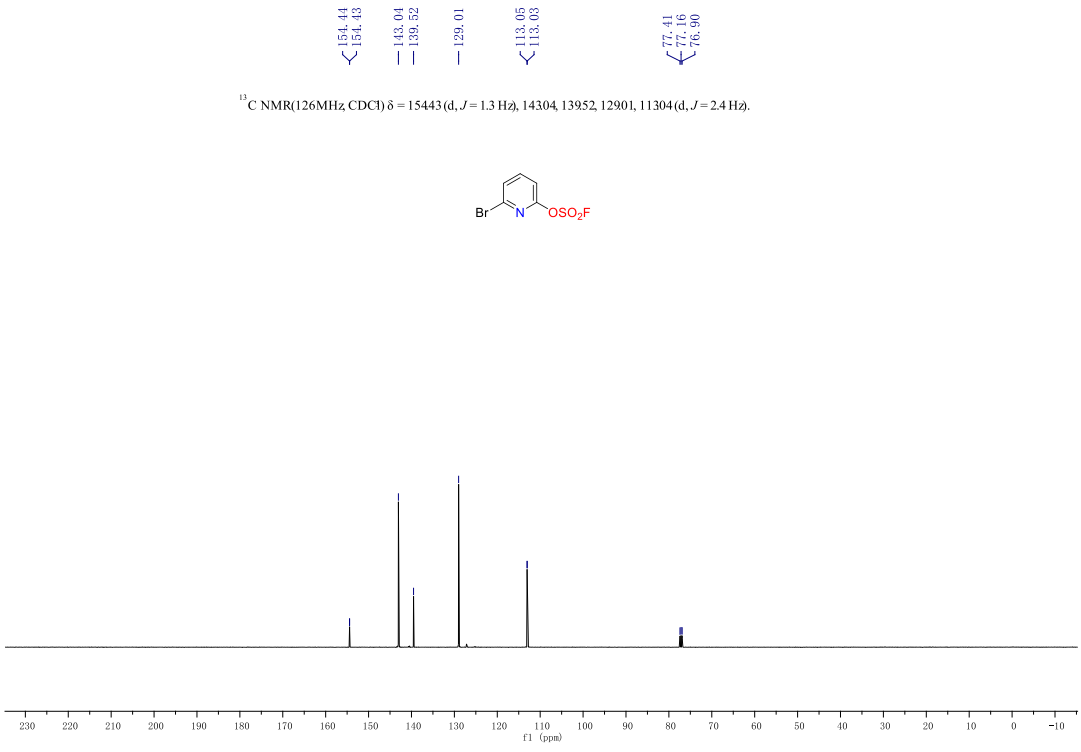


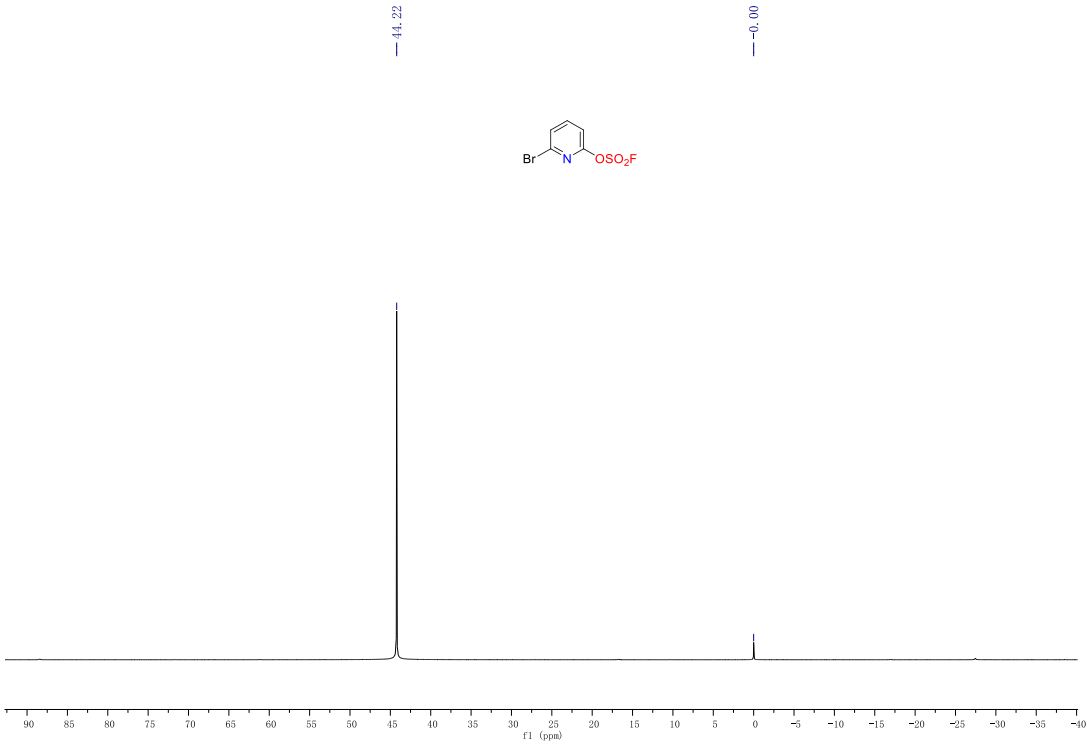
Compound **1-15**. *6-Bromopyridin-2-yl fluorosulfate*



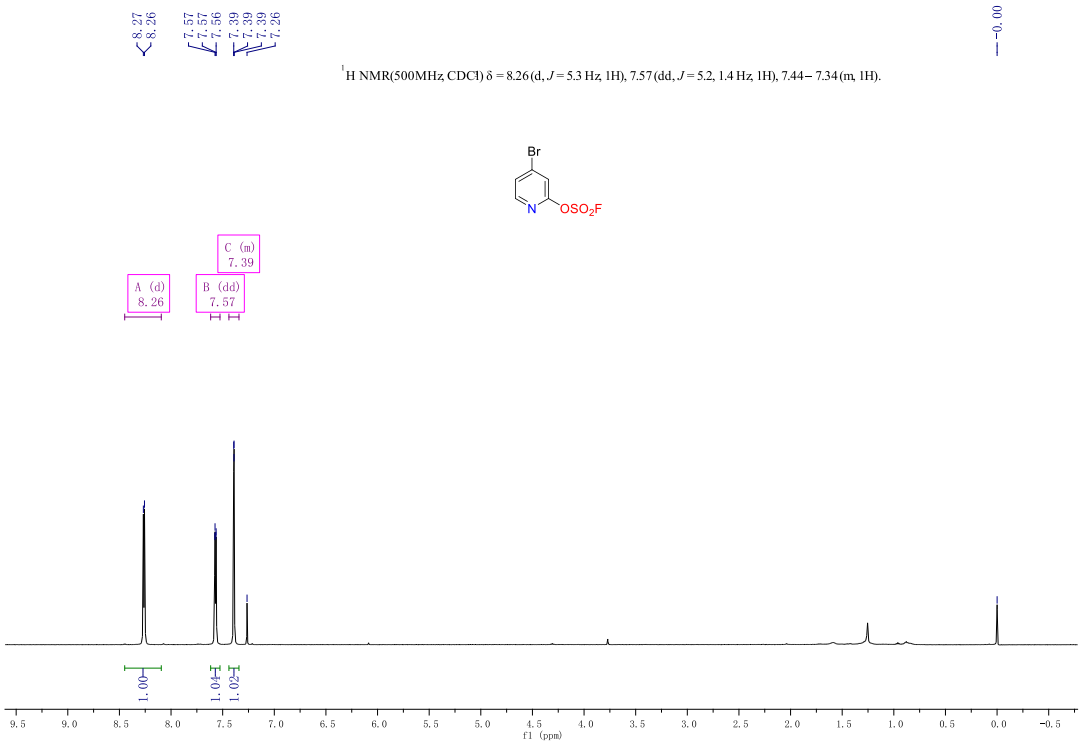

$^{1}$H NMR(500MHz, CDCl) δ = 7.84 (t, *J* = 7.9 Hz, 1H), 7.70 – 7.57 (m, 1H), 7.29 – 7.16 (m, 1H).




$^{13}$C NMR(126MHz, CDCl) δ = 154.43 (d, *J* = 1.3 Hz), 143.04, 139.52, 129.01, 113.04 (d, *J* = 2.4 Hz).

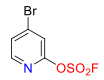


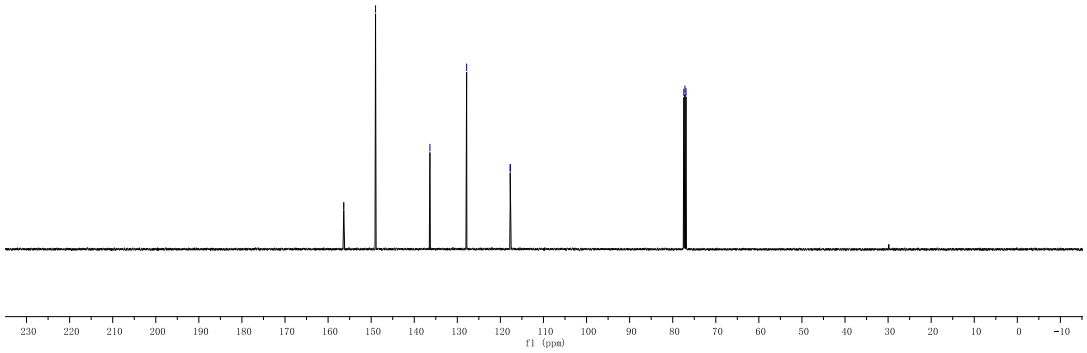

Compound **1-16**. *4-Bromopyridin-2-yl fluorosulfate*




$^{1}$H NMR(500MHz, CDCl) $\delta$ = 8.26 (d, $J$ = 5.3 Hz, 1H), 7.57 (dd, $J$ = 5.2, 1.4 Hz, 1H), 7.44 – 7.34 (m, 1H).

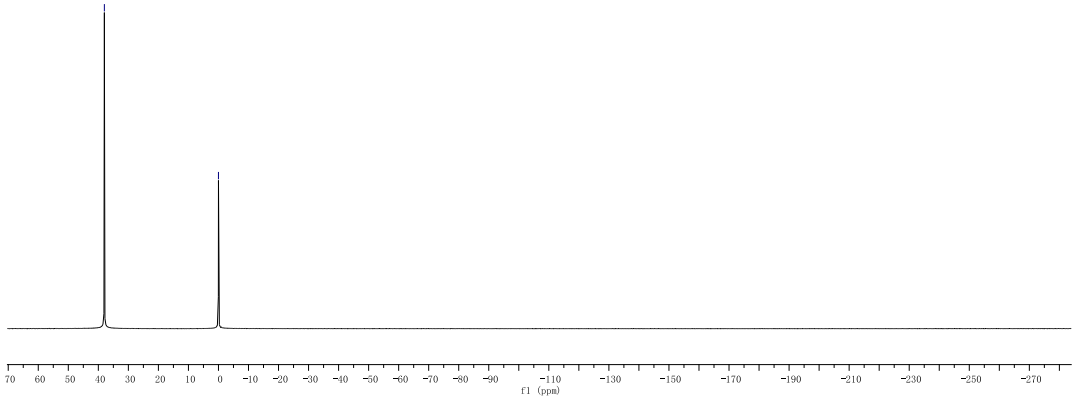

$^{13}$C NMR(126MHz, CDCl) δ = 156.37 (d, *J* = 1.4 Hz), 148.98, 136.36, 127.84, 117.71 (d, *J* = 2.5 Hz).



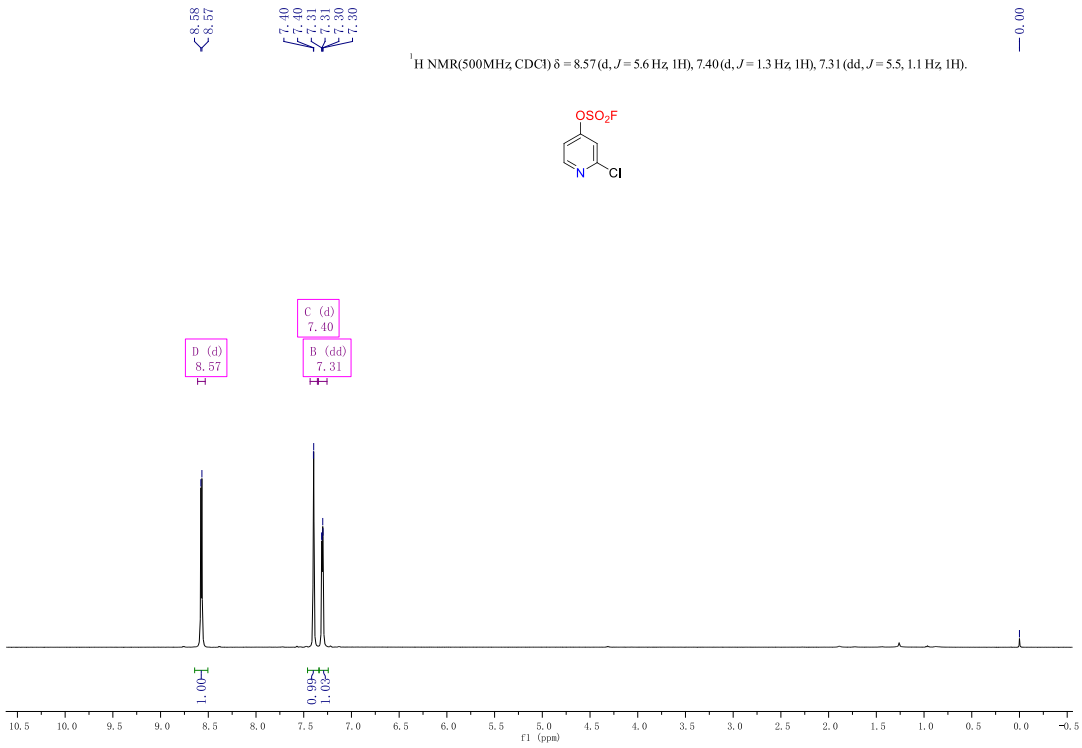





$^{19}$F NMR(282MHz, CDCl) δ = 37.99.

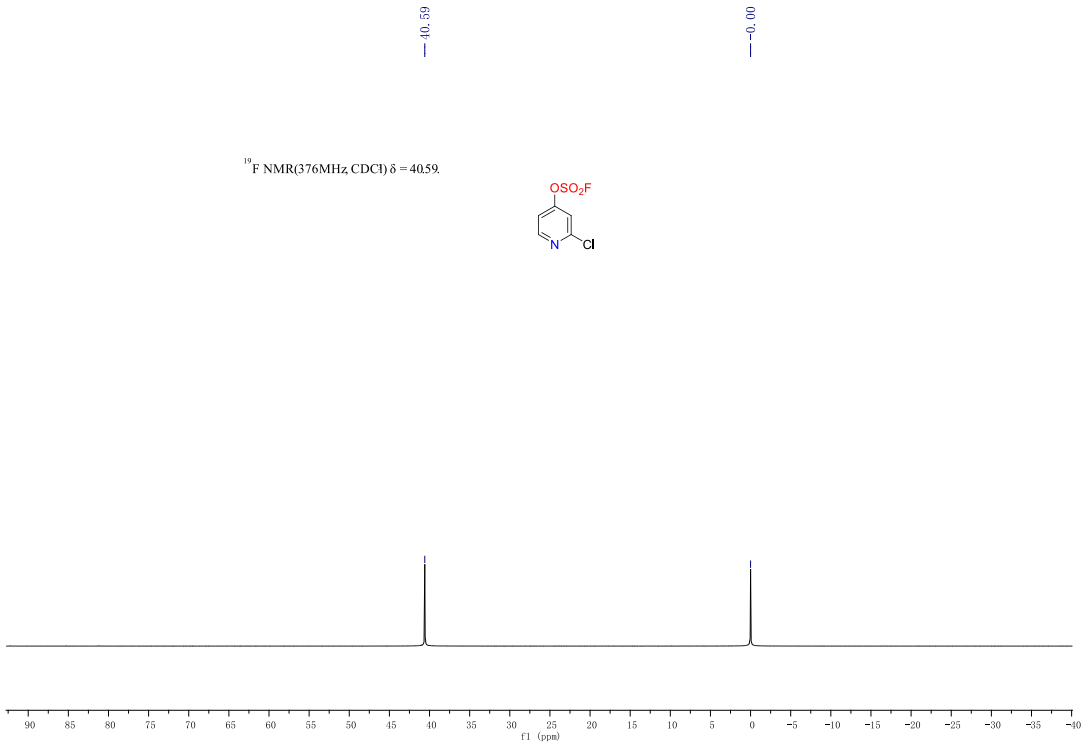
Compound **1-17**. *2-Chloropyridin-4-yl fluorosulfate*




$^{1}$H NMR(500MHz, CDCl) δ = 8.57 (d, *J* = 5.6 Hz, 1H), 7.40 (d, *J* = 1.3 Hz, 1H), 7.31 (dd, *J* = 5.5, 1.1 Hz, 1H).

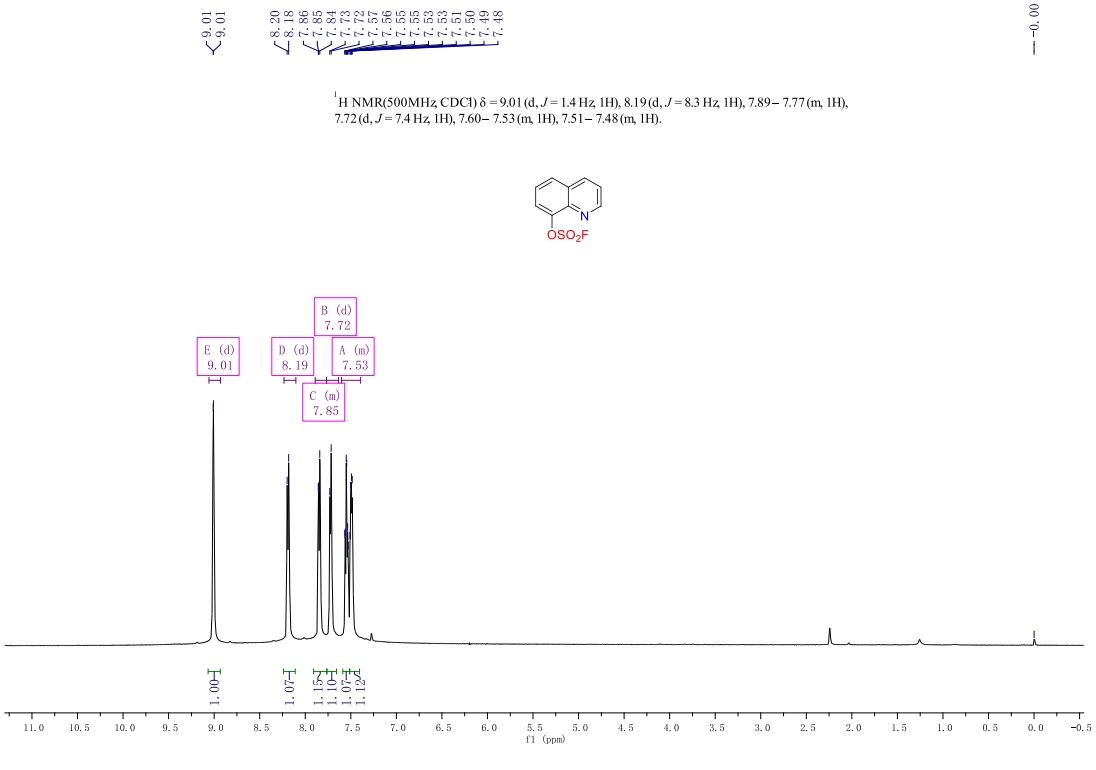



$^{13}$C NMR(126MHz, CDCl) δ = 157.17, 153.64, 152.10, 116.60, 114.62.

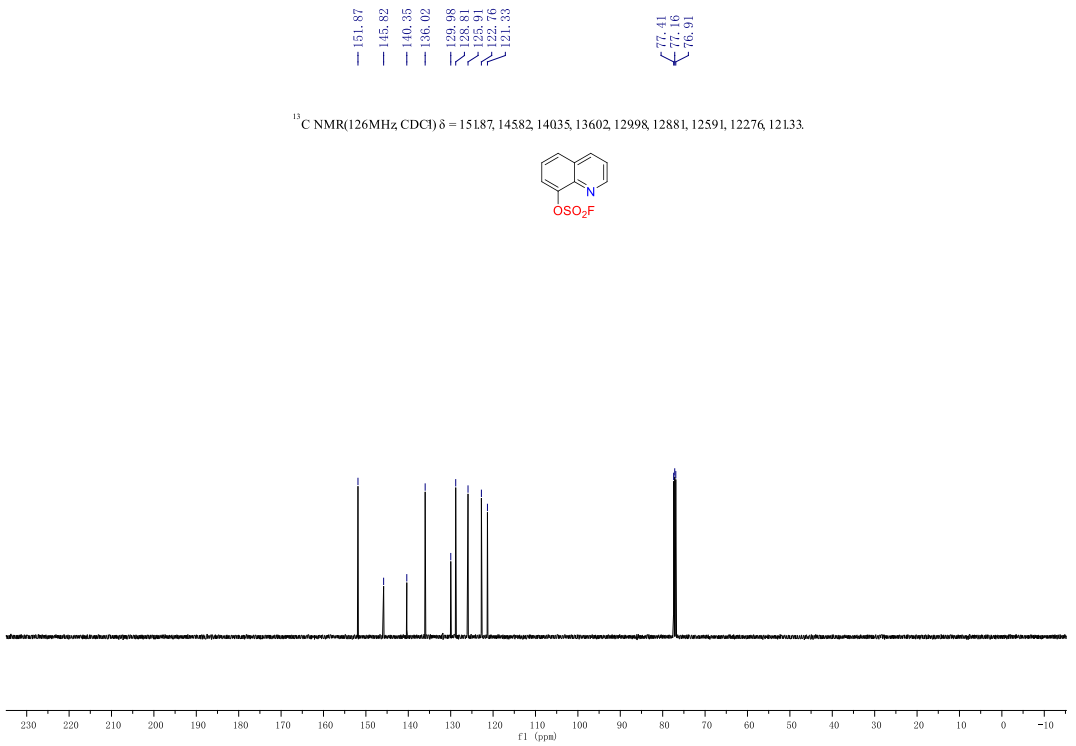



$^{19}$F NMR(376MHz, CDCl) δ = 40.59.

Compound **1-20**. *Quinolin-8-yl fluorosulfate*

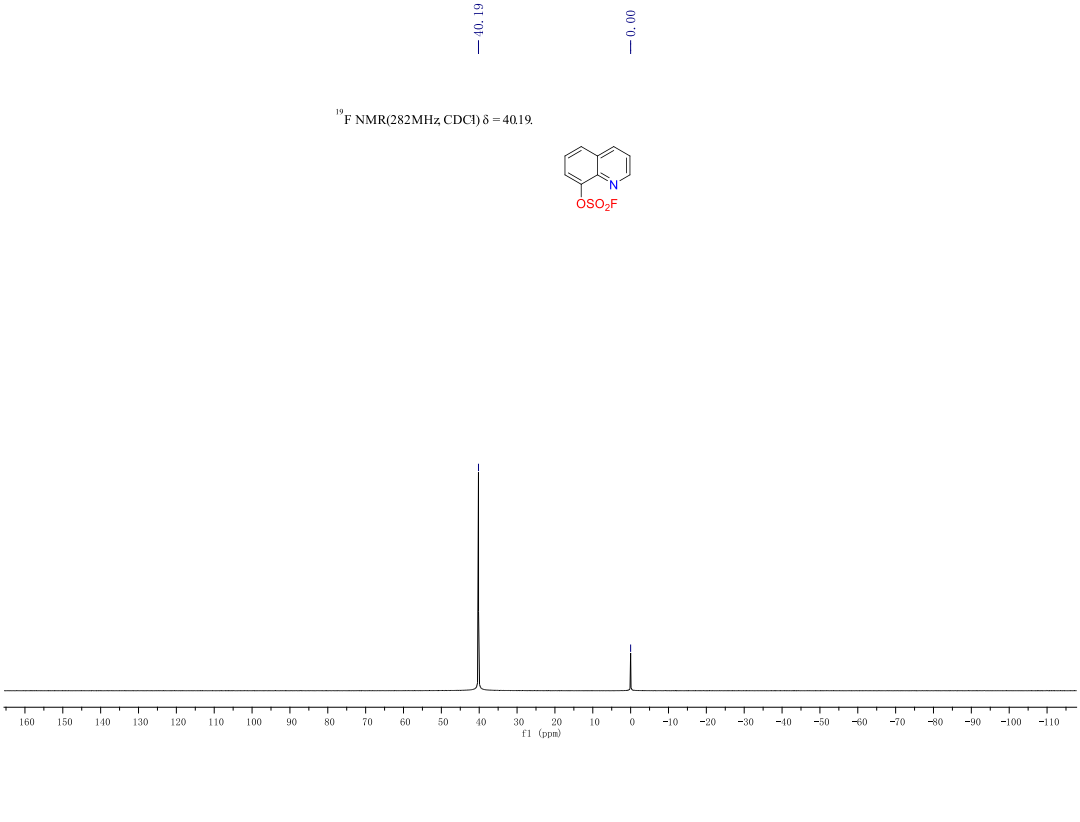



$^{1}$H NMR(500MHz, CDCl) δ = 9.01 (d, *J* = 1.4 Hz, 1H), 8.19 (d, *J* = 8.3 Hz, 1H), 7.89 – 7.77 (m, 1H), 7.72 (d, *J* = 7.4 Hz, 1H), 7.60 – 7.53 (m, 1H), 7.51 – 7.48 (m, 1H).



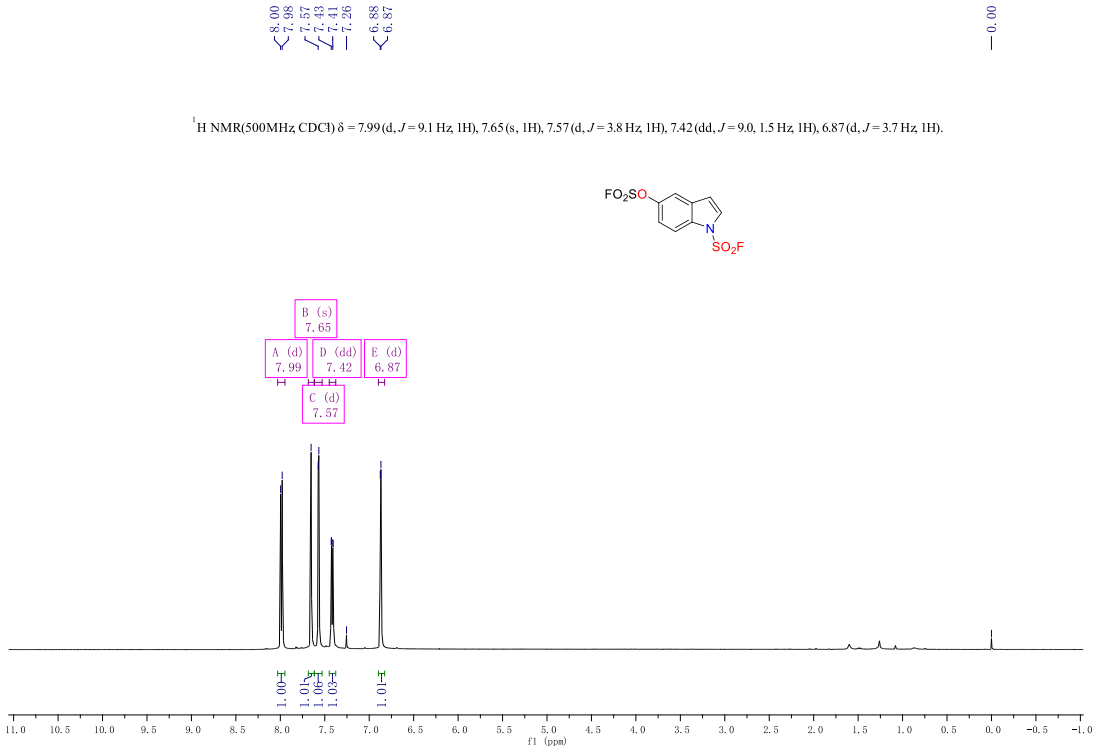

$^{13}$C NMR(126MHz, CDCl) δ = 151.87, 145.82, 140.35, 136.02, 129.98, 128.81, 125.91, 122.76, 121.33.



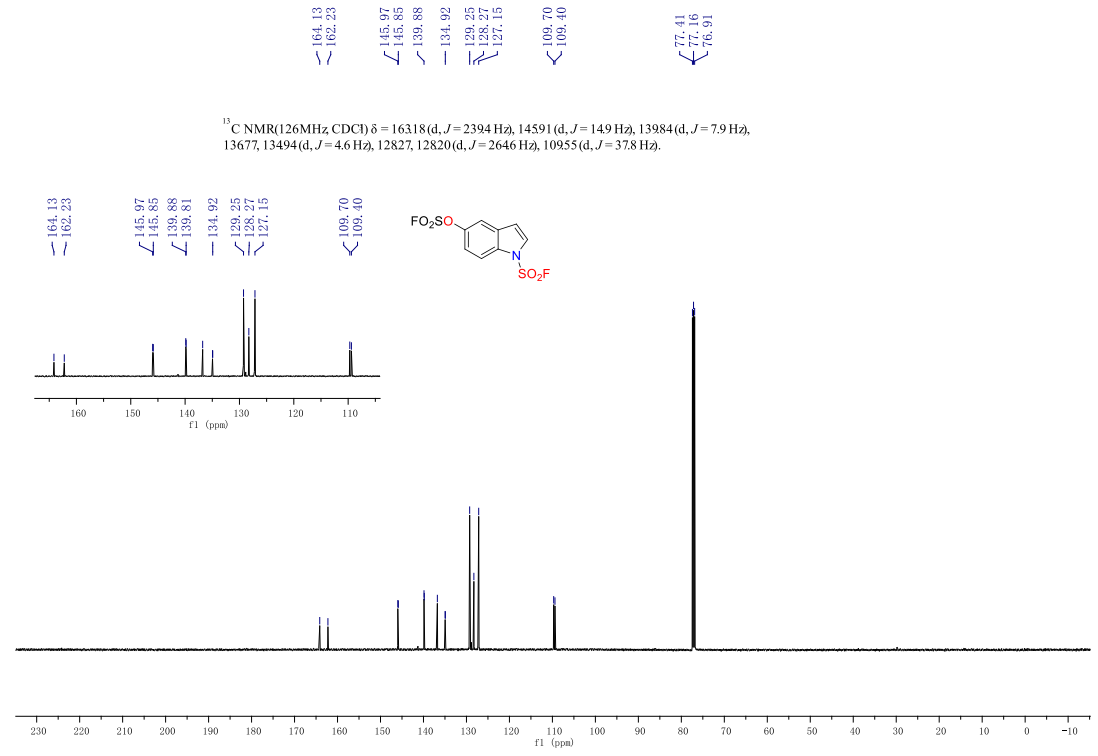




$^{19}$F NMR(282MHz, CDCl) δ = 40.19.

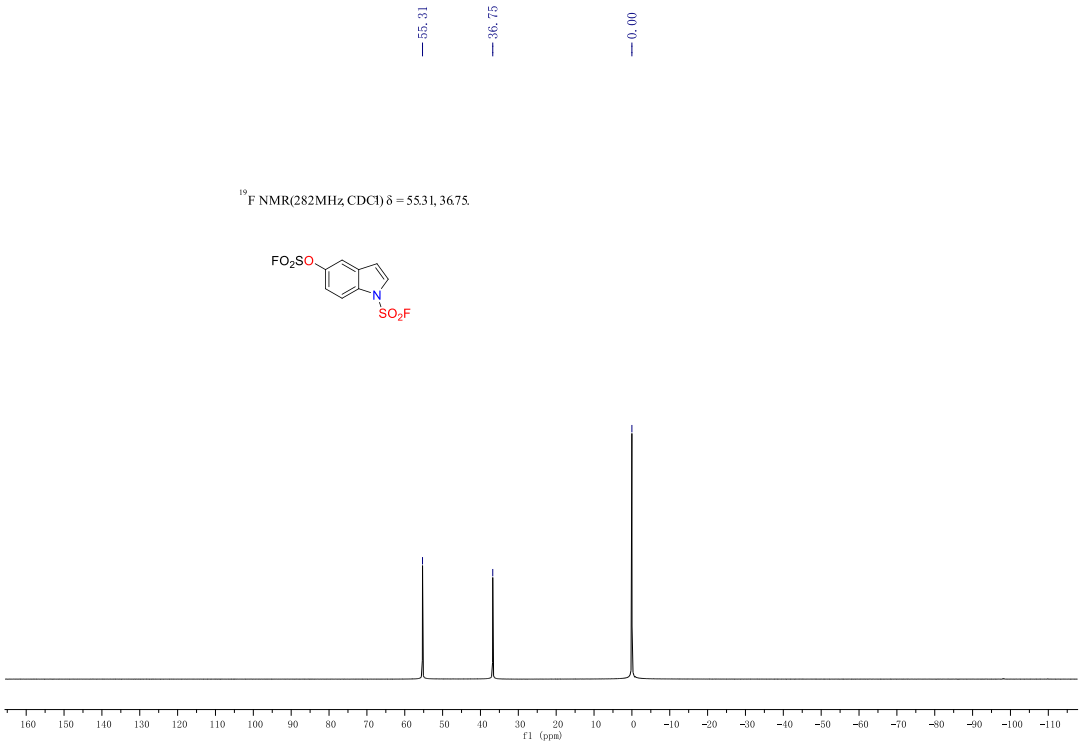
Compound **1-21**. *1-(Fluorosulfonyl)-1H-indol-5-yl fluorosulfate*




$^{1}$H NMR(500MHz, CDCl) δ = 7.99 (d, *J* = 9.1 Hz, 1H), 7.65 (s, 1H), 7.57 (d, *J* = 3.8 Hz, 1H), 7.42 (dd, *J* = 9.0, 1.5 Hz, 1H), 6.87 (d, *J* = 3.7 Hz, 1H).

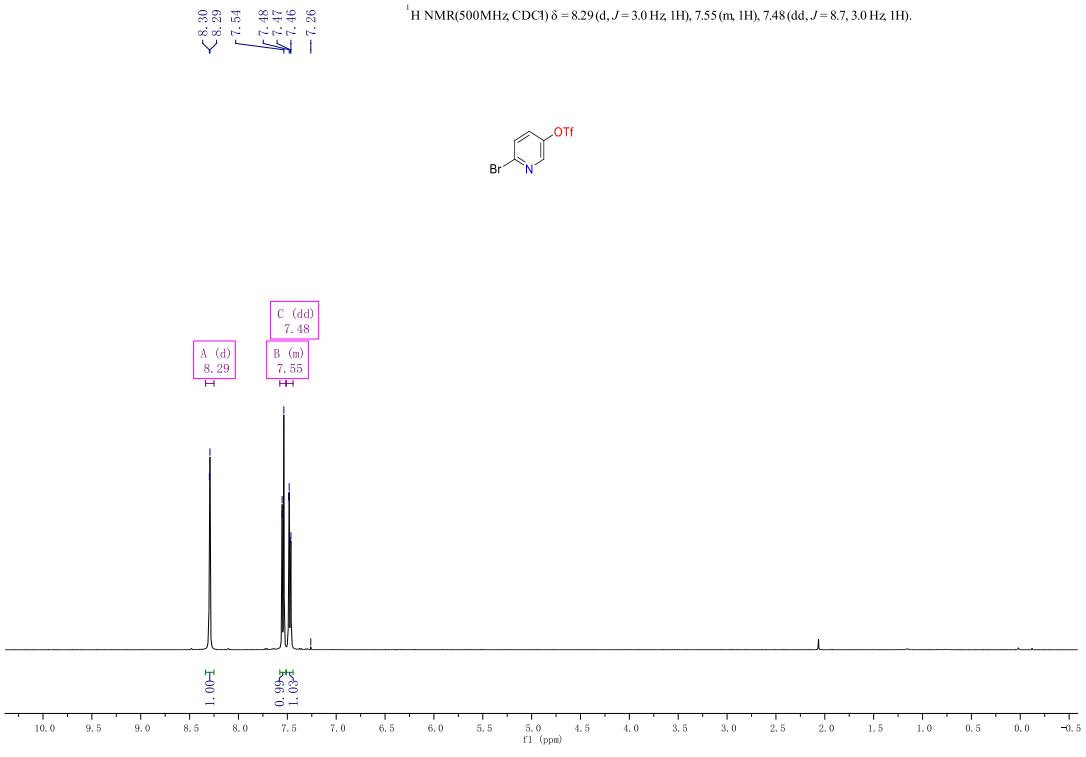



$^{13}$C NMR(126MHz, CDCl) δ = 163.18 (d, *J* = 239.4 Hz), 145.91 (d, *J* = 14.9 Hz), 139.84 (d, *J* = 7.9 Hz), 136.77, 134.94 (d, *J* = 4.6 Hz), 128.27, 128.20 (d, *J* = 26.46 Hz), 109.55 (d, *J* = 37.8 Hz).

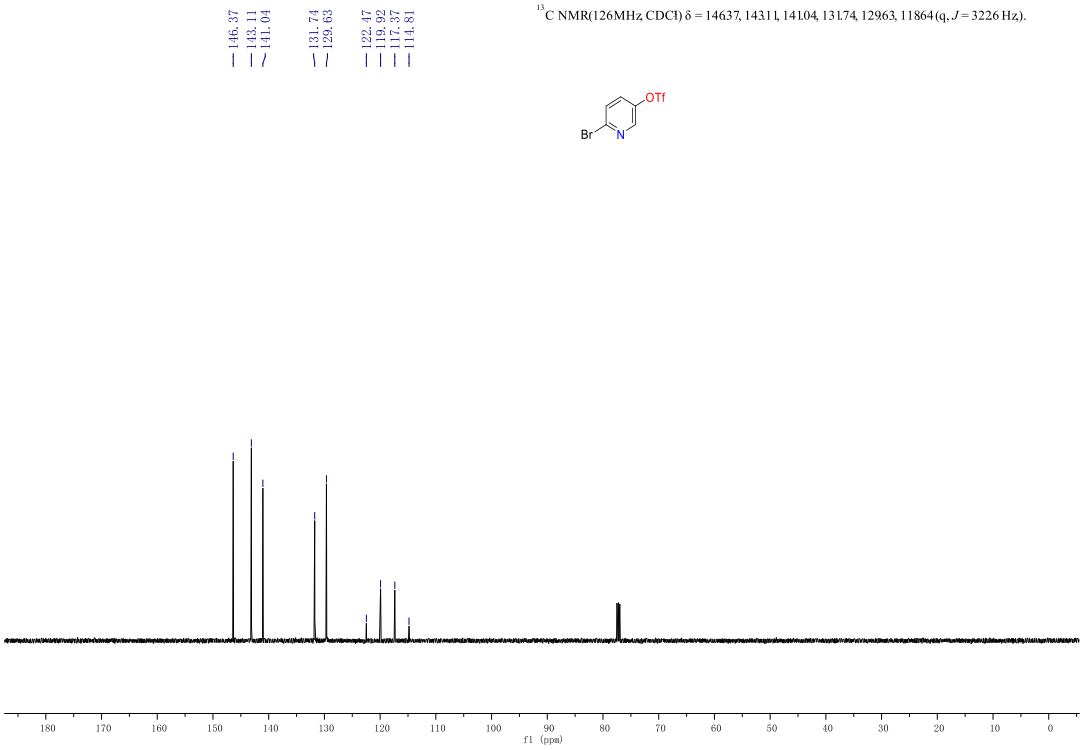



$^{19}$F NMR(282MHz, CDCl) δ = 55.31, 36.75.

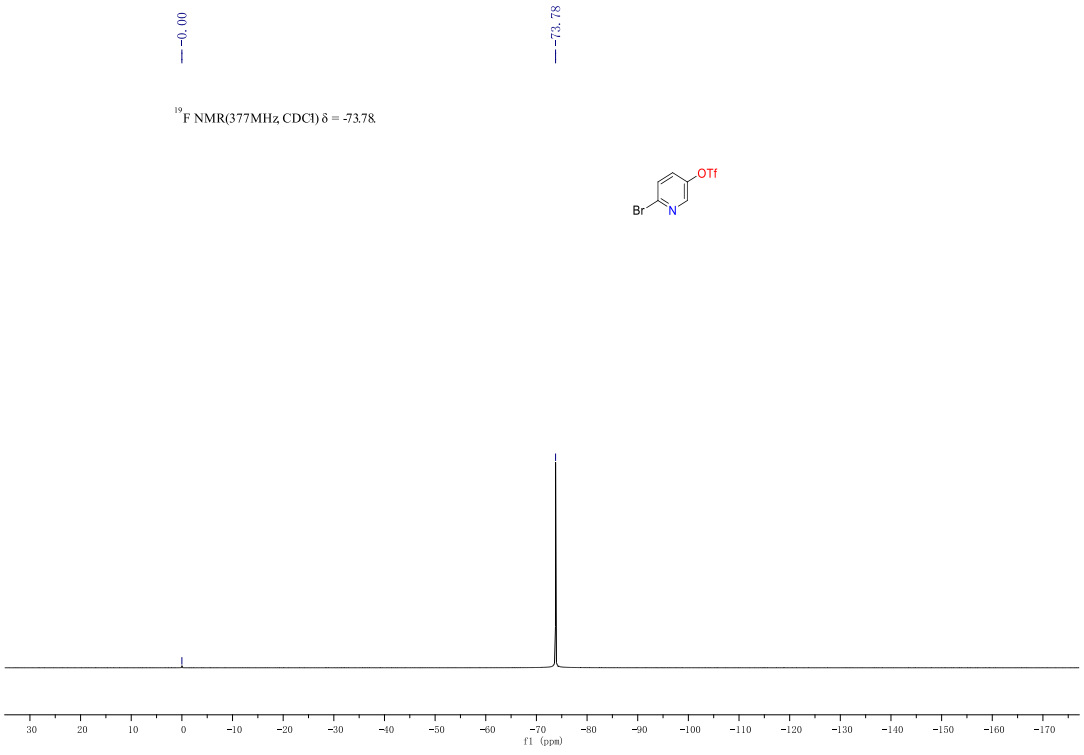
Compound **8**. *6-Bromopyridin-3-yl triflate*




$^{1}$H NMR(500MHz, CDCl) δ = 8.29 (d, *J* = 3.0 Hz, 1H), 7.55 (m, 1H), 7.48 (dd, *J* = 8.7, 3.0 Hz, 1H).

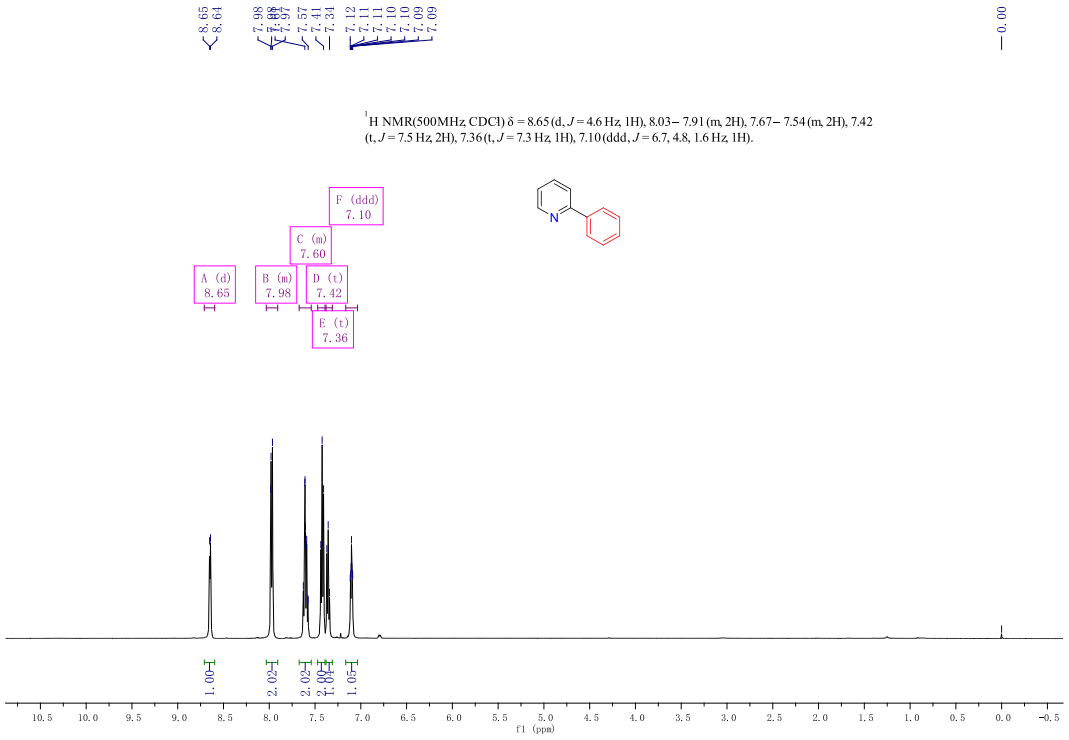



$^{13}$C NMR(126MHz, CDCl) δ = 146.37, 143.11, 141.04, 131.74, 129.63, 118.64 (q, $J$ = 322.6 Hz).



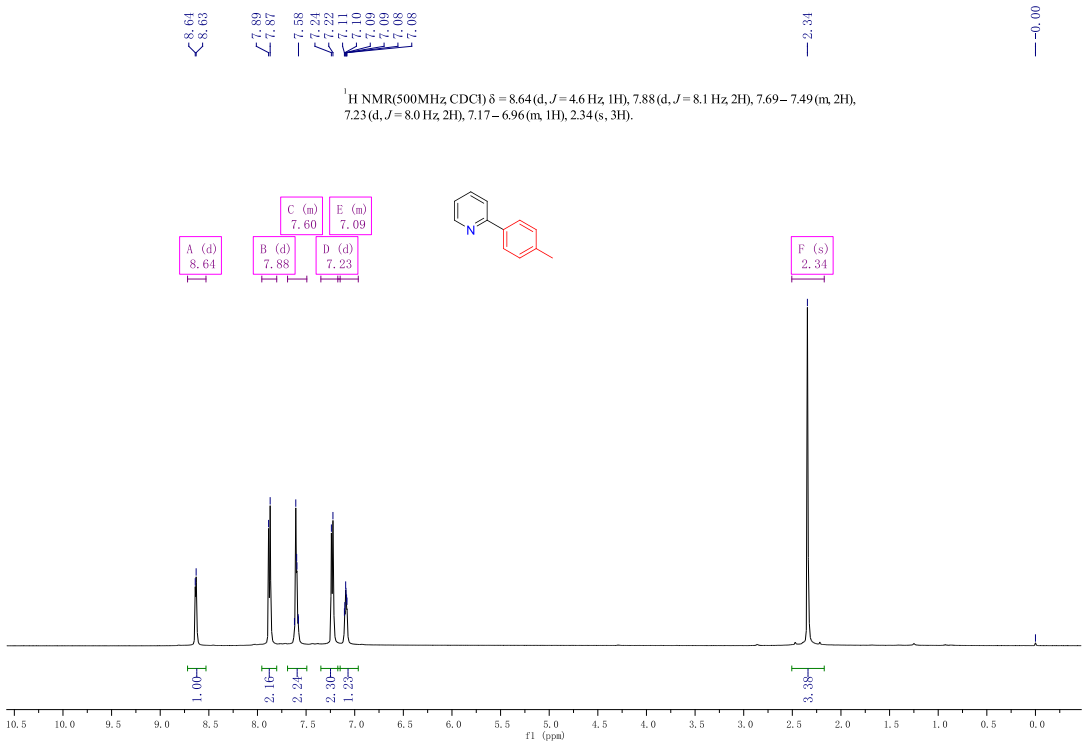

$^{19}$F NMR(377MHz, CDCl) δ = -73.78.

Compound **3-1**. *2-Phenylpyridine*



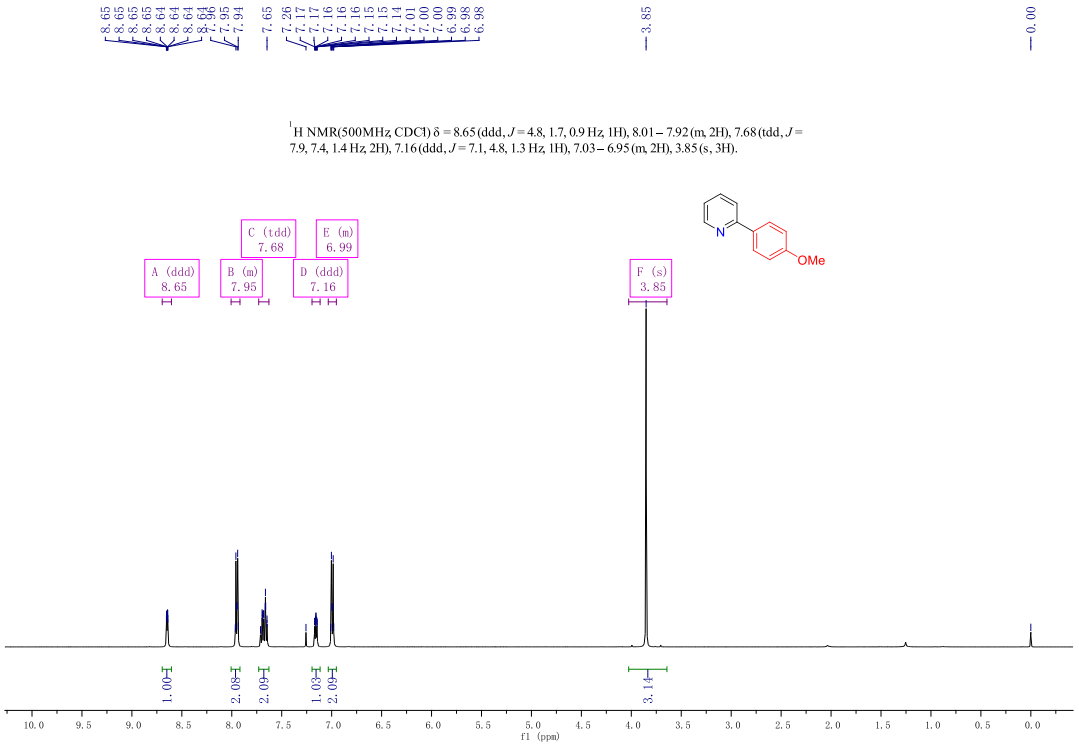

$^1$H NMR(500MHz, CDCl) δ = 8.65 (d, *J* = 4.6 Hz, 1H), 8.03 – 7.91 (m, 2H), 7.67 – 7.54 (m, 2H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.36 (t, *J* = 7.3 Hz, 1H), 7.10 (ddd, *J* = 6.7, 4.8, 1.6 Hz, 1H).

Compound **3-2**. *2-p-Tolylpyridine*

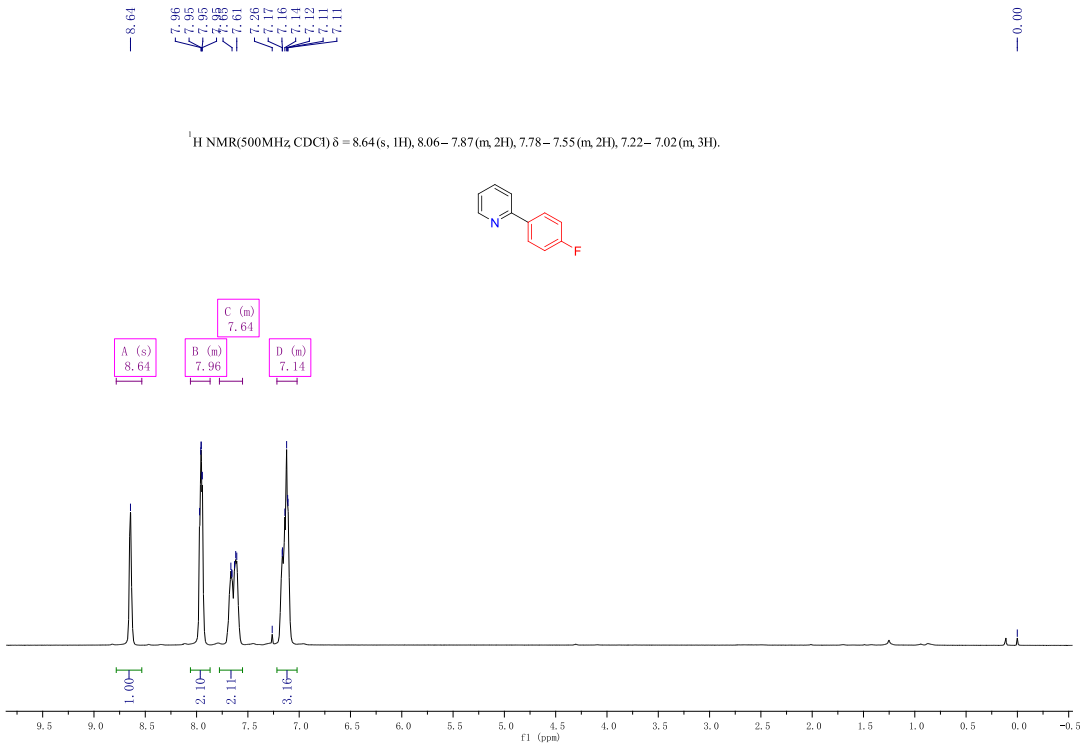


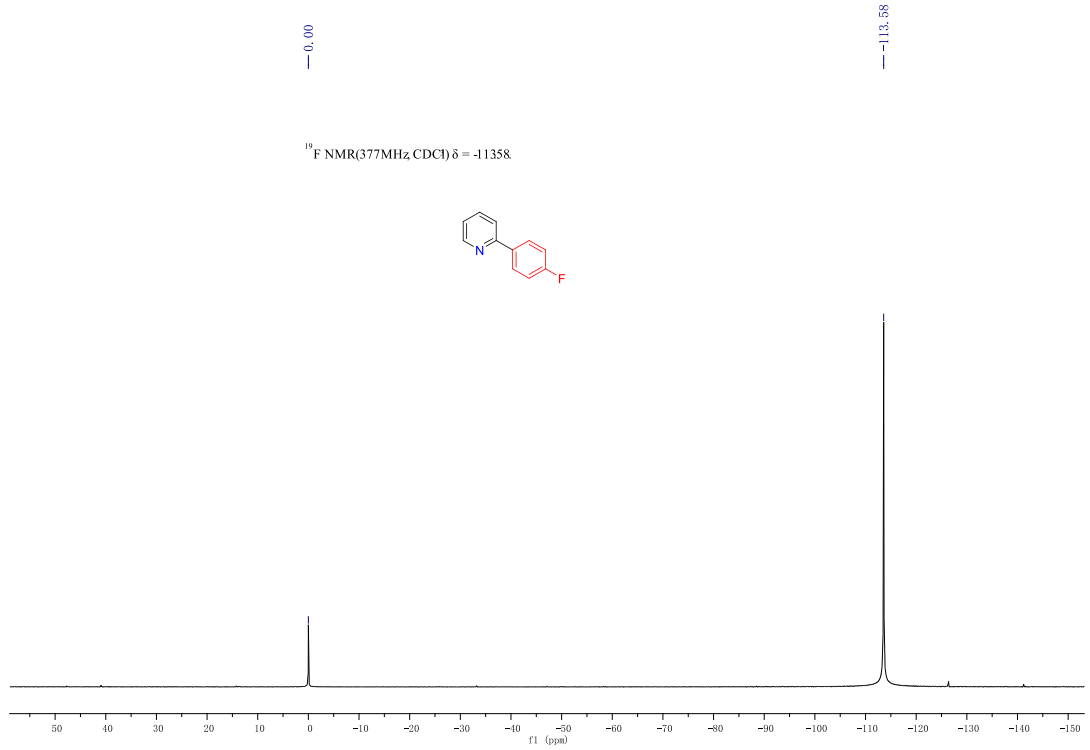

$^1$H NMR(500MHz, CDCl) δ = 8.64 (d, *J* = 4.6 Hz, 1H), 7.88 (d, *J* = 8.1 Hz, 2H), 7.69 – 7.49 (m, 2H), 7.23 (d, *J* = 8.0 Hz, 2H), 7.17 – 6.96 (m, 1H), 2.34 (s, 3H).

Compound **3-3**. *2-(4-Methoxyphenyl)pyridine*

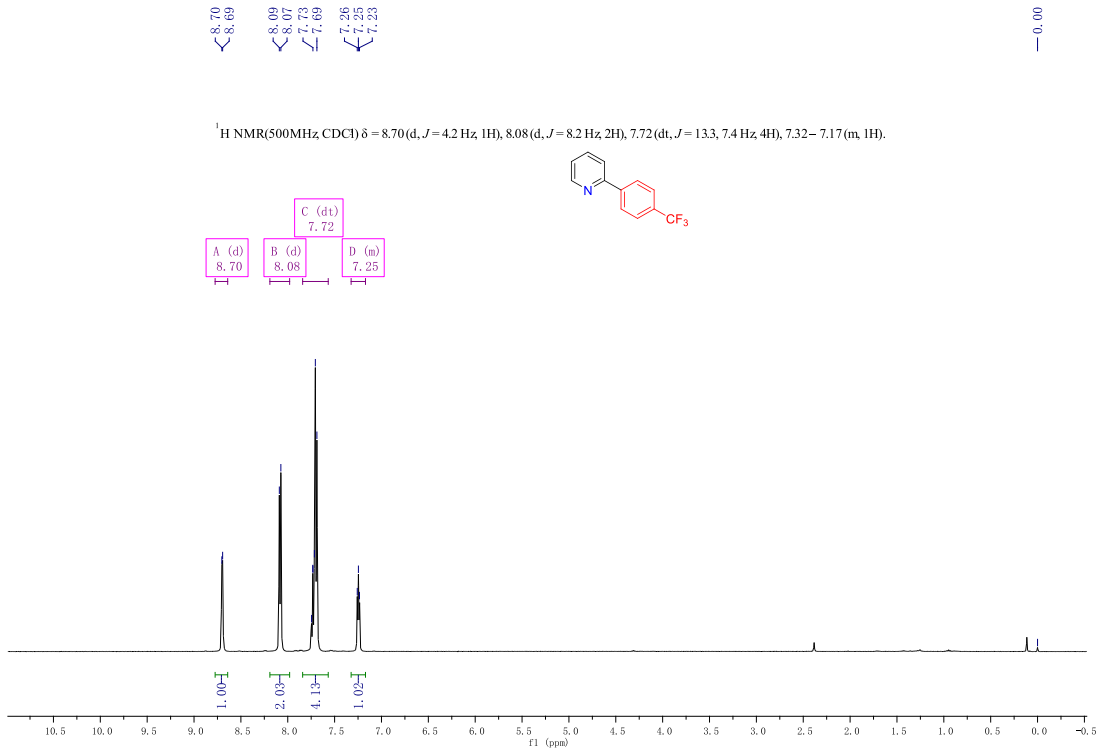


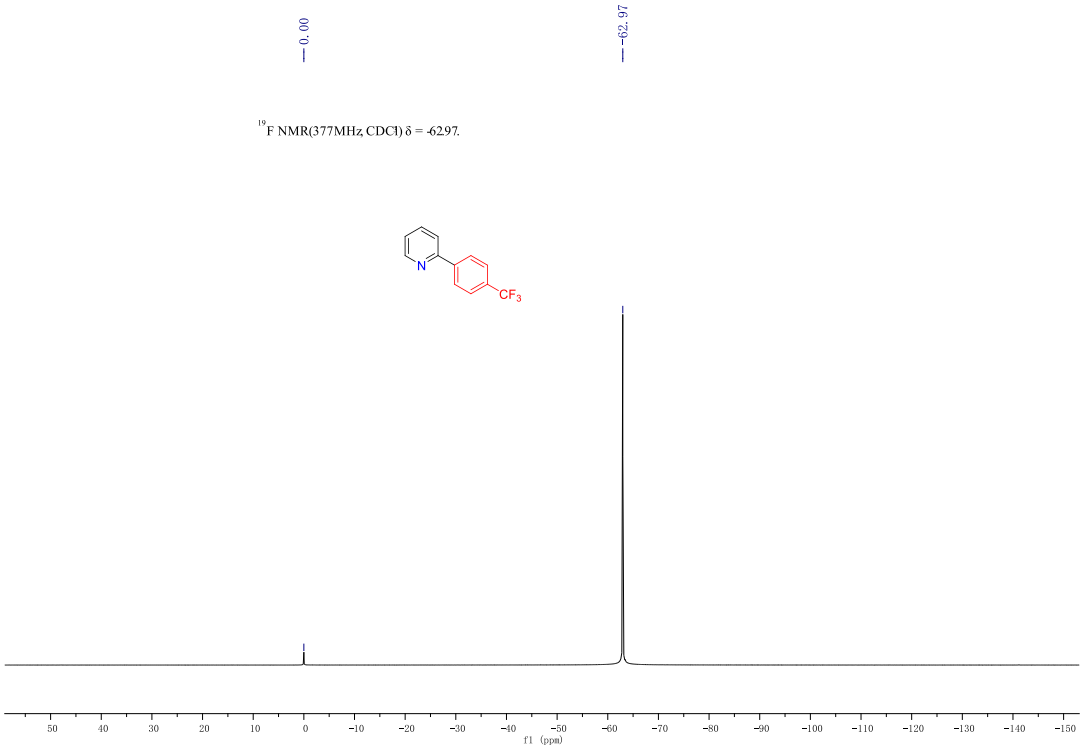

Compound **3-4**. *2-(4-Fluorophenyl)pyridine*



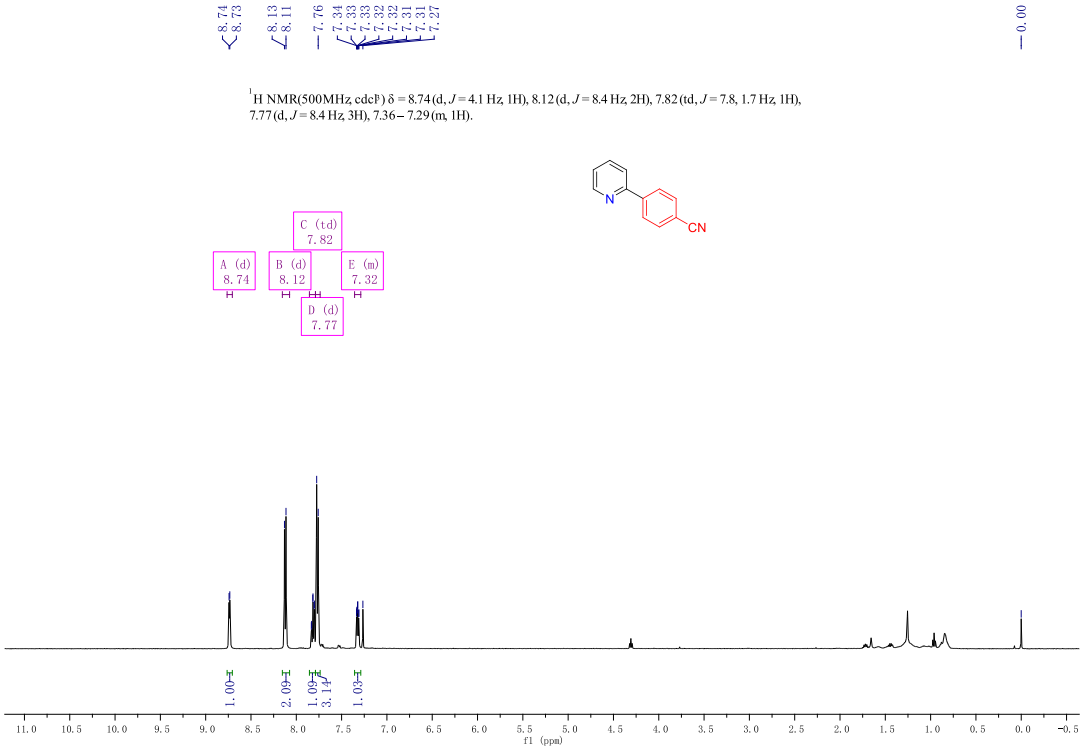



Compound **3-5**. *2-(4-(Trifluoromethyl)phenyl)pyridine*

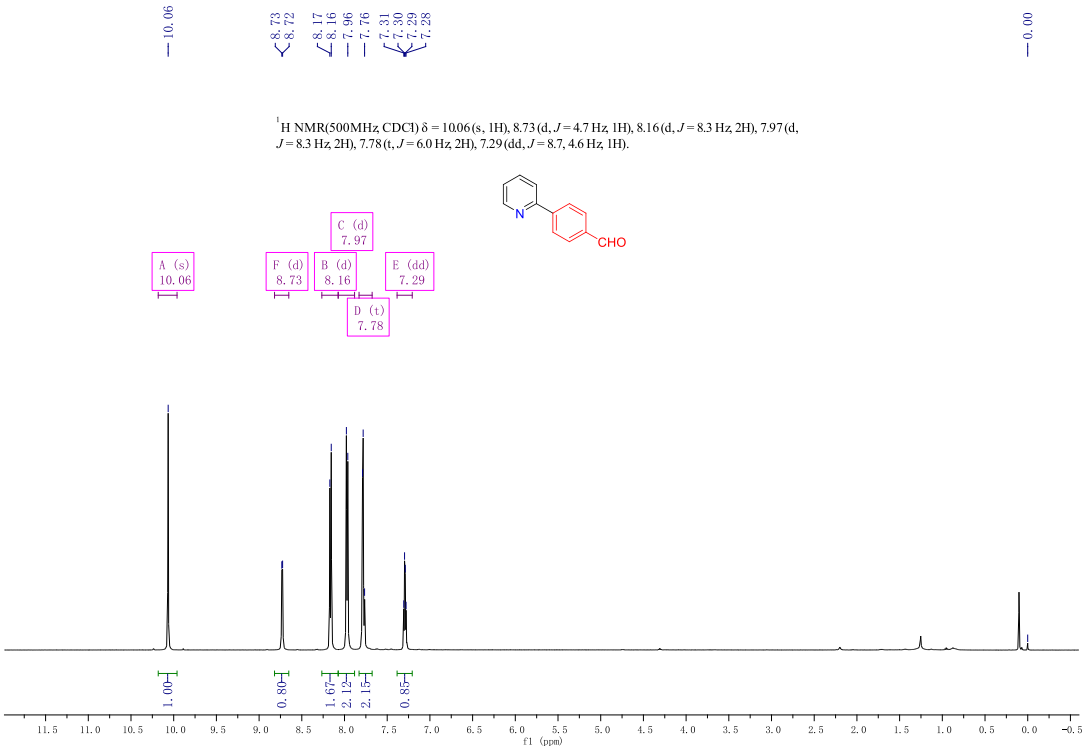





Compound **3-6**. *4-(Pyridin-2-yl)benzonitrile*

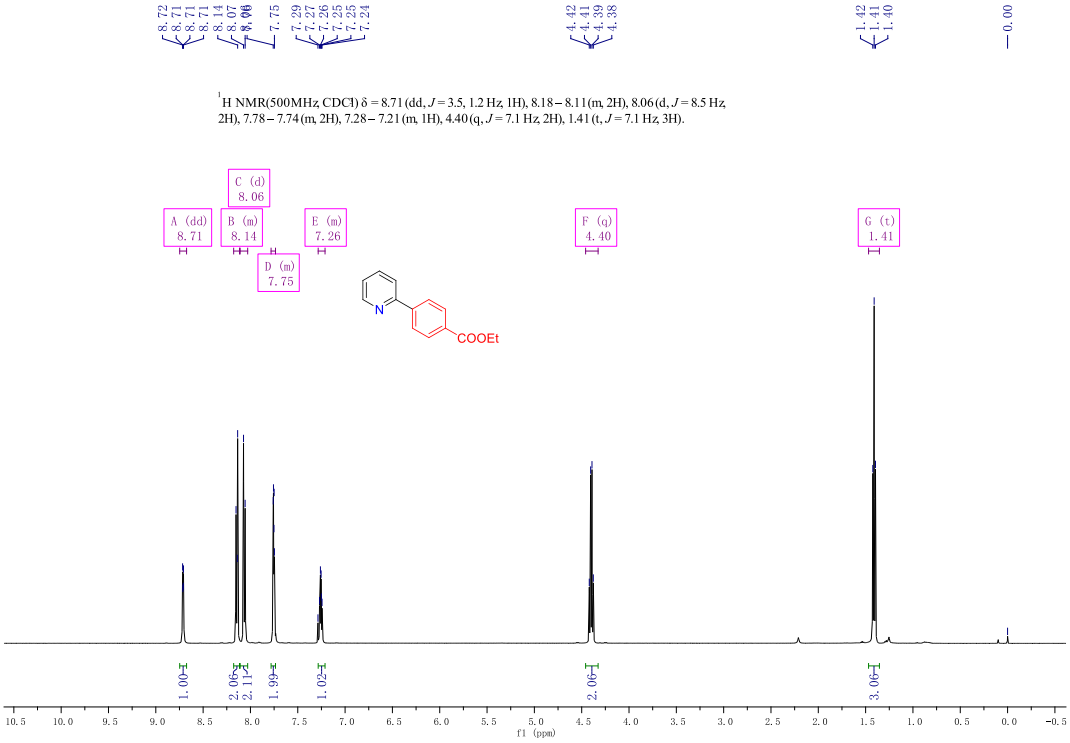


Compound **3-7**. *4-(Pyridin-2-yl)benzaldehyde*



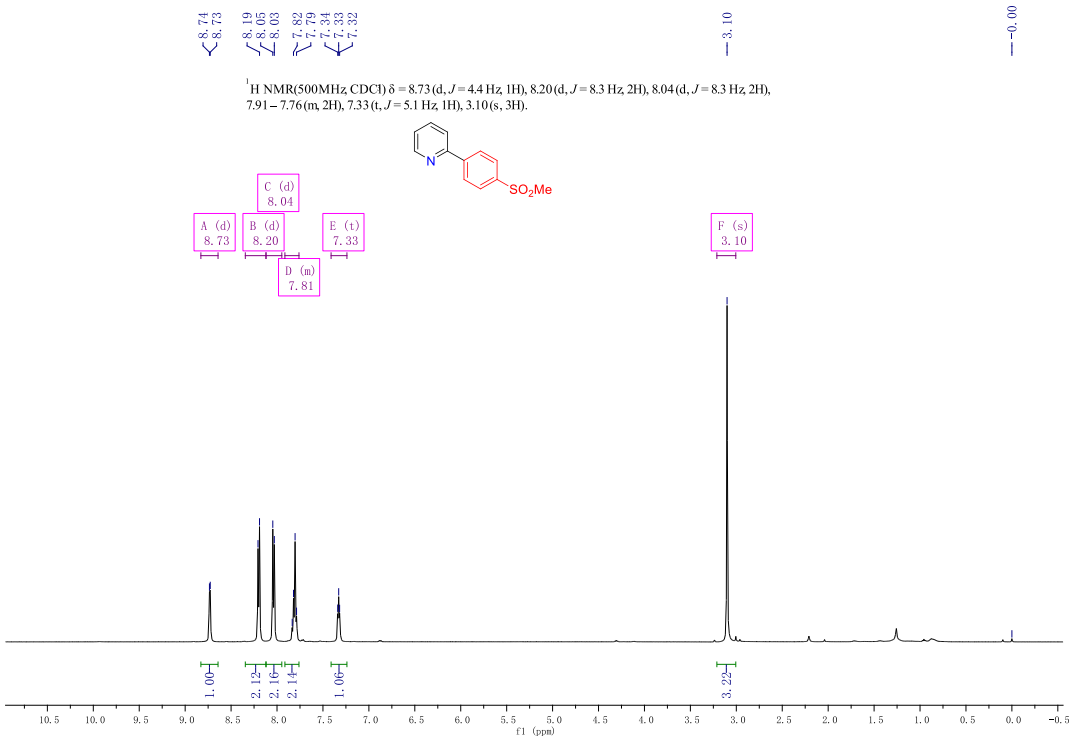

$^1$H NMR(500MHz, CDCl) δ = 10.06 (s, 1H), 8.73 (d, *J* = 4.7 Hz, 1H), 8.16 (d, *J* = 8.3 Hz, 2H), 7.97 (d, *J* = 8.3 Hz, 2H), 7.78 (t, *J* = 6.0 Hz, 2H), 7.29 (dd, *J* = 8.7, 4.6 Hz, 1H).

Compound **3-8**. *Ethyl 4-(pyridin-2-yl)benzoate*

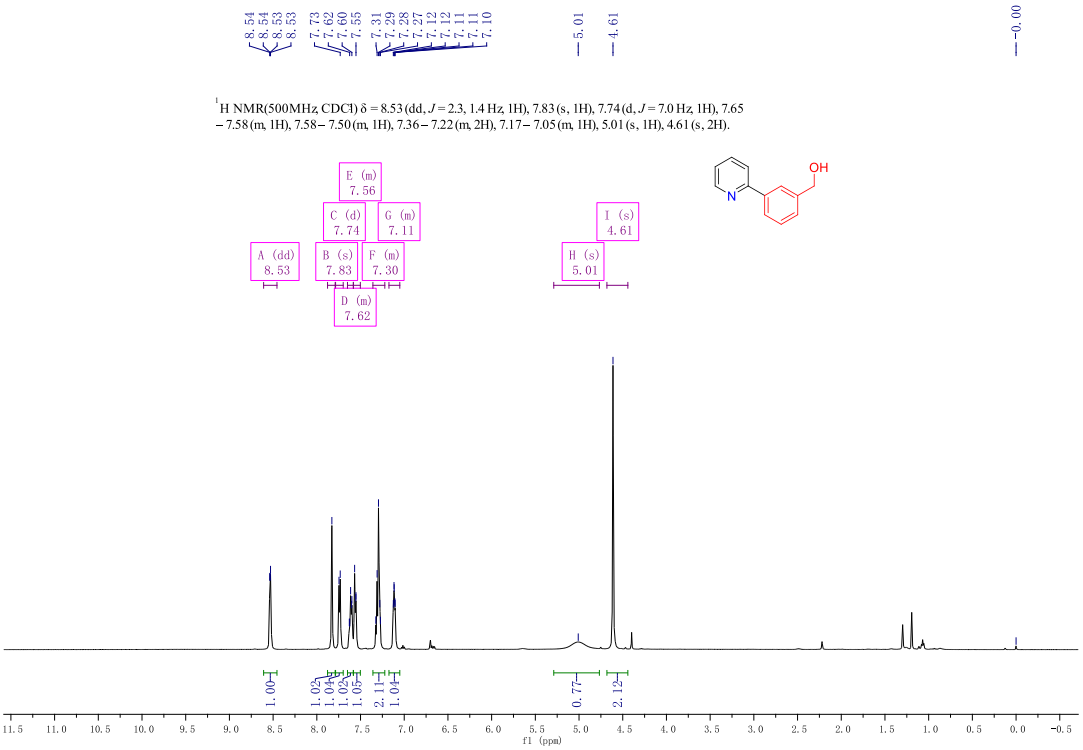



$^1$H NMR(500MHz, CDCl) δ = 8.71 (dd, *J* = 3.5, 1.2 Hz, 1H), 8.18 – 8.11 (m, 2H), 8.06 (d, *J* = 8.5 Hz, 2H), 7.78 – 7.74 (m, 2H), 7.28 – 7.21 (m, 1H), 4.40 (q, *J* = 7.1 Hz, 2H), 1.41 (t, *J* = 7.1 Hz, 3H).

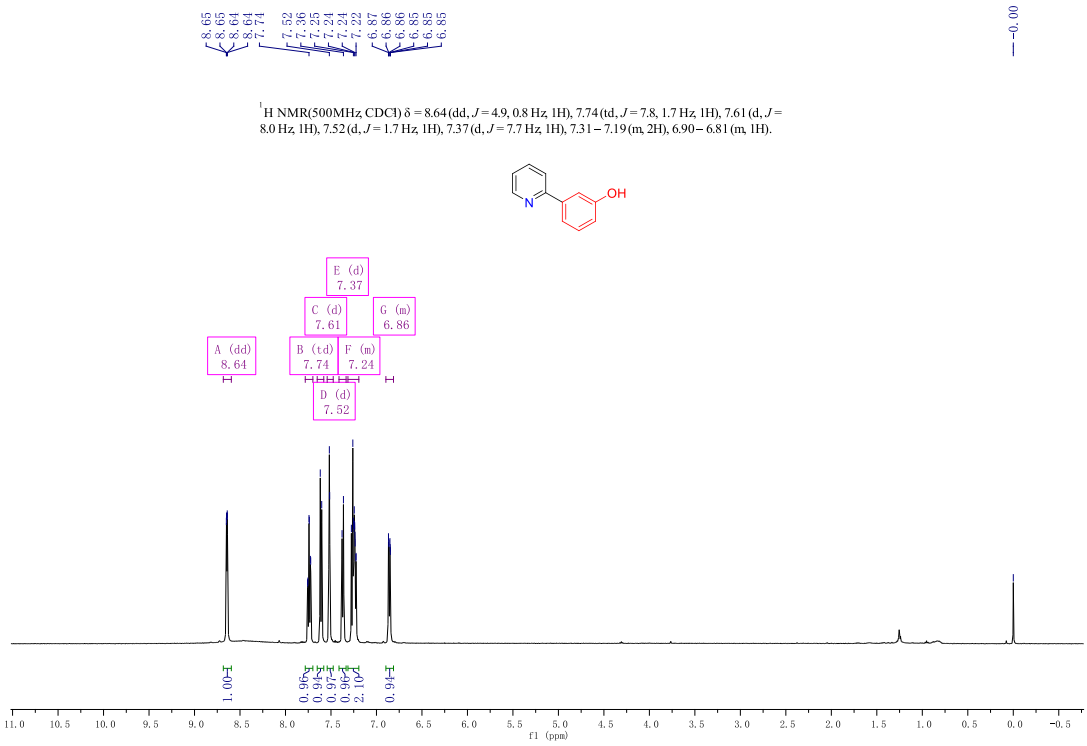
Compound **3-9**. *2-(4-(methylsulfonyl)phenyl)pyridine*



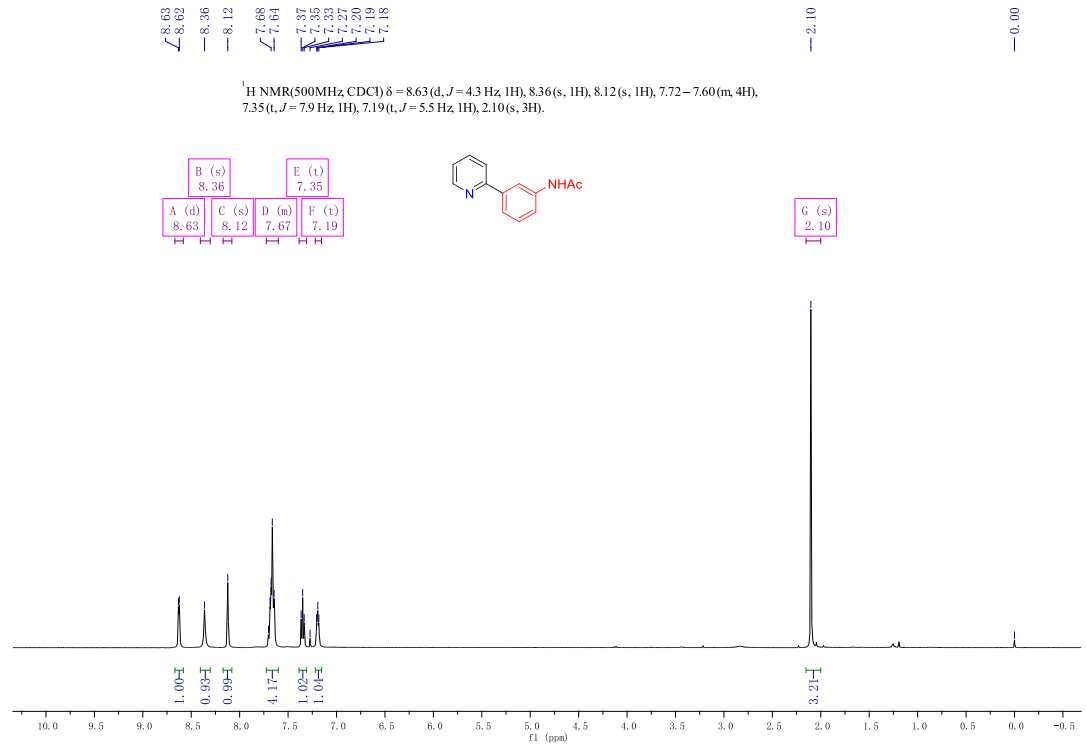

Compound **3-10**. *(3-(Pyridin-2-yl)phenyl)methanol*



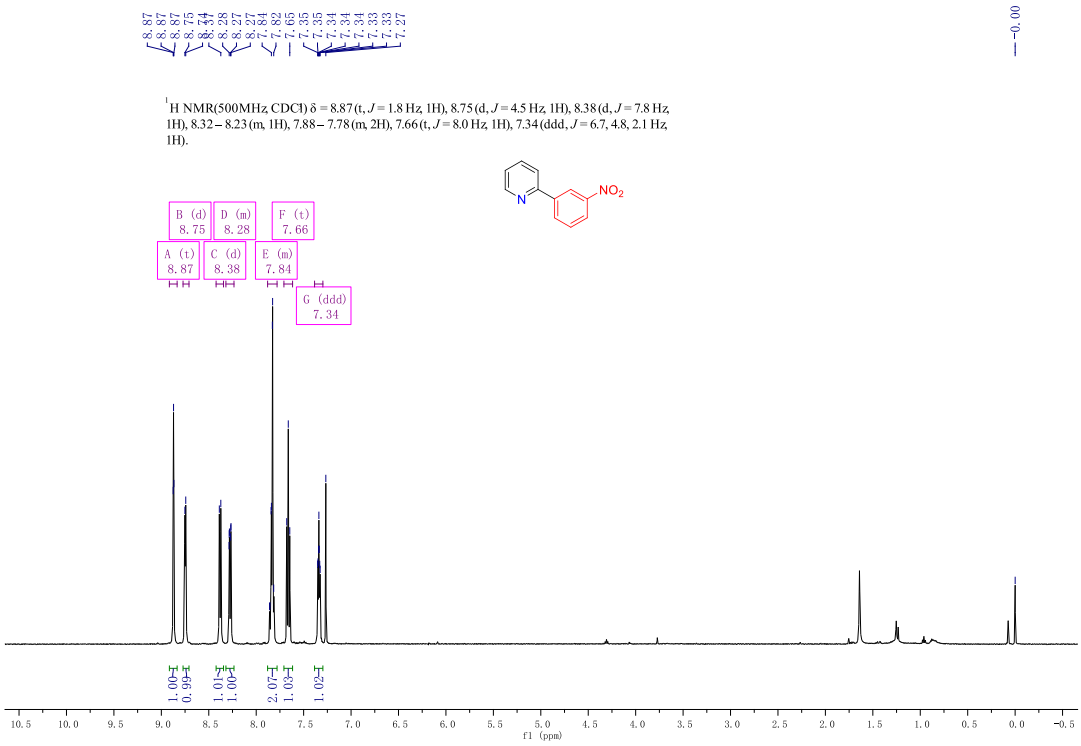
Compound **3-11**. *3-(pyridin-2-yl)phenol* (***5-11***)



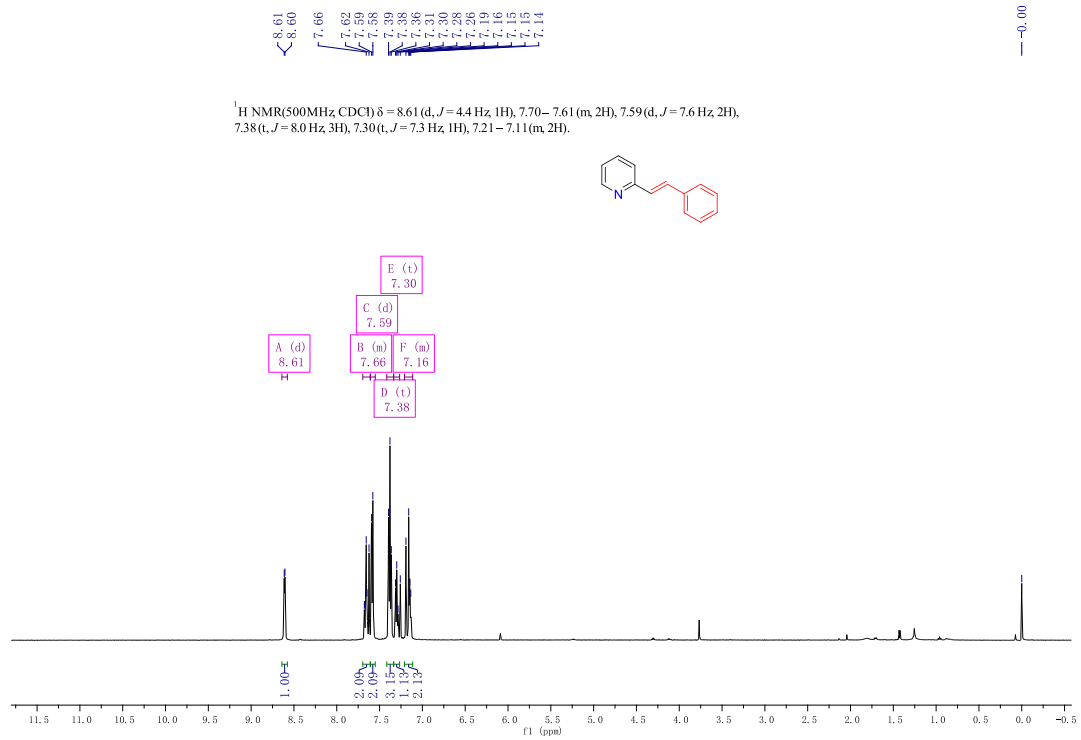

Compound **3-12**. *N-(3-(pyridin-2-yl)phenyl)acetamide*



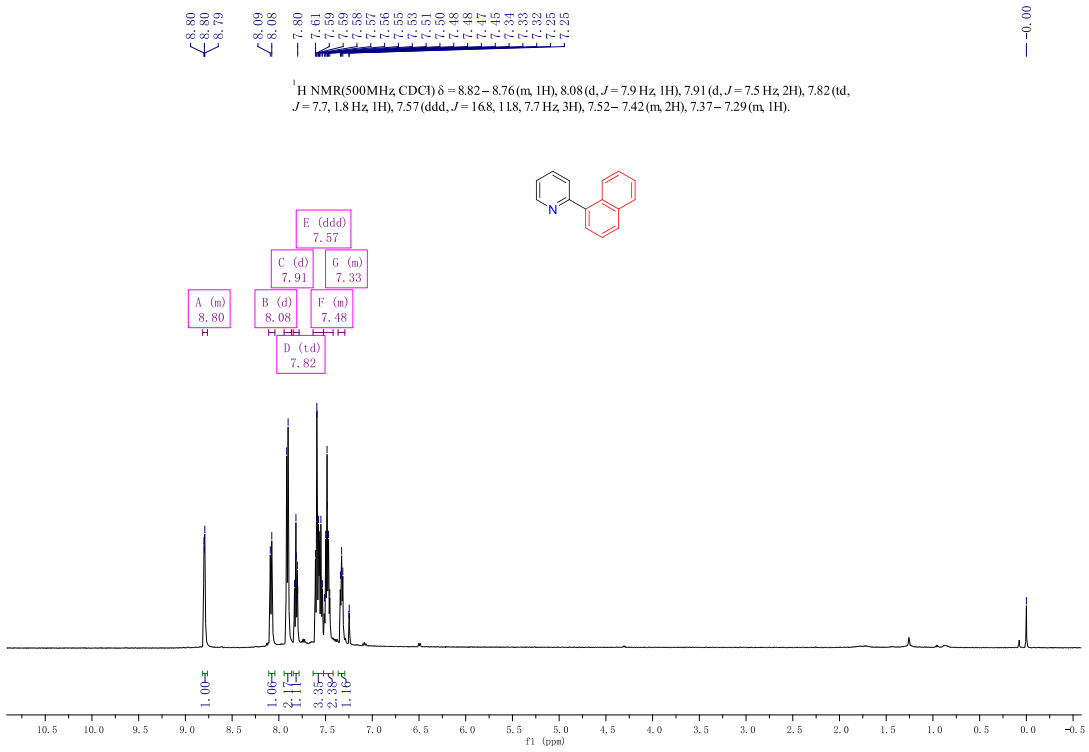
Compound **3-13**. *2-(3-nitrophenyl)pyridine*



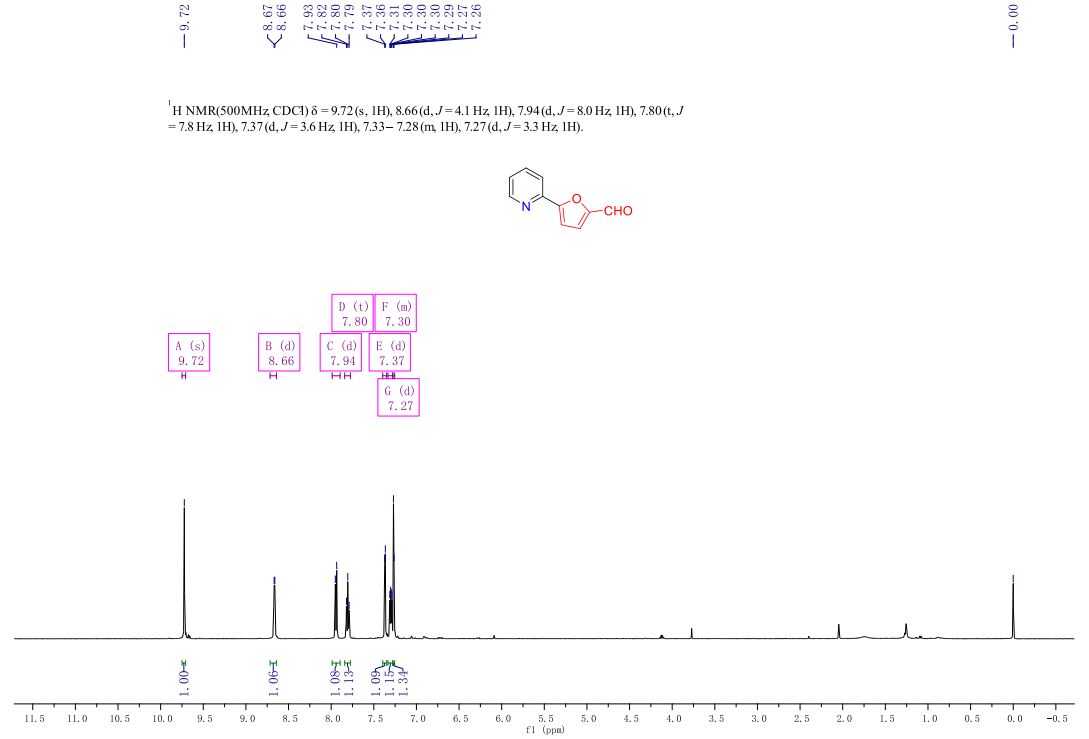

Compound **3-14**. *(E)-2-styrylpyridine*



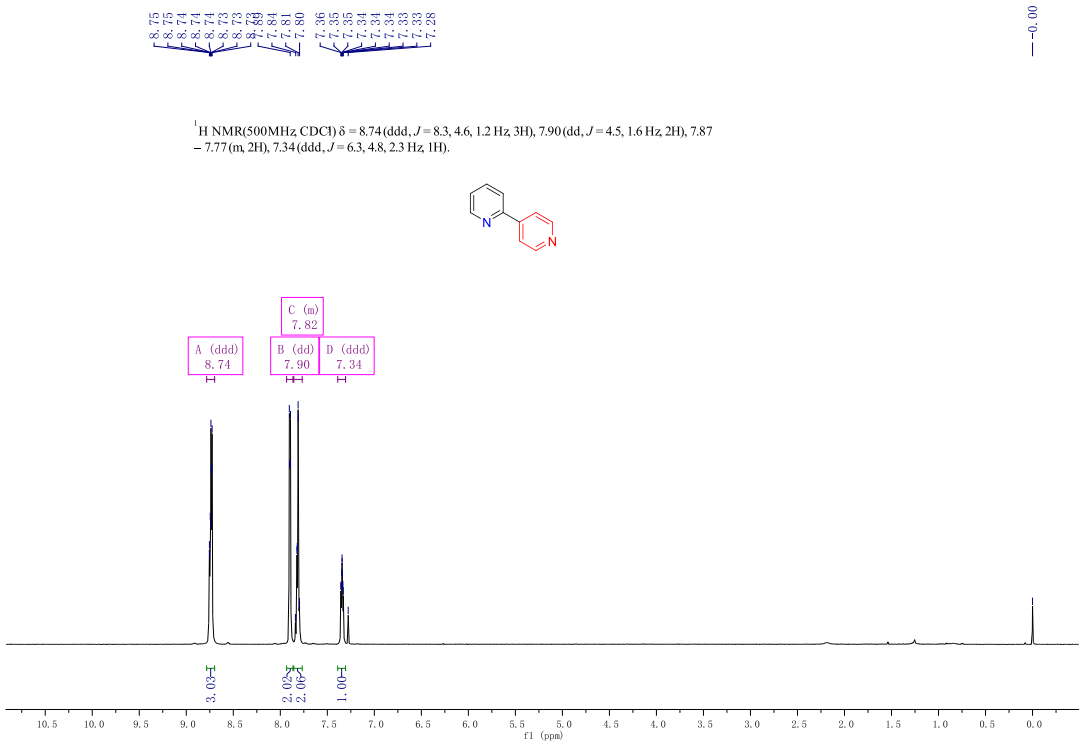
Compound **3-15**. *2-(Naphthalen-1-yl)pyridine*




Compound **3-16**. *5-(Pyridin-2-yl)furan-2-carbaldehyde*

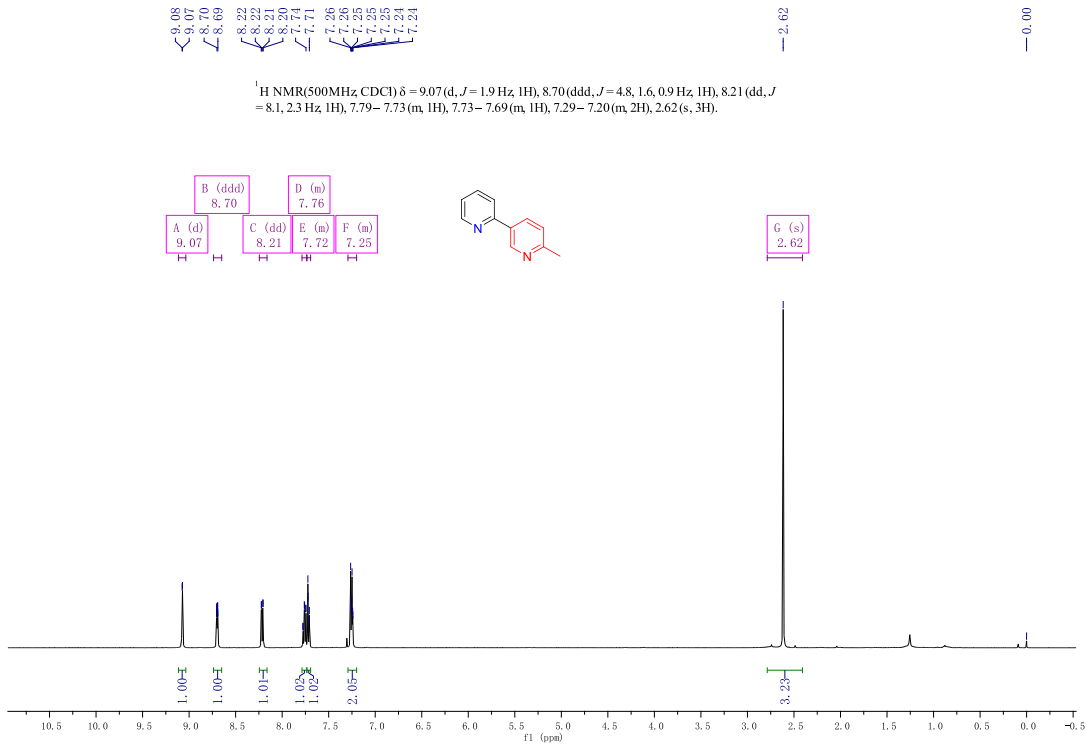


Compound **3-17**. *2,4'-Bipyridine*



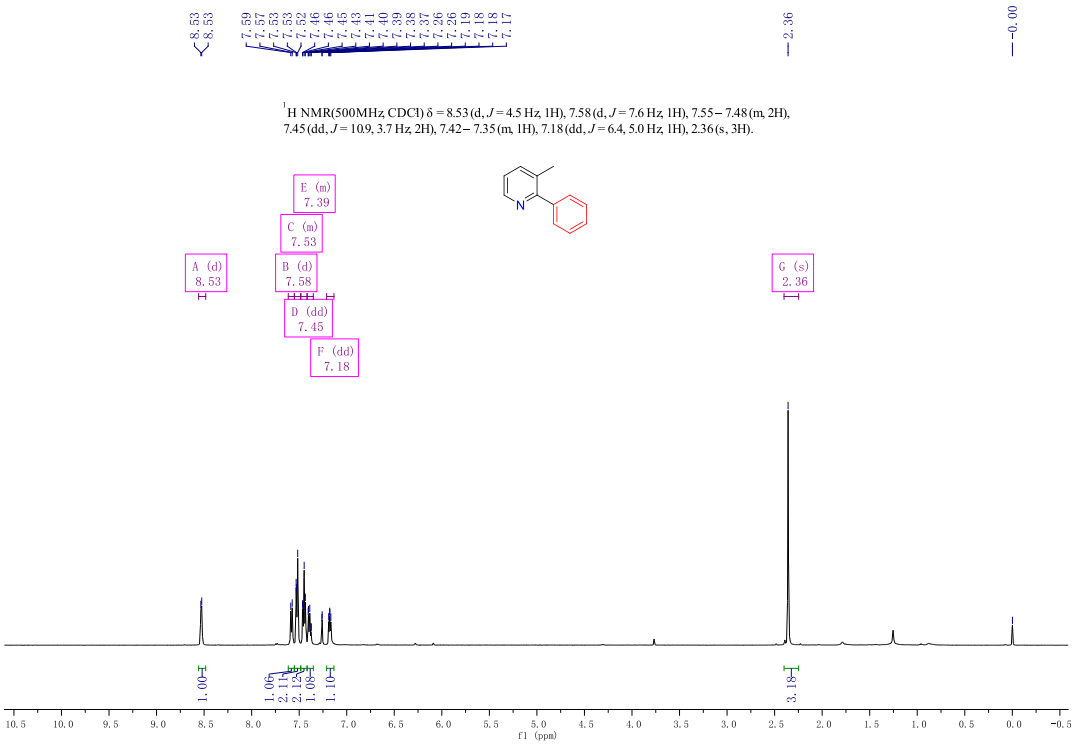

$^1$H NMR(500MHz, CDCl) δ = 8.74 (ddd, *J* = 8.3, 4.6, 1.2 Hz, 3H), 7.90 (dd, *J* = 4.5, 1.6 Hz, 2H), 7.87 – 7.77 (m, 2H), 7.34 (ddd, *J* = 6.3, 4.8, 2.3 Hz, 1H).

Compound **3-18**. *6'-Methyl-2,3'-bipyridine*

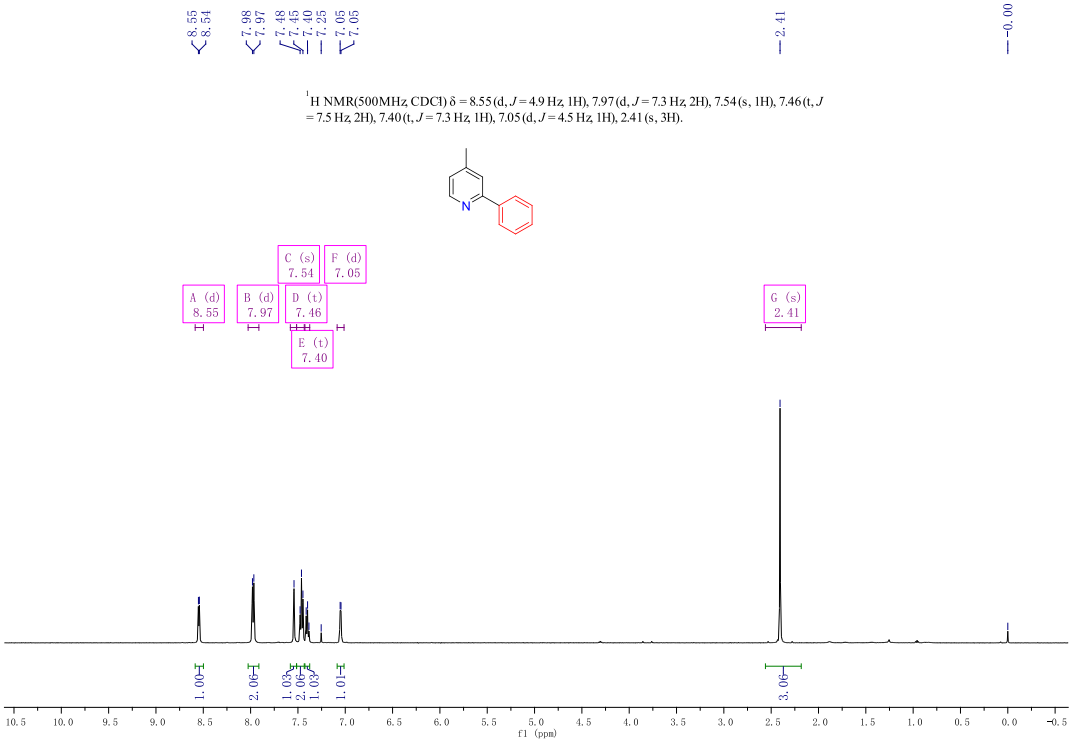



$^1$H NMR(500MHz, CDCl) δ = 9.07 (d, *J* = 1.9 Hz, 1H), 8.70 (ddd, *J* = 4.8, 1.6, 0.9 Hz, 1H), 8.21 (dd, *J* = 8.1, 2.3 Hz, 1H), 7.79 – 7.73 (m, 1H), 7.73 – 7.69 (m, 1H), 7.29 – 7.20 (m, 2H), 2.62 (s, 3H).

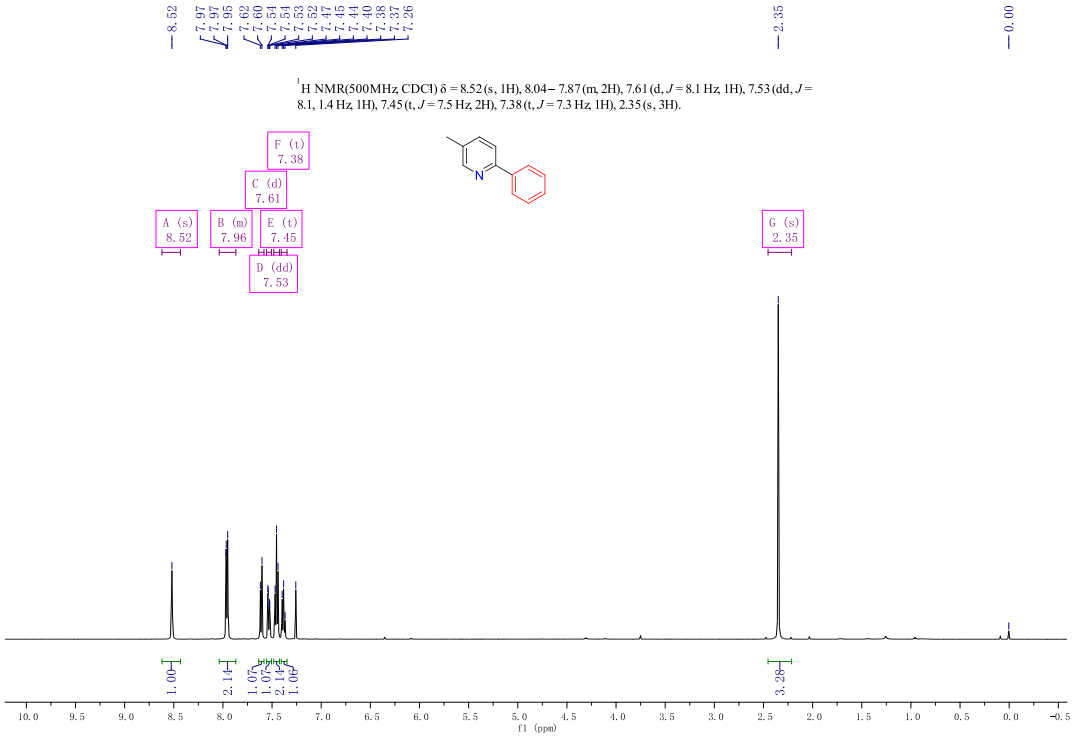
Compound **4-1**. *3-Methyl-2-phenylpyridine*




Compound **4-2**. *4-Methyl-2-phenylpyridine*

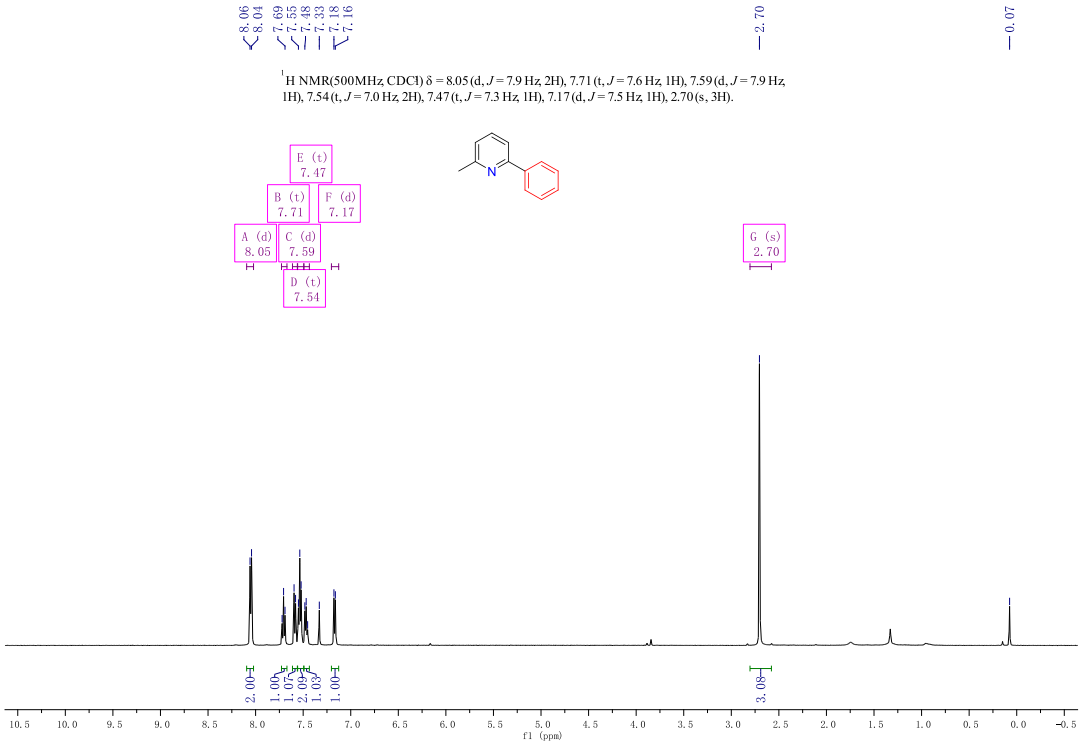


Compound **4-3**. *5-Methyl-2-phenylpyridine*



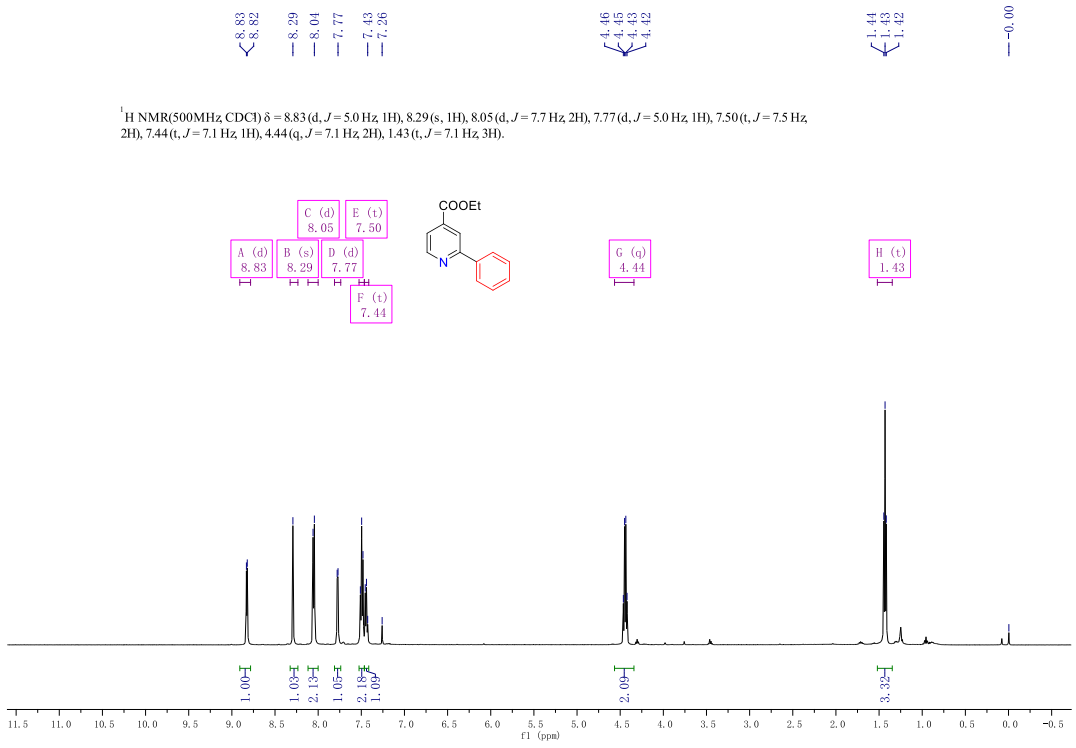

$^1$H NMR(500MHz, CDCl) δ = 8.52 (s, 1H), 8.04– 7.87 (m, 2H), 7.61 (d, *J* = 8.1 Hz, 1H), 7.53 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.45 (t, *J* = 7.5 Hz, 2H), 7.38 (t, *J* = 7.3 Hz, 1H), 2.35 (s, 3H).

Compound **4-4**. *6-Methyl-2-phenylpyridine*



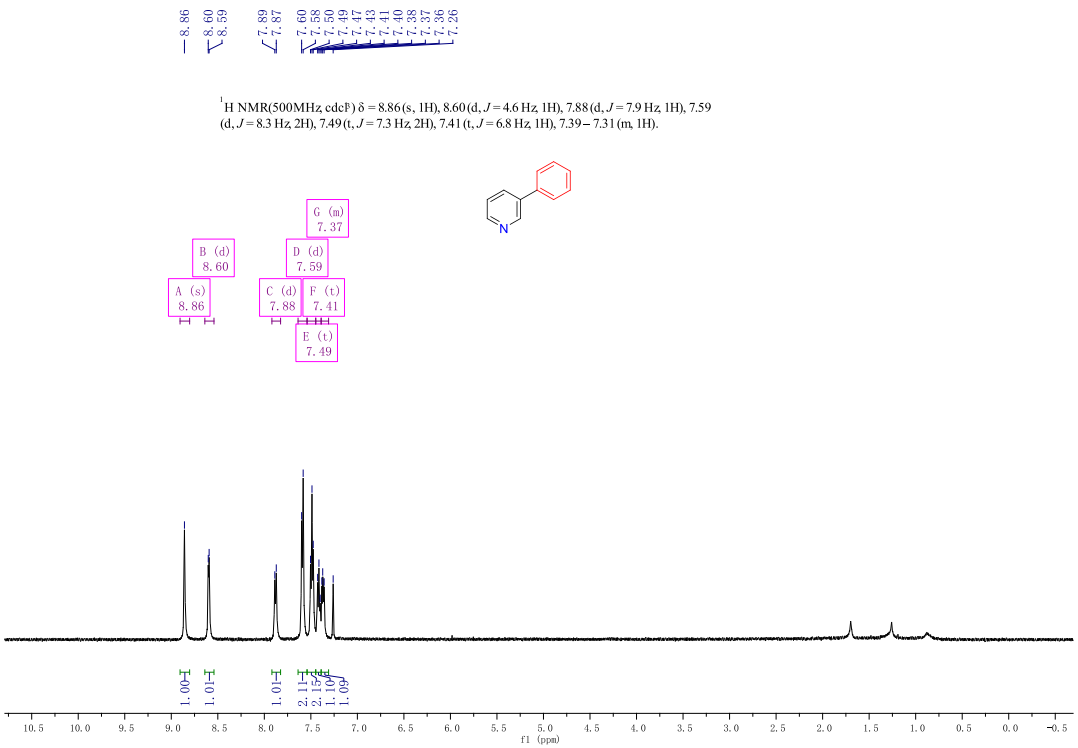

$^1$H NMR(500MHz, CDCl) δ = 8.05 (d, *J* = 7.9 Hz, 2H), 7.71 (t, *J* = 7.6 Hz, 1H), 7.59 (d, *J* = 7.9 Hz, 1H), 7.54 (t, *J* = 7.0 Hz, 2H), 7.47 (t, *J* = 7.3 Hz, 1H), 7.17 (d, *J* = 7.5 Hz, 1H), 2.70 (s, 3H).

Compound **4-5**. *Ethyl 2-phenylisonicotinate*



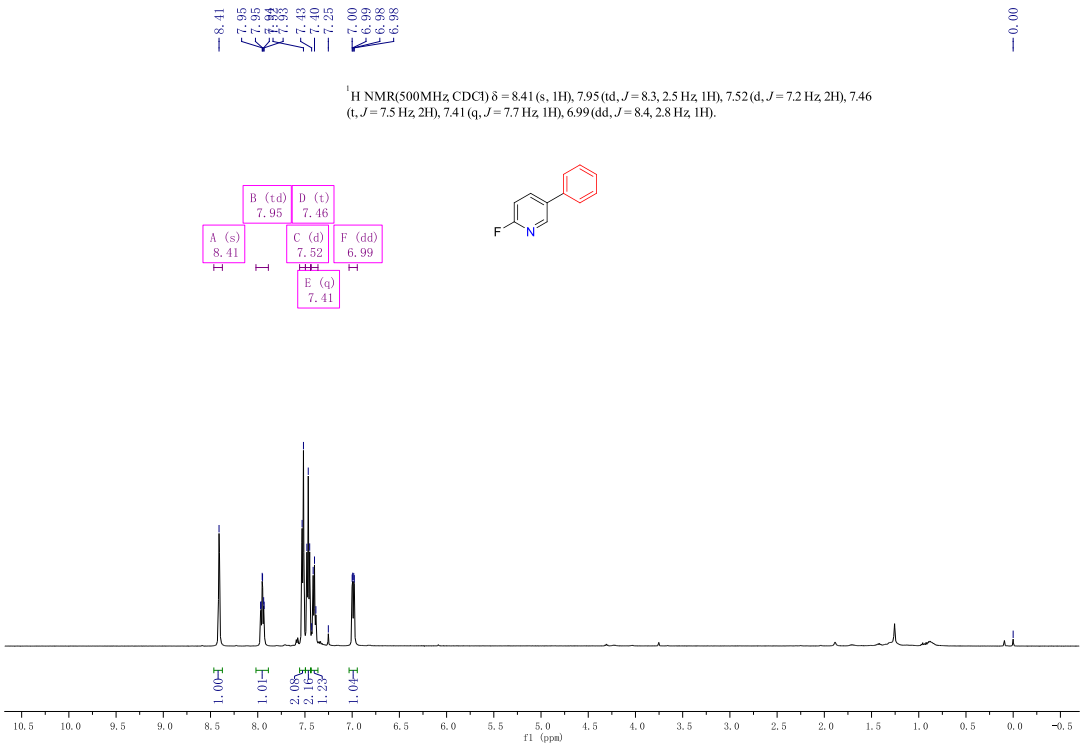

$^1$H NMR(500MHz, CDCl) δ = 8.83 (d, *J* = 5.0 Hz, 1H), 8.29 (s, 1H), 8.05 (d, *J* = 7.7 Hz, 2H), 7.77 (d, *J* = 5.0 Hz, 1H), 7.50 (t, *J* = 7.5 Hz, 2H), 7.44 (t, *J* = 7.1 Hz, 1H), 4.44 (q, *J* = 7.1 Hz, 2H), 1.43 (t, *J* = 7.1 Hz, 3H).

Compound **4-6**. *3-Phenylpyridine*



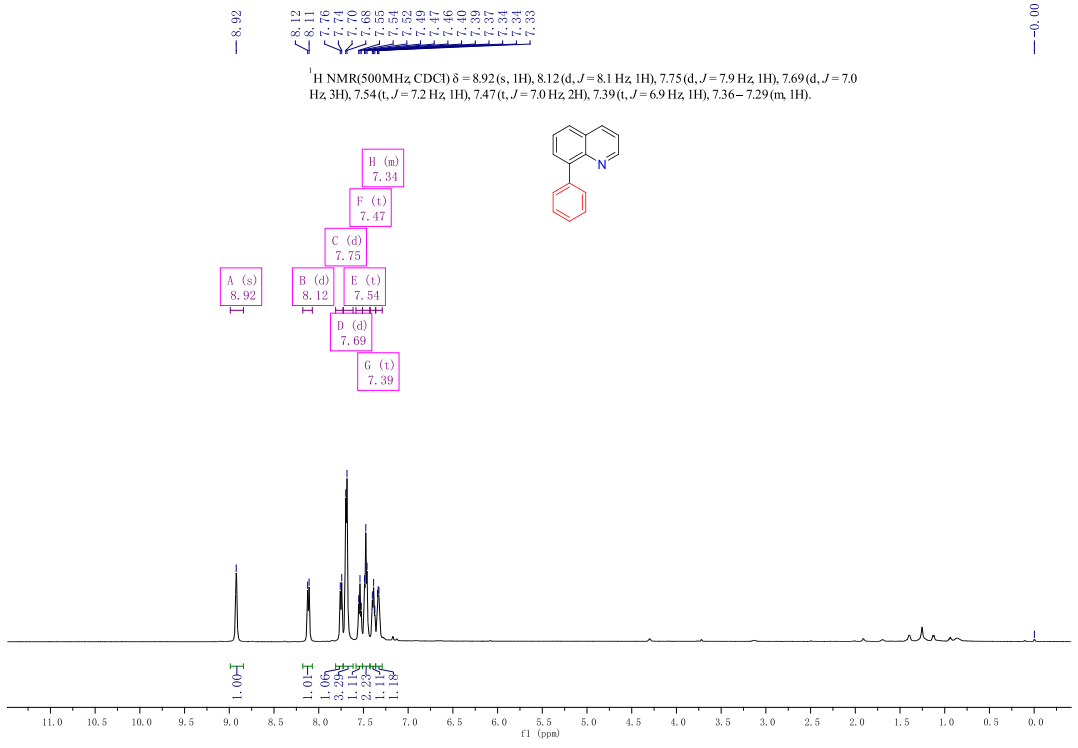

$^1$H NMR(500MHz, cdcl$^3$) δ = 8.86 (s, 1H), 8.60 (d, *J* = 4.6 Hz, 1H), 7.88 (d, *J* = 7.9 Hz, 1H), 7.59 (d, *J* = 8.3 Hz, 2H), 7.49 (t, *J* = 7.3 Hz, 2H), 7.41 (t, *J* = 6.8 Hz, 1H), 7.39 – 7.31 (m, 1H).

Compound **4-7**. *2-Fluoro-5-phenylpyridine*



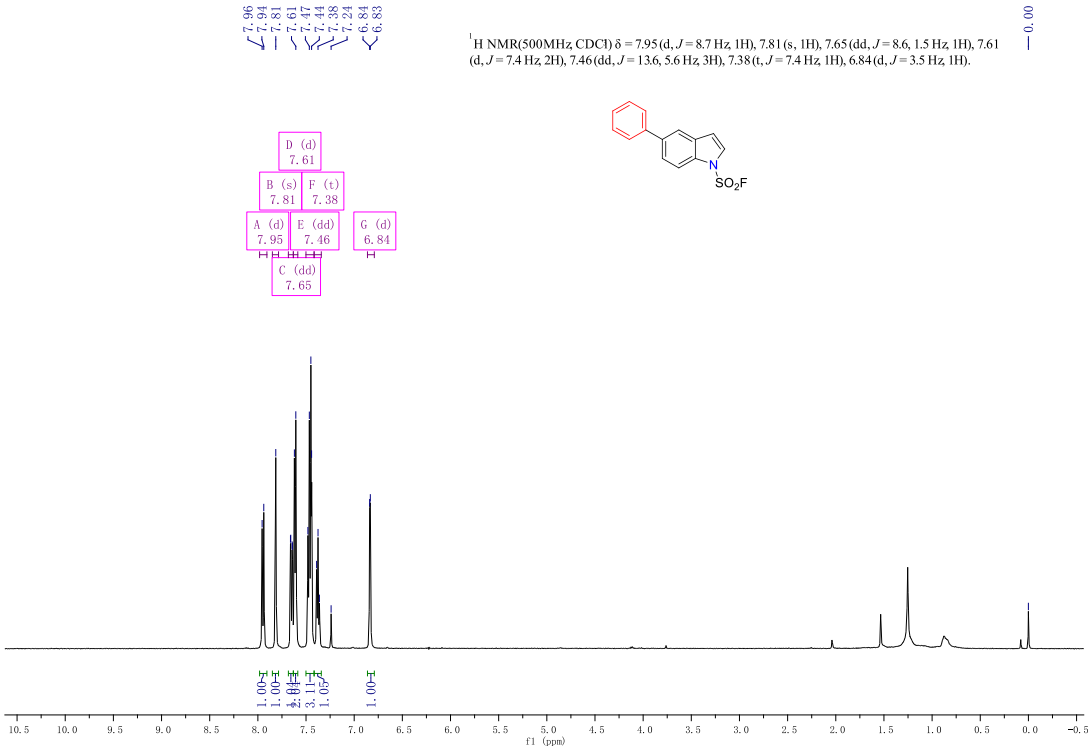

$^1$H NMR(500MHz, CDCl) δ = 8.41 (s, 1H), 7.95 (td, *J* = 8.3, 2.5 Hz, 1H), 7.52 (d, *J* = 7.2 Hz, 2H), 7.46 (t, *J* = 7.5 Hz, 2H), 7.41 (q, *J* = 7.7 Hz, 1H), 6.99 (dd, *J* = 8.4, 2.8 Hz, 1H).

Compound **4-8**. *8-Phenylquinoline*

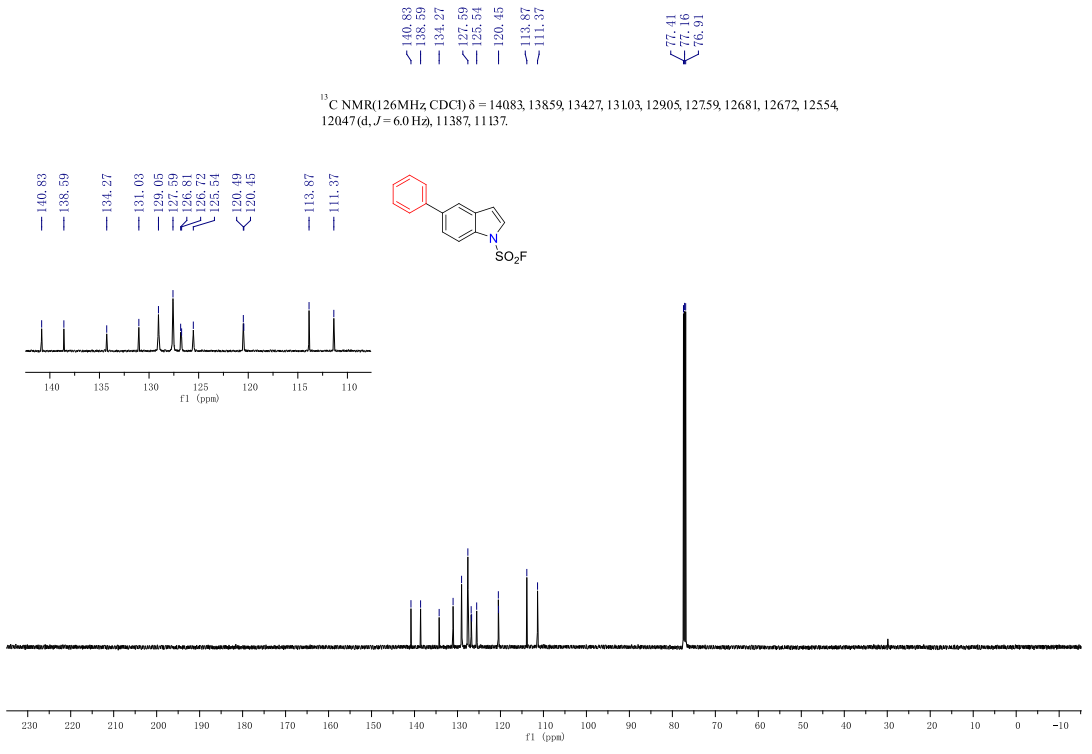



$^1$H NMR(500MHz, CDCl) δ = 8.92 (s, 1H), 8.12 (d, *J* = 8.1 Hz, 1H), 7.75 (d, *J* = 7.9 Hz, 1H), 7.69 (d, *J* = 7.0 Hz, 3H), 7.54 (t, *J* = 7.2 Hz, 1H), 7.47 (t, *J* = 7.0 Hz, 2H), 7.39 (t, *J* = 6.9 Hz, 1H), 7.36– 7.29 (m, 1H).

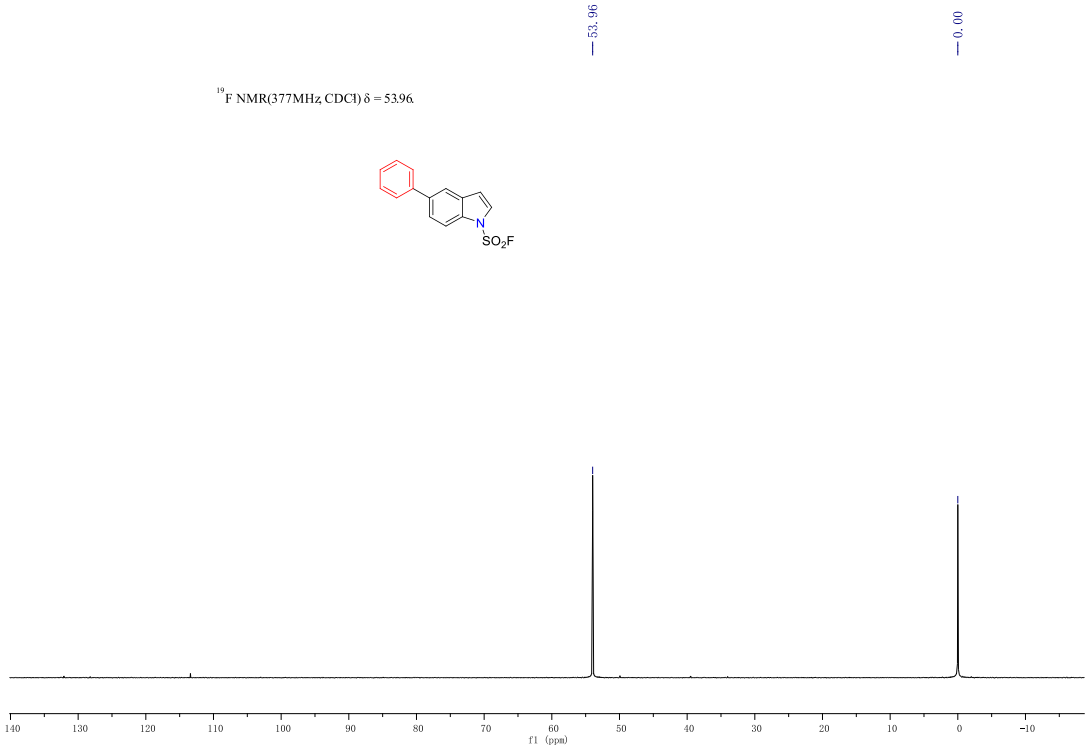
Compound **4-9**. *5-Phenyl-1H-indole-1-sulfonyl fluoride*



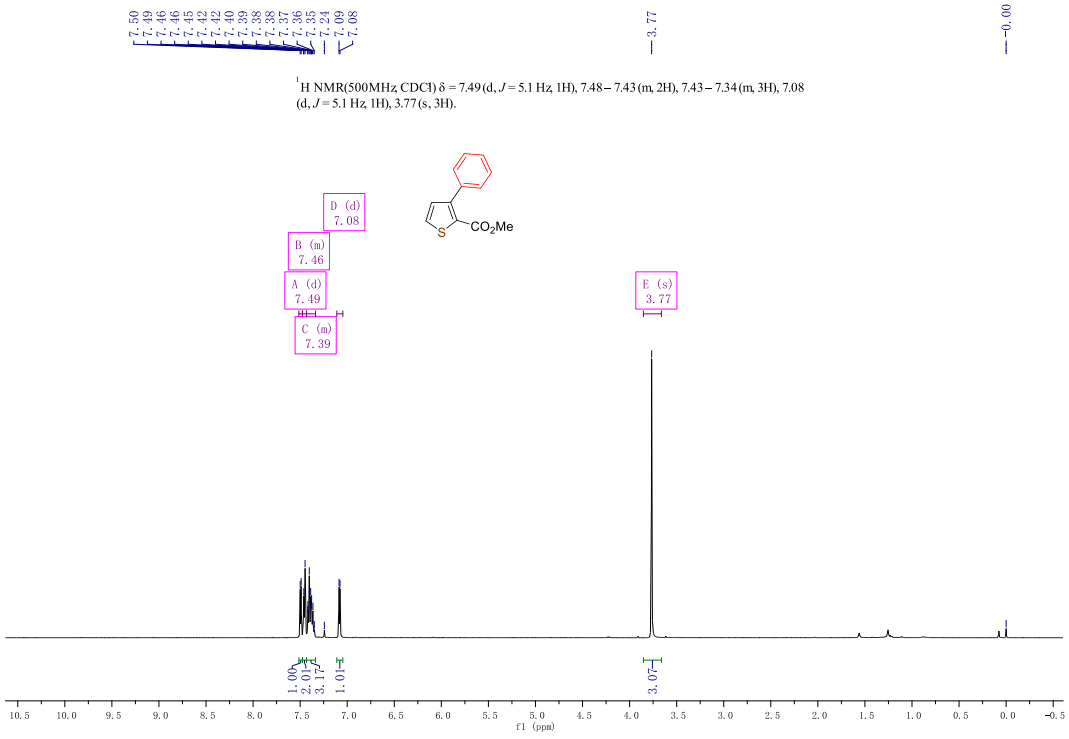

$^{1}$H NMR(500MHz, CDCl) δ = 7.95 (d, *J* = 8.7 Hz, 1H), 7.81 (s, 1H), 7.65 (dd, *J* = 8.6, 1.5 Hz, 1H), 7.61 (d, *J* = 7.4 Hz, 2H), 7.46 (dd, *J* = 13.6, 5.6 Hz, 3H), 7.38 (t, *J* = 7.4 Hz, 1H), 6.84 (d, *J* = 3.5 Hz, 1H).



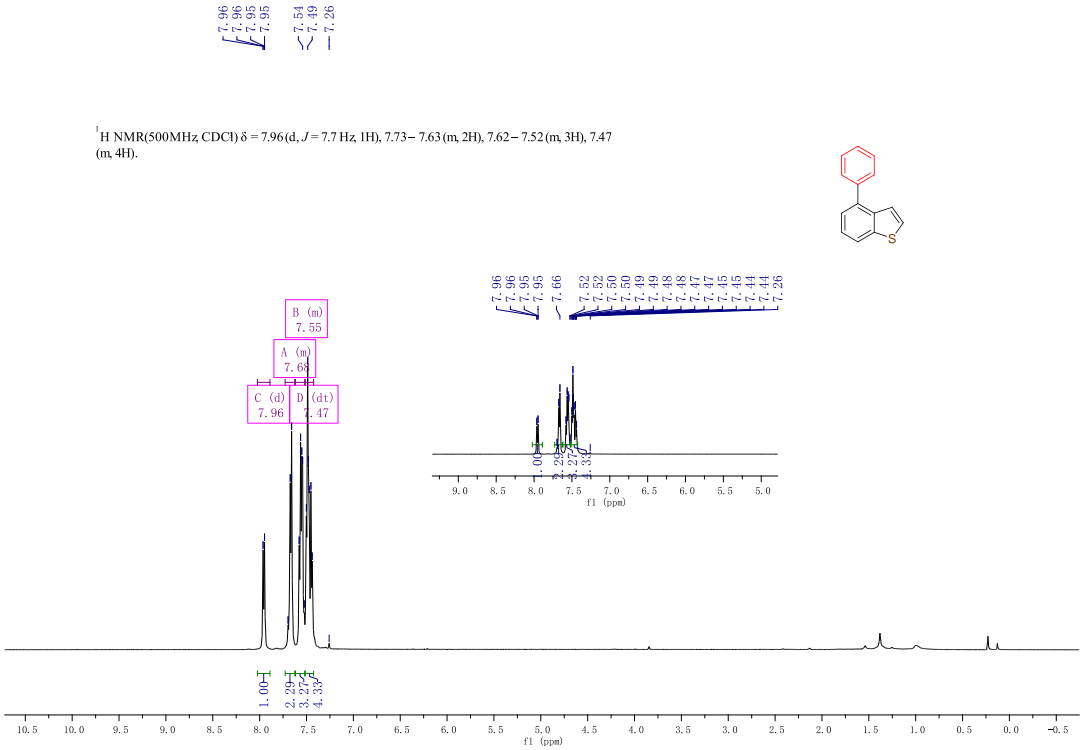

$^{13}$C NMR(126MHz, CDCl) δ = 140.83, 138.59, 134.27, 131.03, 129.05, 127.59, 126.81, 126.72, 125.54, 120.47 (d, *J* = 6.0 Hz), 113.87, 111.37.



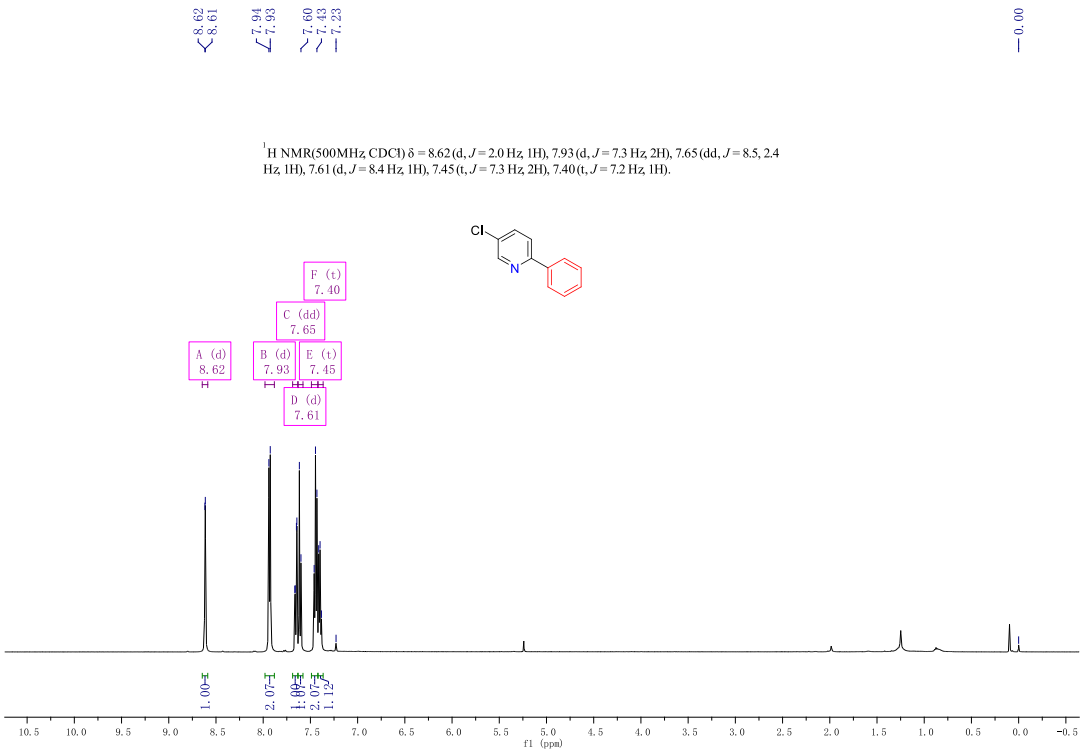

Compound **4-10**. *Methyl 3-phenylthiophene-2-carboxylate*



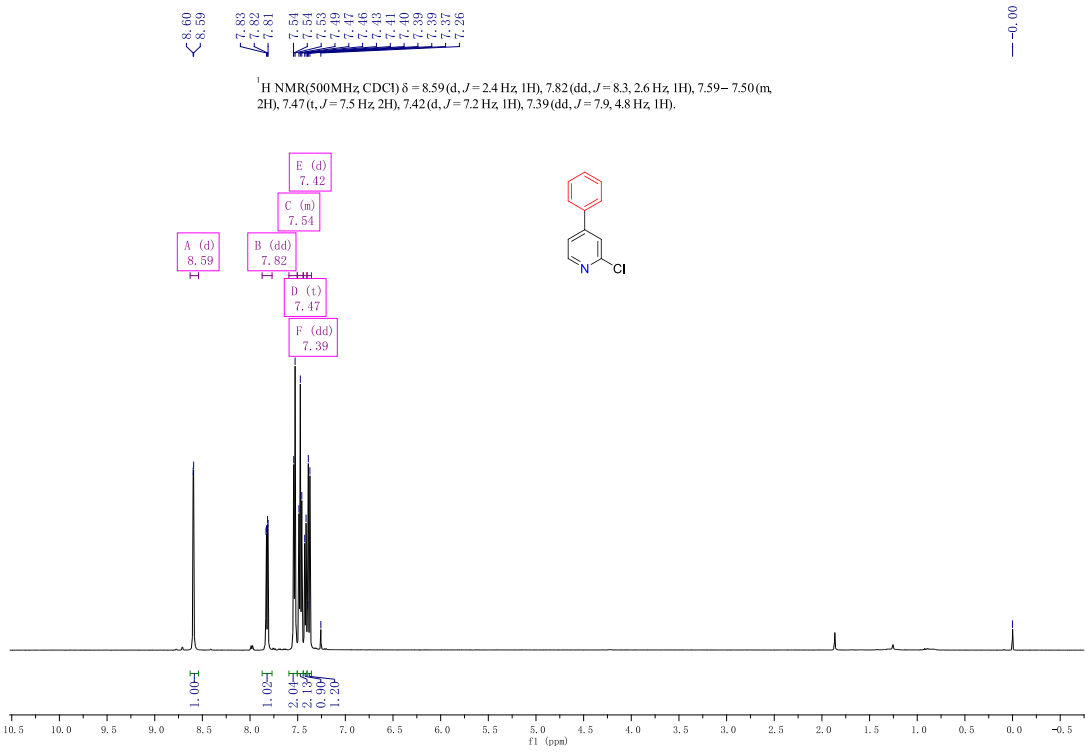
Compound **4-11**. *4-Phenylbenzo[b]thiophene*




Compound **6-1**. *5-Chloro-2-phenylpyridine*

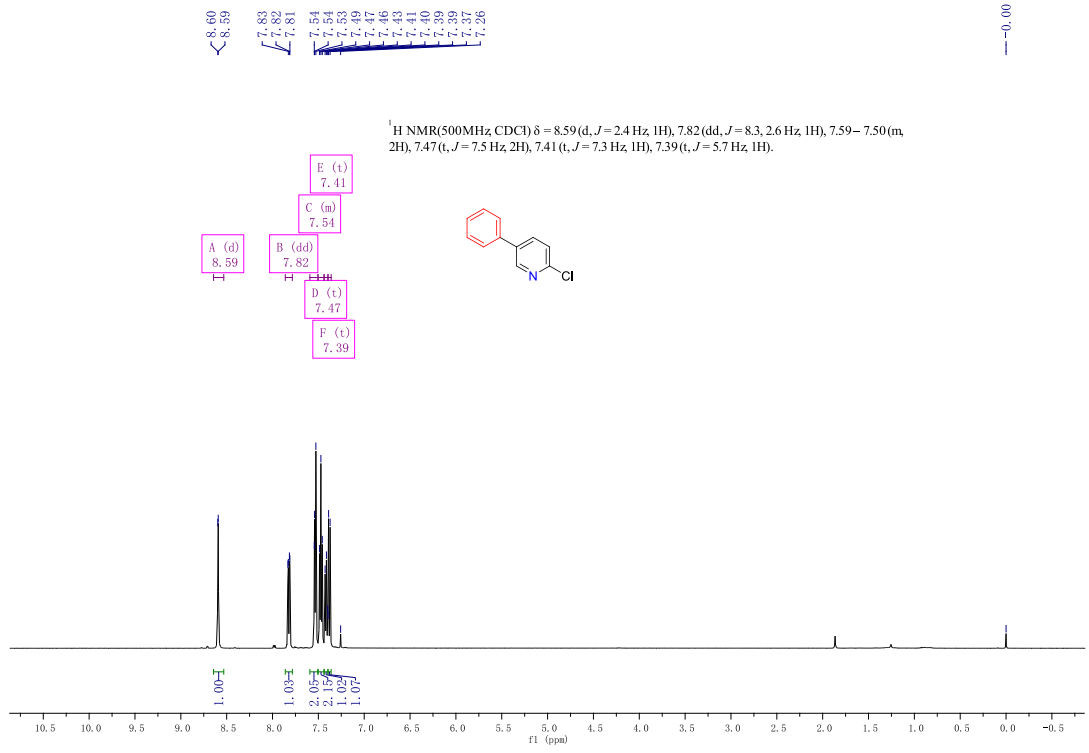


Compound **6-2**. *2-Chloro-4-phenylpyridine*



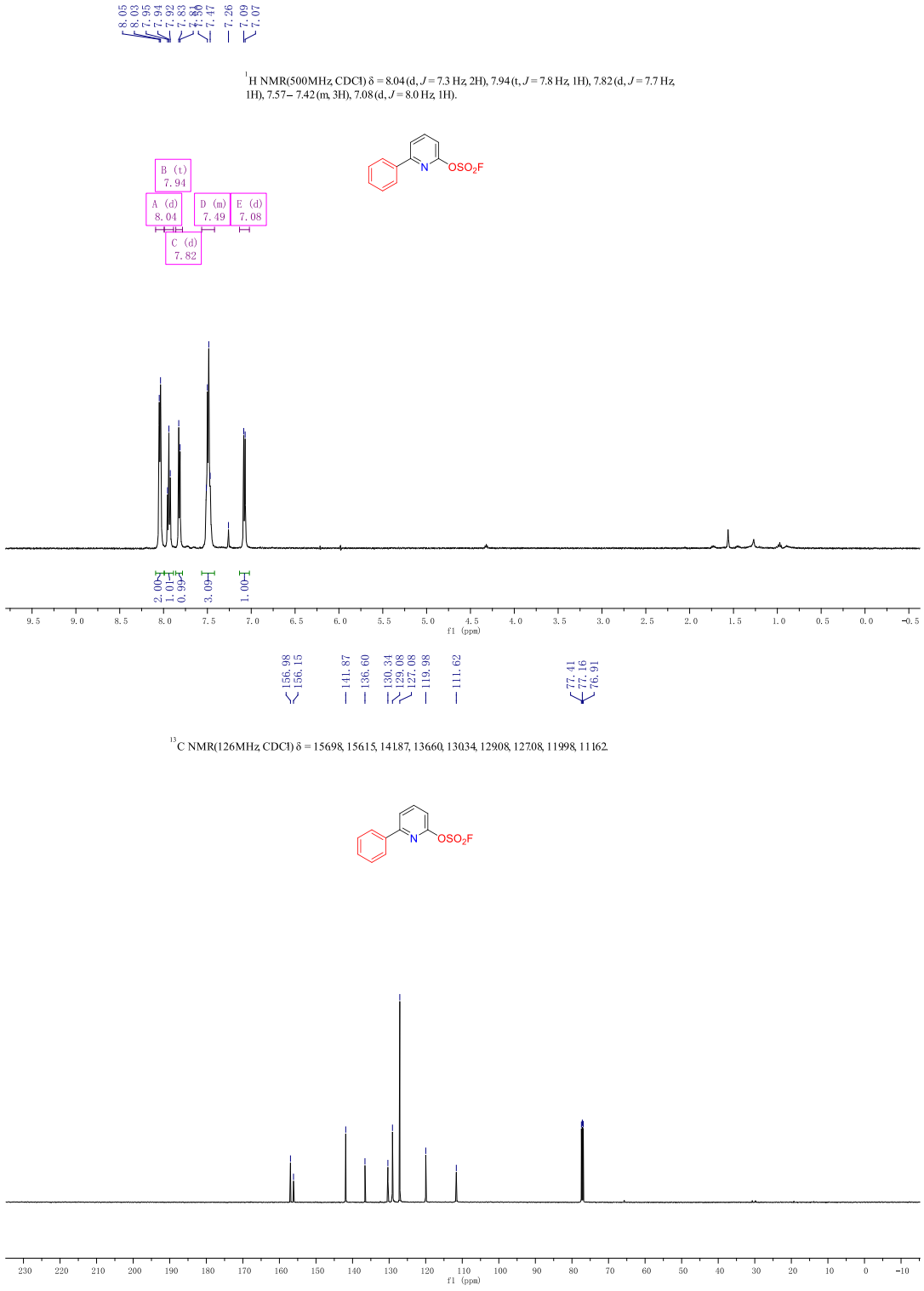

$^1$H NMR(500MHz, CDCl) δ = 8.59 (d, *J* = 2.4 Hz, 1H), 7.82 (dd, *J* = 8.3, 2.6 Hz, 1H), 7.59 – 7.50 (m, 2H), 7.47 (t, *J* = 7.5 Hz, 2H), 7.42 (d, *J* = 7.2 Hz, 1H), 7.39 (dd, *J* = 7.9, 4.8 Hz, 1H).

Compound **6-3**. *2-Chloro-5-phenylpyridine*



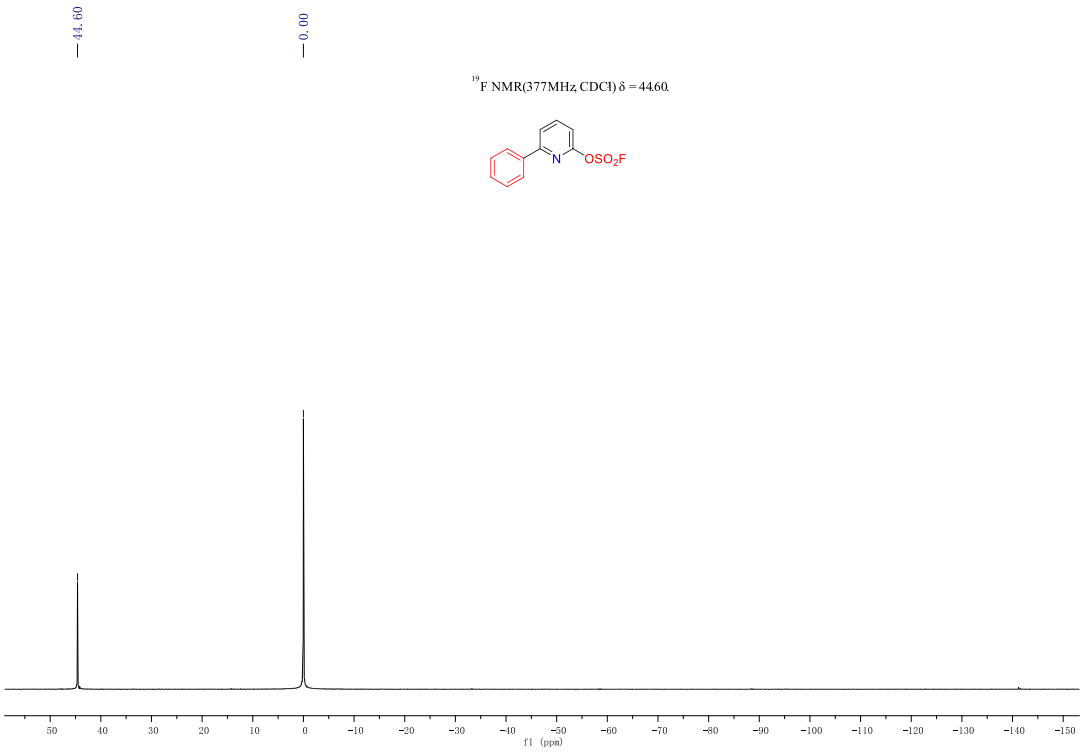

$^1$H NMR(500MHz, CDCl) δ = 8.59 (d, *J* = 2.4 Hz, 1H), 7.82 (dd, *J* = 8.3, 2.6 Hz, 1H), 7.59 – 7.50 (m, 2H), 7.47 (t, *J* = 7.5 Hz, 2H), 7.41 (t, *J* = 7.3 Hz, 1H), 7.39 (t, *J* = 5.7 Hz, 1H).

Compound **7-1**. *6-Phenylpyridin-2-yl fluorosulfate*

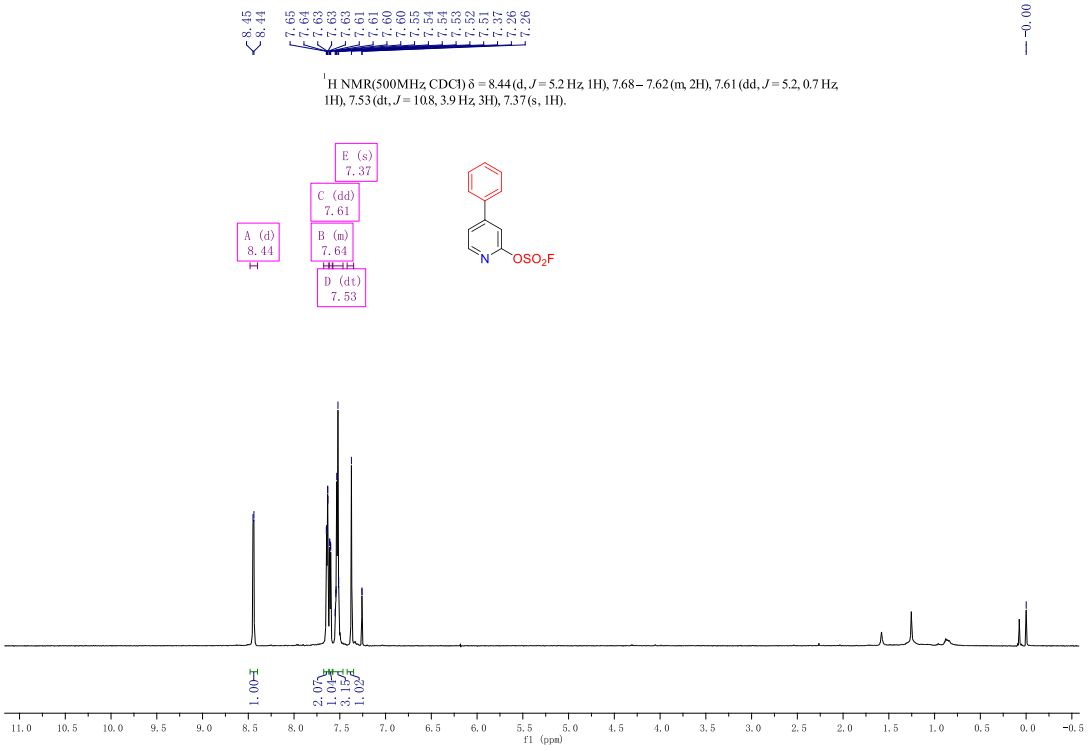



$^{1}$H NMR(500MHz, CDCl) δ = 8.04 (d, *J* = 7.3 Hz, 2H), 7.94 (t, *J* = 7.8 Hz, 1H), 7.82 (d, *J* = 7.7 Hz, 1H), 7.57– 7.42 (m, 3H), 7.08 (d, *J* = 8.0 Hz, 1H).

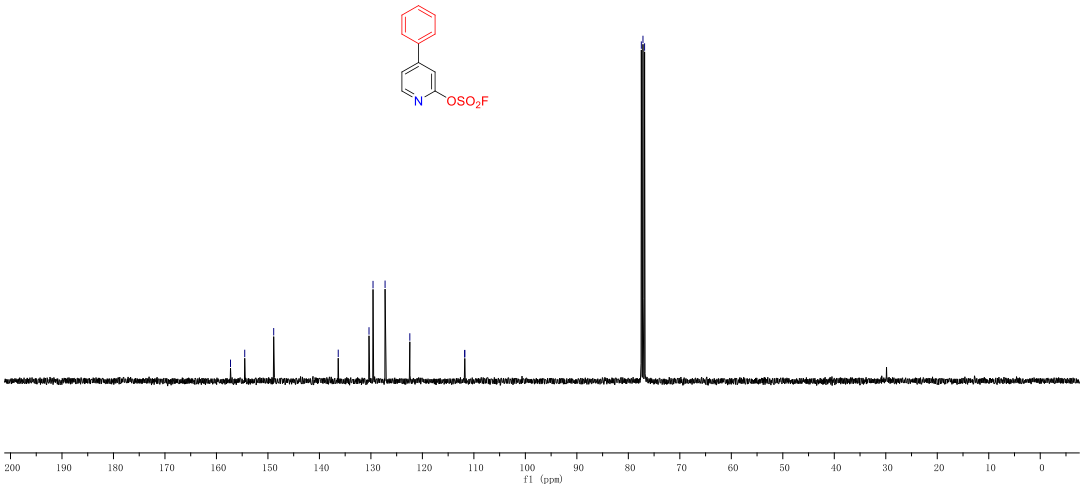
$^{13}$C NMR(126MHz, CDCl) δ = 156.98, 156.15, 141.87, 136.60, 130.34, 129.08, 127.08, 119.98, 111.62.




Compound **7-2**. *4-Phenylpyridin-2-yl fluorosulfate*

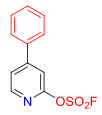


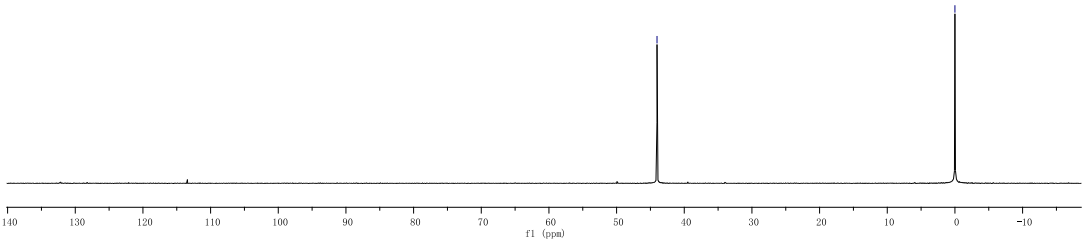

$^{13}$C NMR(101MHz, CDCl) δ = 157.27, 154.51, 148.88, 136.35, 130.37, 129.59, 127.25, 122.44, 111.78 (d, *J* = 2.6 Hz, 3H).



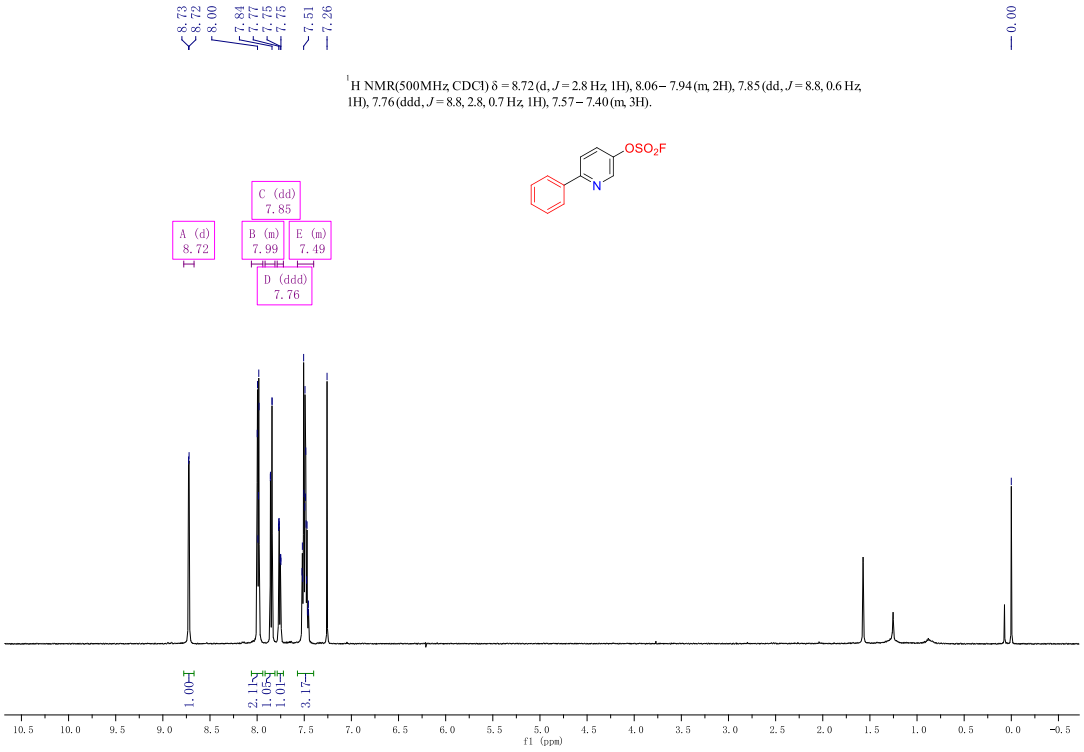


$^{19}$F NMR(377MHz, CDCl) δ = 44.03.

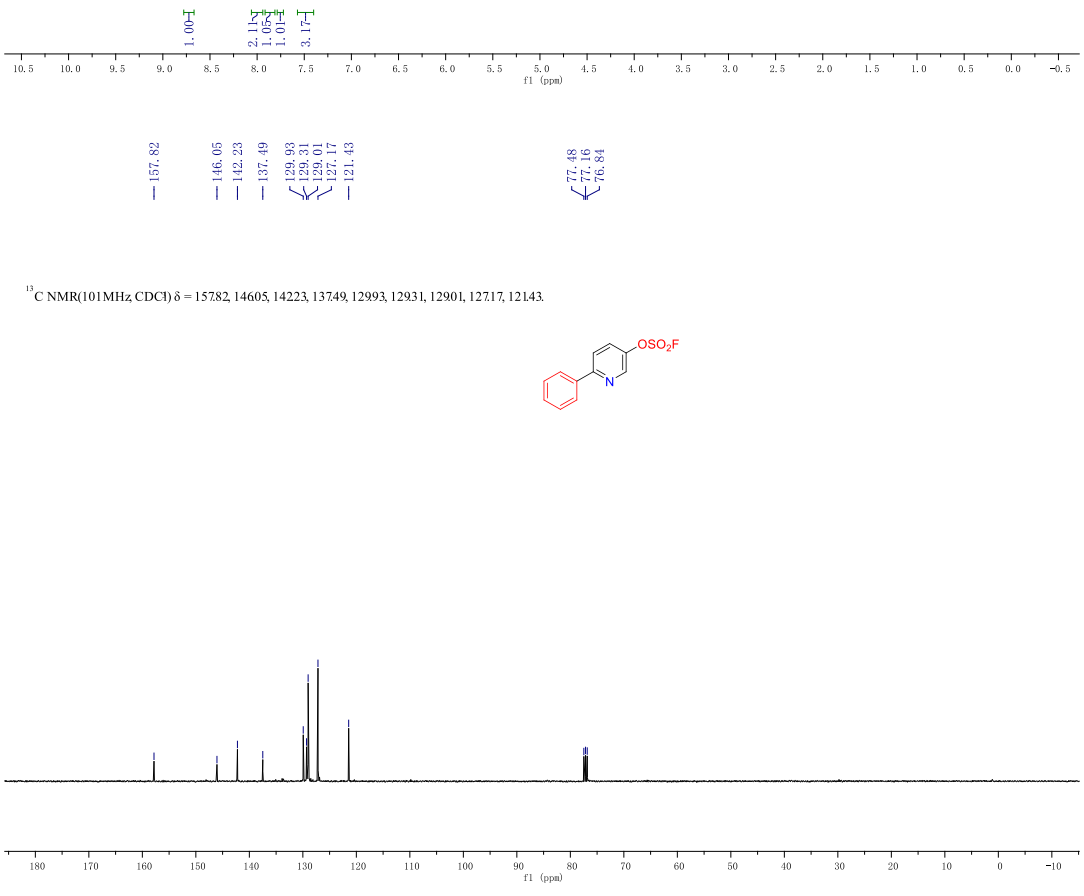


Compound **7-3**. *6-Phenylpyridin-3-yl fluorosulfate*

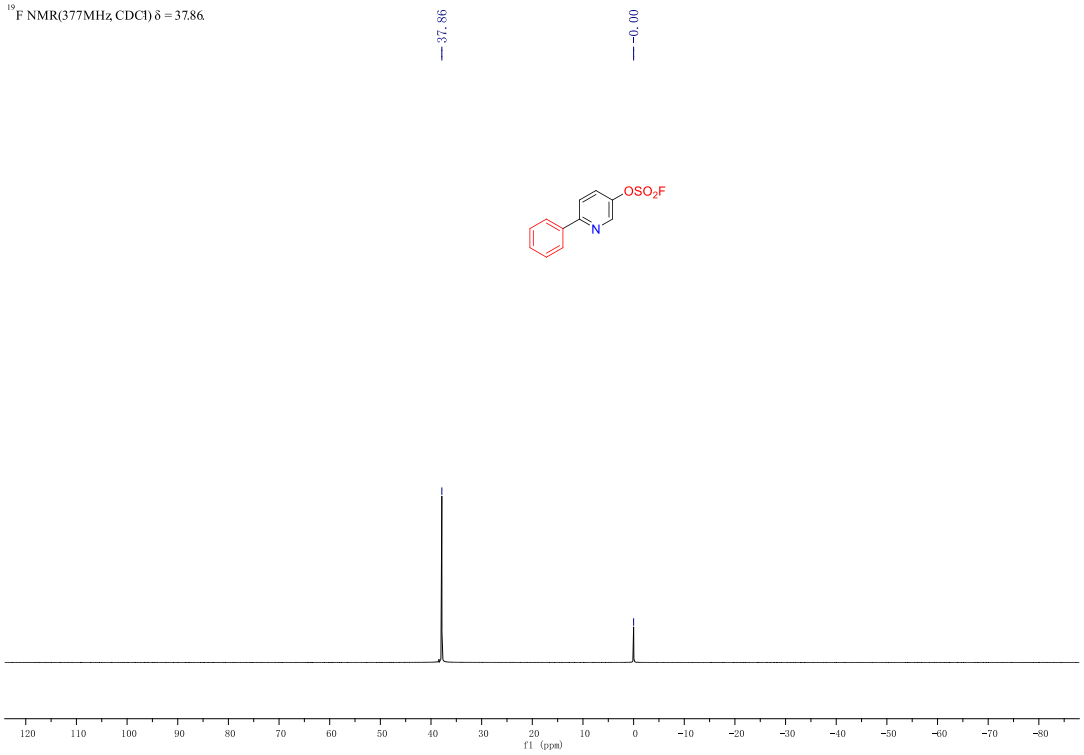



$^{1}$H NMR(500MHz, CDCl) δ = 8.72 (d, *J* = 2.8 Hz, 1H), 8.06 – 7.94 (m, 2H), 7.85 (dd, *J* = 8.8, 0.6 Hz, 1H), 7.76 (ddd, *J* = 8.8, 2.8, 0.7 Hz, 1H), 7.57 – 7.40 (m, 3H).



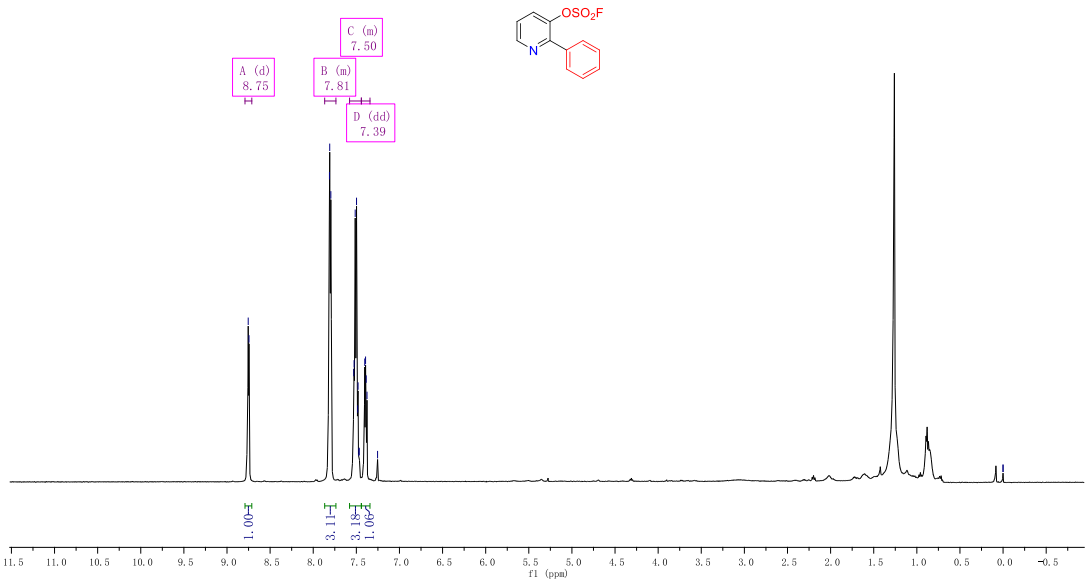

$^{13}$C NMR(101MHz, CDCl) δ = 157.82, 146.05, 142.23, 137.49, 129.93, 129.31, 129.01, 127.17, 121.43.

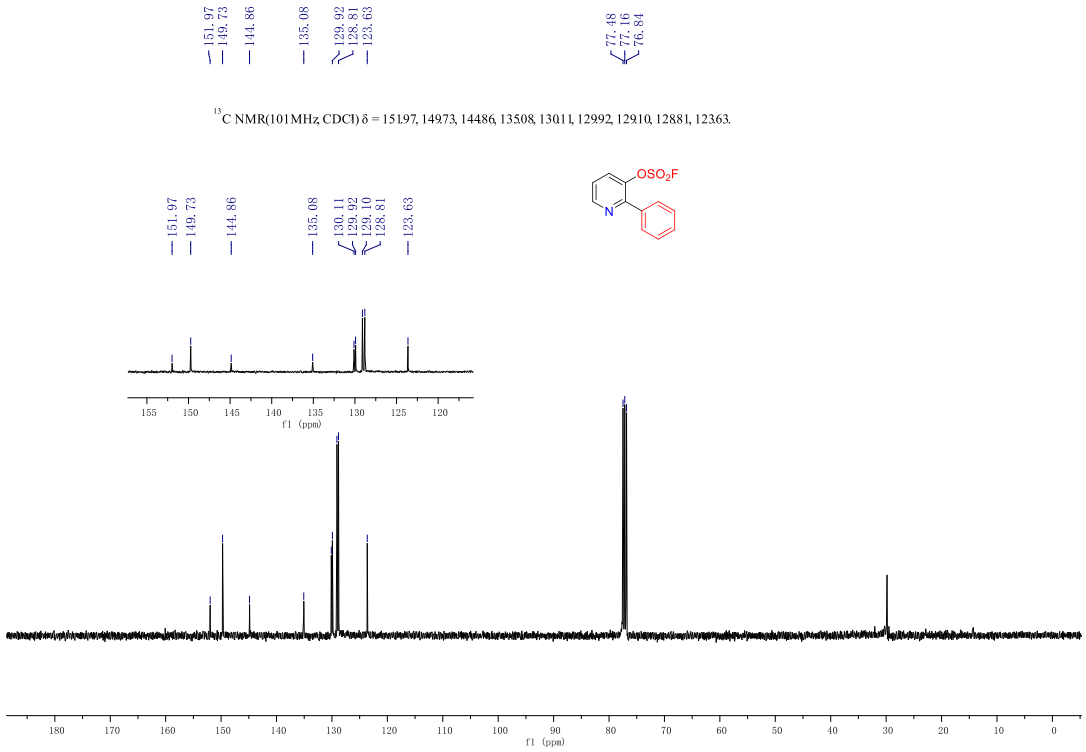
$^{19}$F NMR(377MHz, CDCl) δ = 37.86.



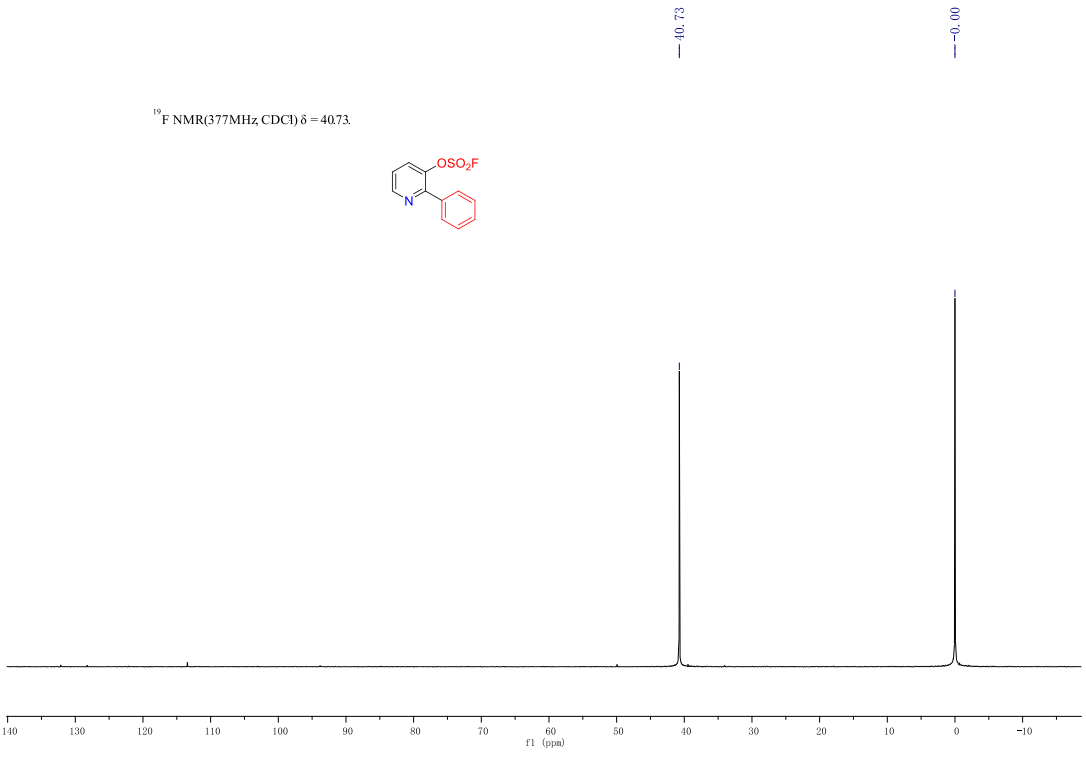

Compound **7-4**. *2-Phenylpyridin-3-yl fluorosulfate*


$^{1}$H NMR(500MHz, CDCl) δ = 8.75 (d, *J* = 4.6 Hz, 1H), 7.87 – 7.74 (m, 3H), 7.58 – 7.44 (m, 3H), 7.39 (dd, *J* = 8.3, 4.6 Hz, 1H).



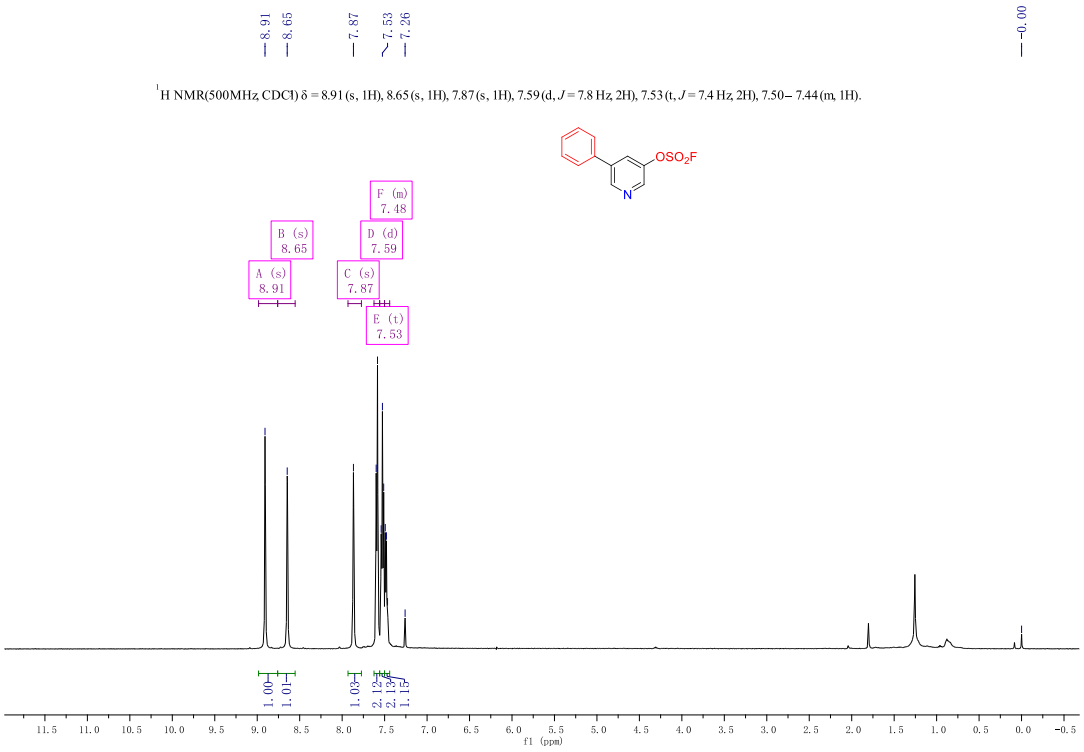



$^{13}$C NMR(101MHz, CDCl) δ = 151.97, 149.73, 144.86, 135.08, 130.11, 129.92, 129.10, 128.81, 123.63.

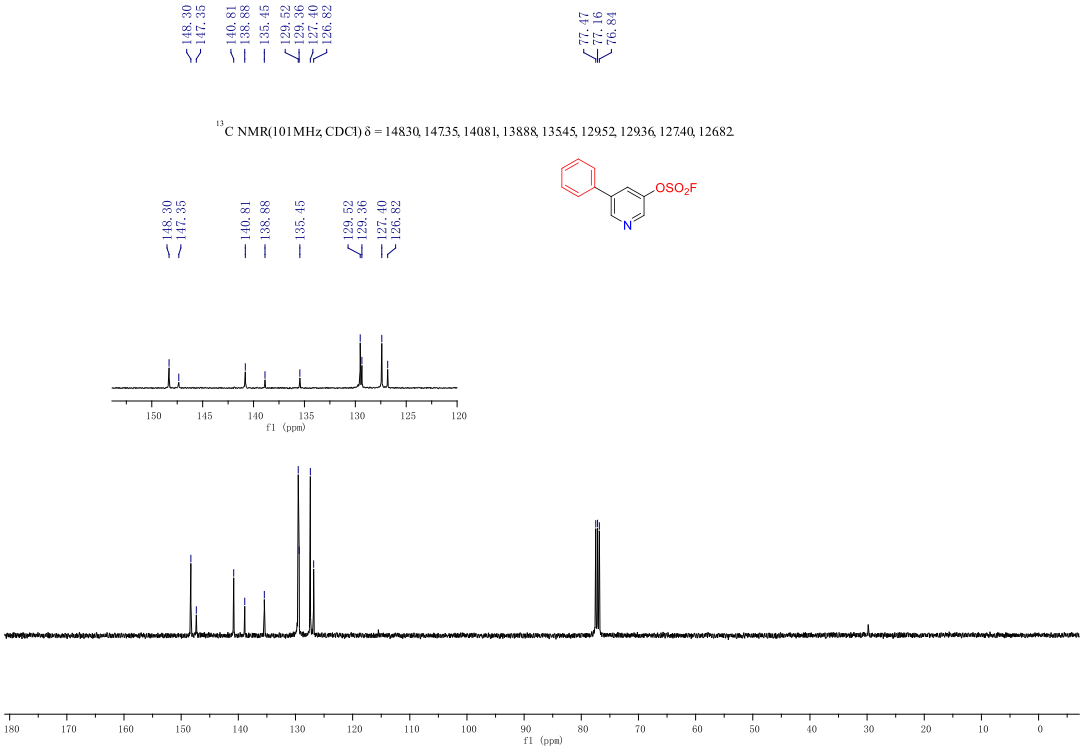



$^{19}$F NMR(377MHz, CDCl) δ = 40.73.

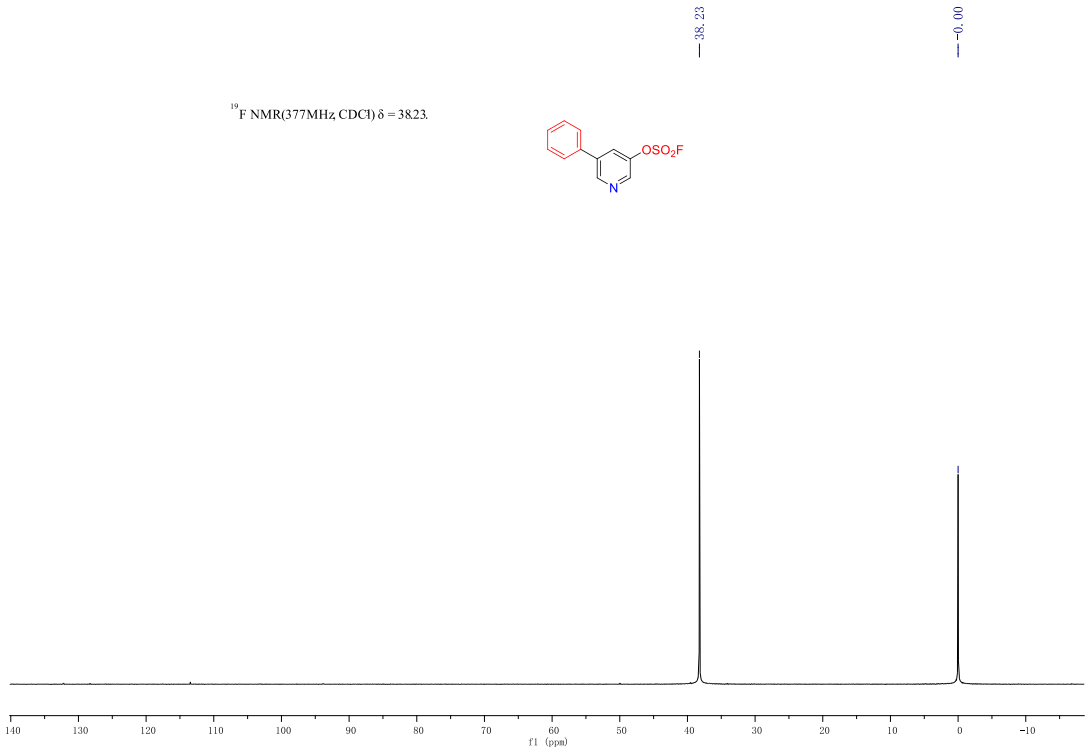
Compound **7-5**. *5-Phenylpyridin-3-yl fluorosulfate*




$^{1}$H NMR(500MHz, CDCl) δ = 8.91 (s, 1H), 8.65 (s, 1H), 7.87 (s, 1H), 7.59 (d, *J* = 7.8 Hz, 2H), 7.53 (t, *J* = 7.4 Hz, 2H), 7.50 – 7.44 (m, 1H).

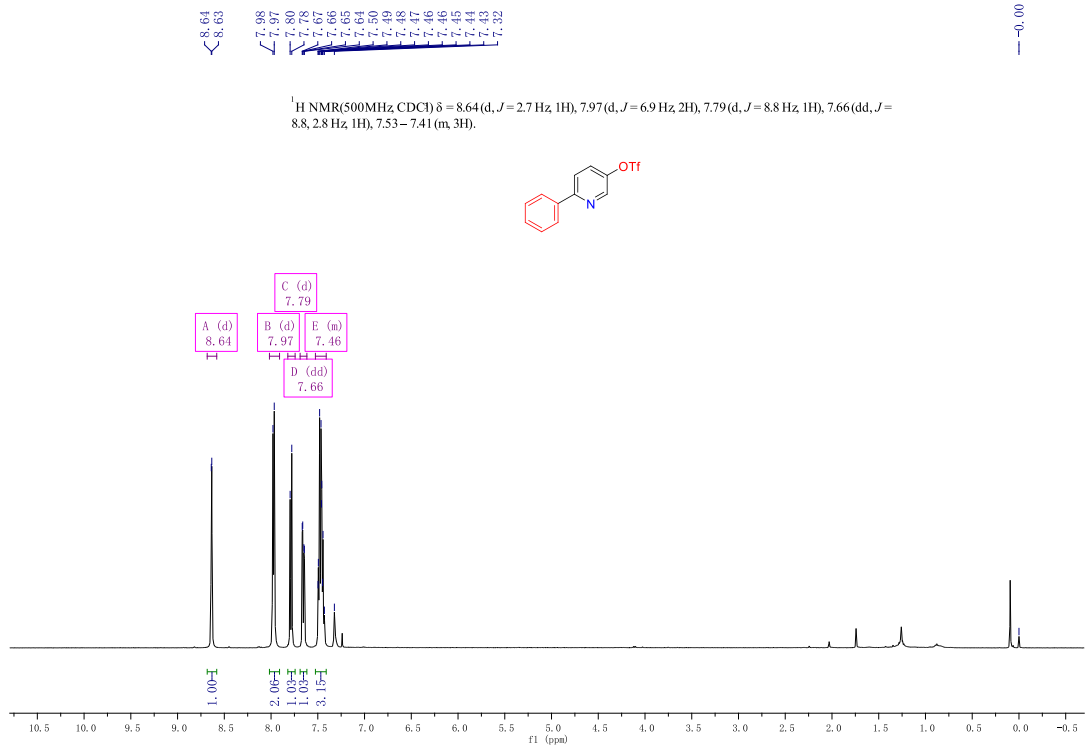



$^{13}$C NMR(101MHz, CDCl) δ = 148.30, 147.35, 140.81, 138.88, 135.45, 129.52, 129.36, 127.40, 126.82.

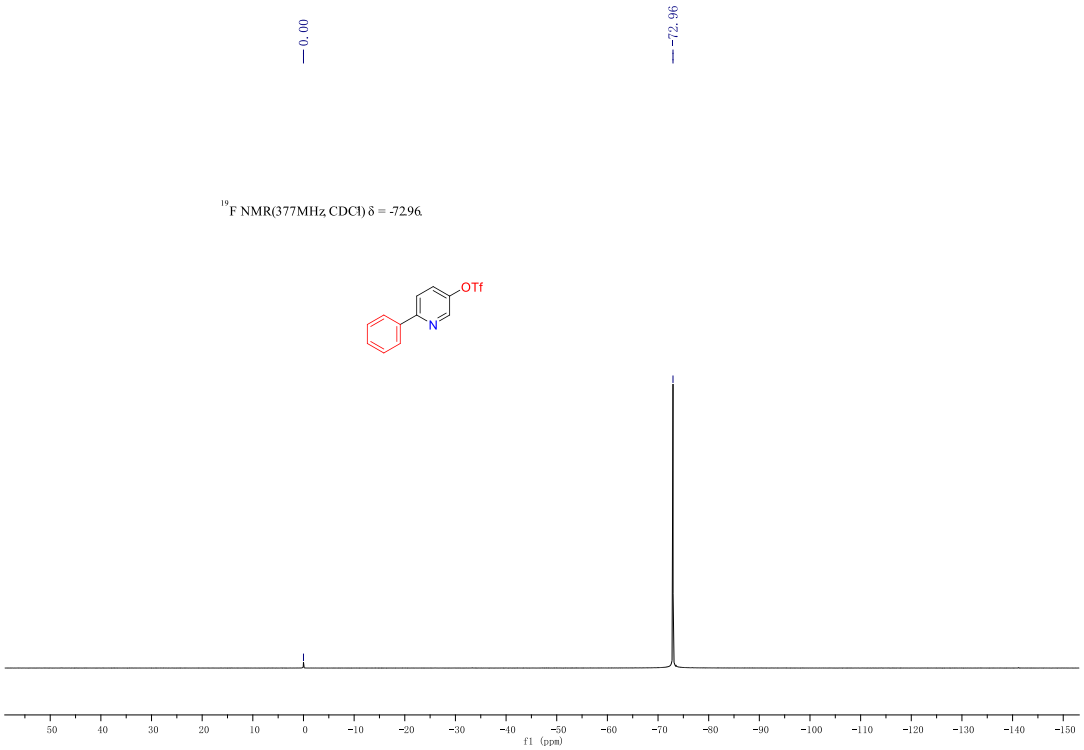



$^{19}$F NMR(377MHz, CDCl) δ = 38.23.

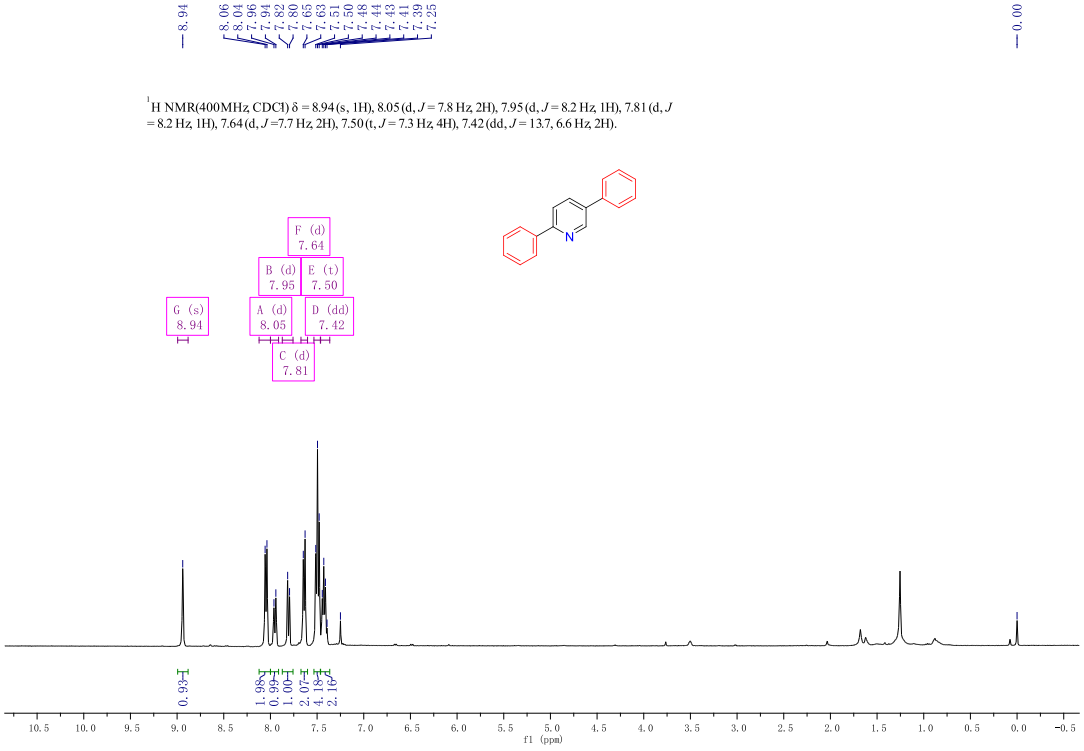
Compound **9**. *6-Phenylpyridin-3-yl triflate*



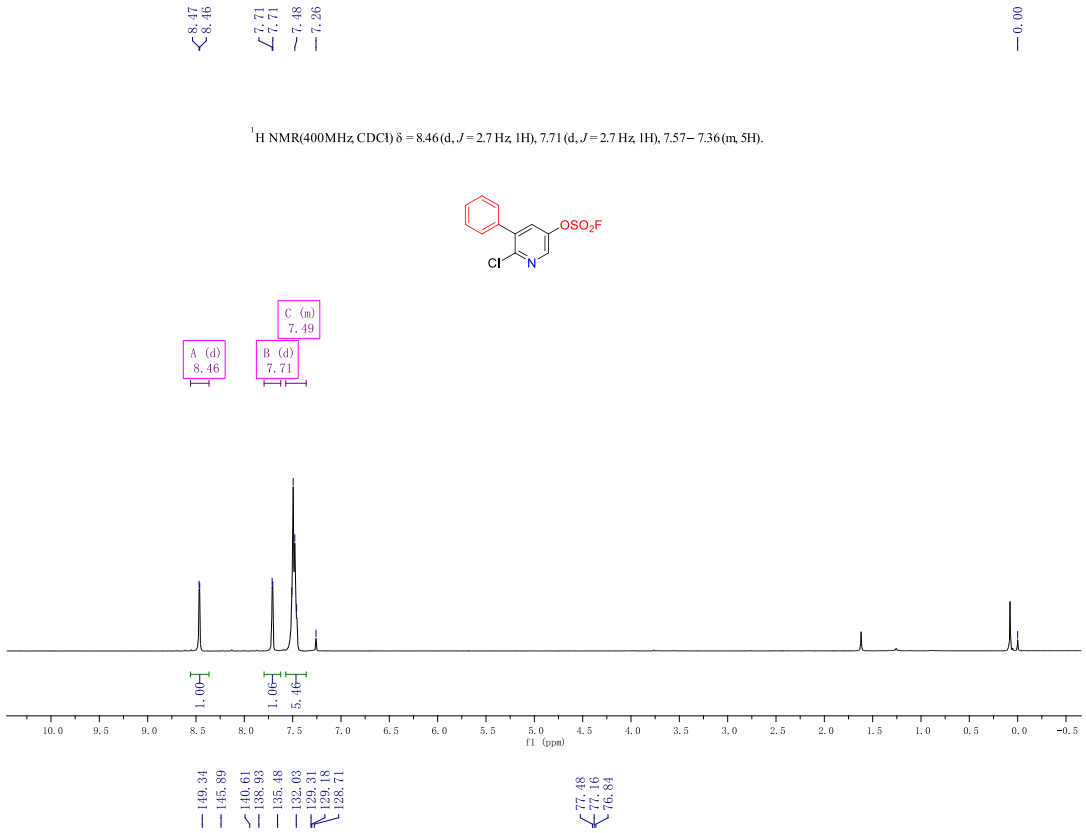

$^{1}$H NMR(500MHz, CDCl) δ = 8.64 (d, *J* = 2.7 Hz, 1H), 7.97 (d, *J* = 6.9 Hz, 2H), 7.79 (d, *J* = 8.8 Hz, 1H), 7.66 (dd, *J* = 8.8, 2.8 Hz, 1H), 7.53 – 7.41 (m, 3H).



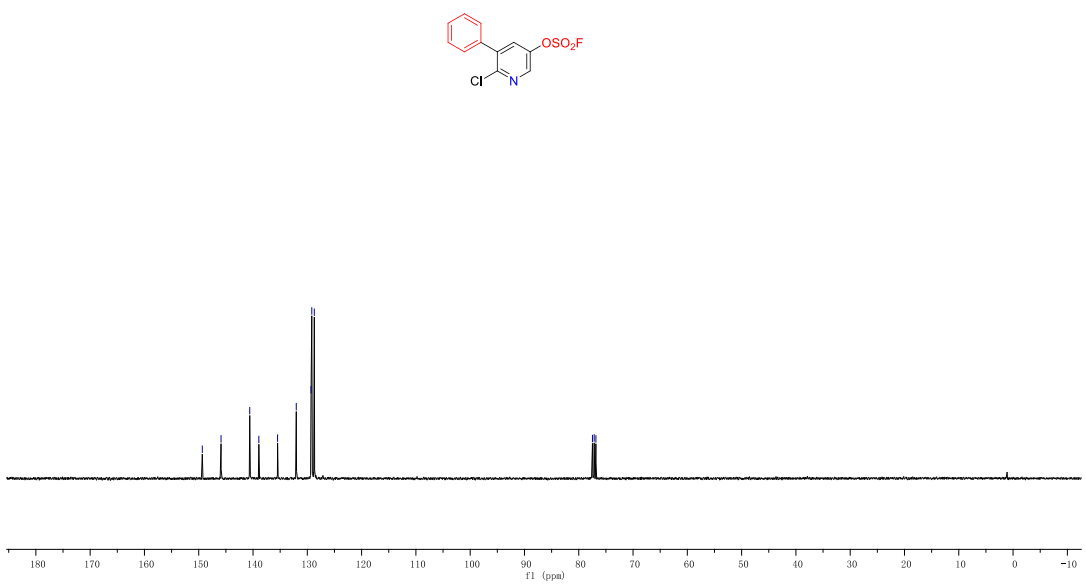

Compound **10**. *2,5-Diphenylpyridine*



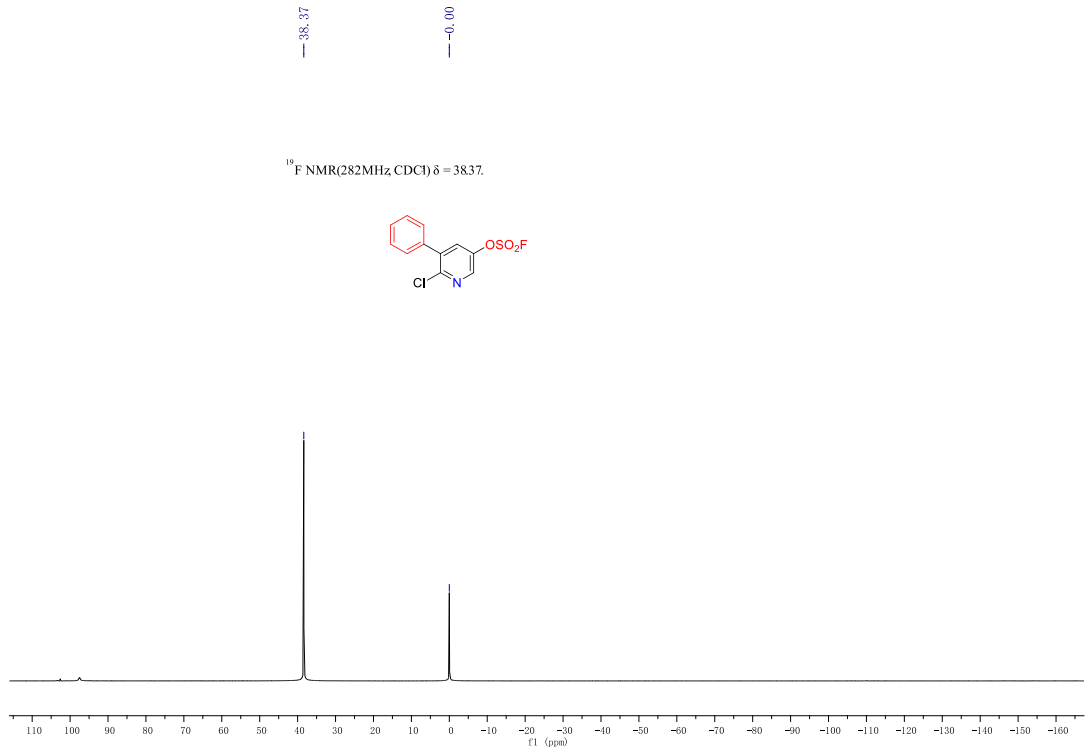
Compound **11**. *6-Chloro-5-phenylpyridin-3-yl fluorosulfate*




$^{1}$H NMR(400MHz, CDCl) δ = 8.46 (d, *J* = 2.7 Hz, 1H), 7.71 (d, *J* = 2.7 Hz, 1H), 7.57 – 7.36 (m, 5H).

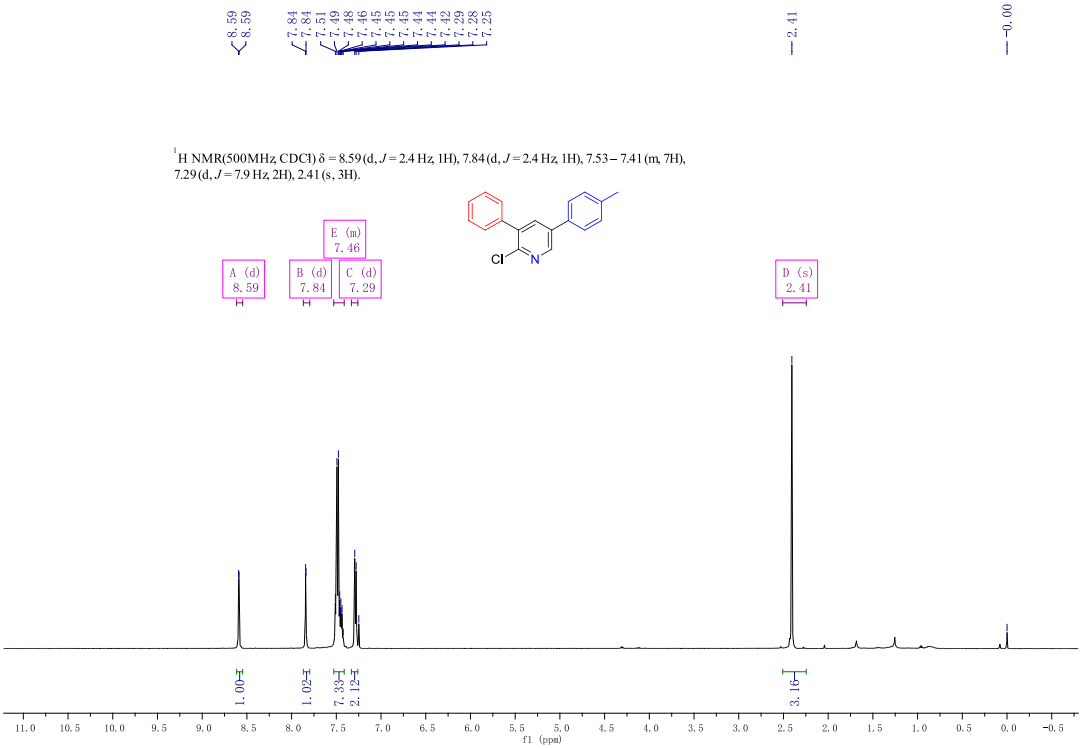



$^{13}$C NMR(101MHz, CDCl) δ = 149.34, 145.89, 140.61, 138.93, 135.48, 132.03, 129.31, 129.18, 128.71.

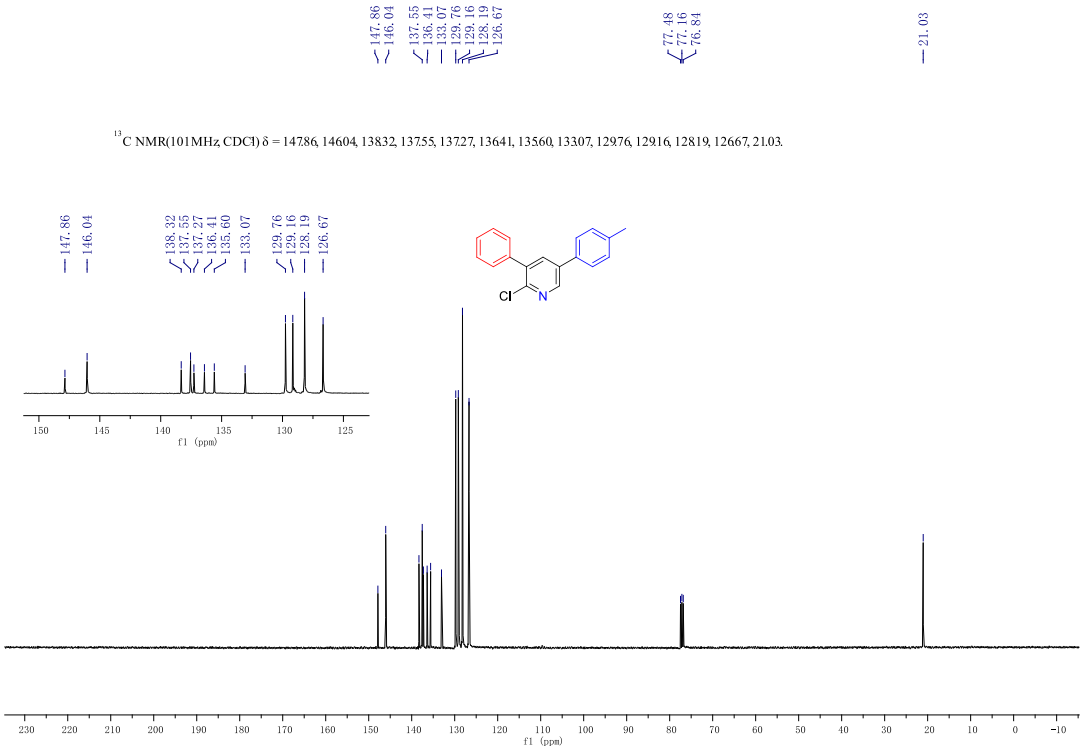



$^{19}$F NMR(282MHz, CDCl) δ = 38.37.

Compound **12**. *2-Chloro-3-phenyl-5-p-tolylpyridine*

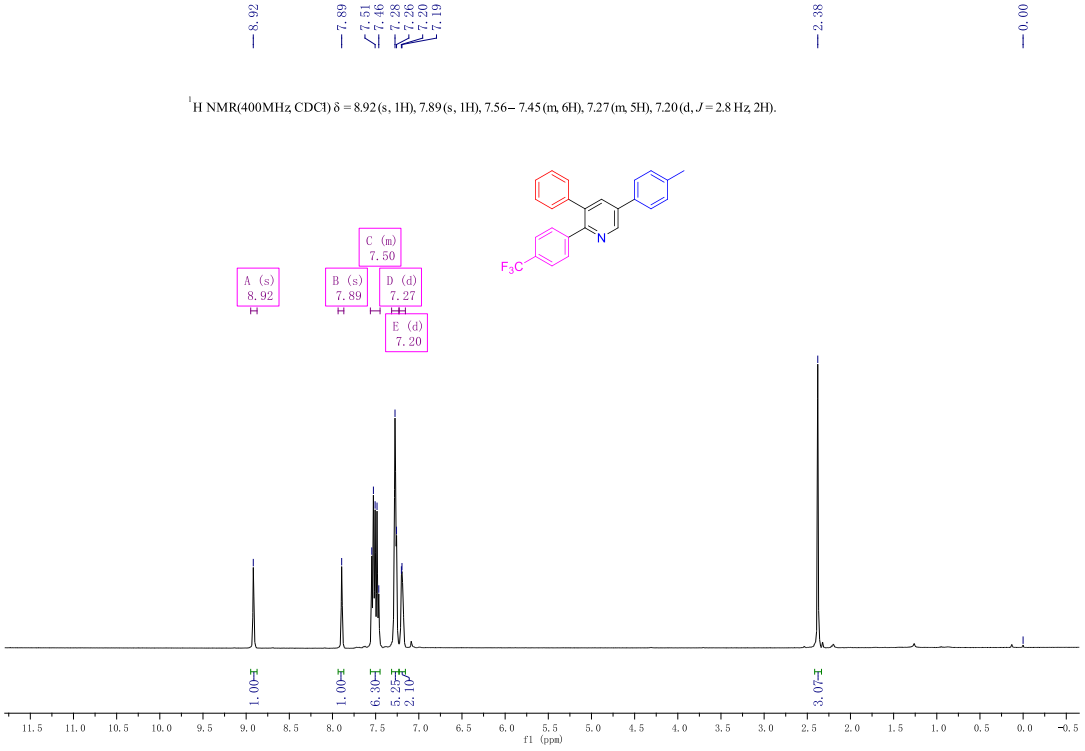



$^{1}$H NMR(500MHz, CDCl) δ = 8.59 (d, *J* = 2.4 Hz, 1H), 7.84 (d, *J* = 2.4 Hz, 1H), 7.53 – 7.41 (m, 7H), 7.29 (d, *J* = 7.9 Hz, 2H), 2.41 (s, 3H).



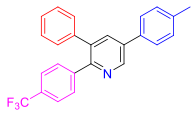

$^{13}$C NMR(101MHz, CDCl) δ = 147.86, 146.04, 138.32, 137.55, 137.27, 136.41, 135.60, 133.07, 129.76, 129.16, 128.19, 126.67, 21.03.

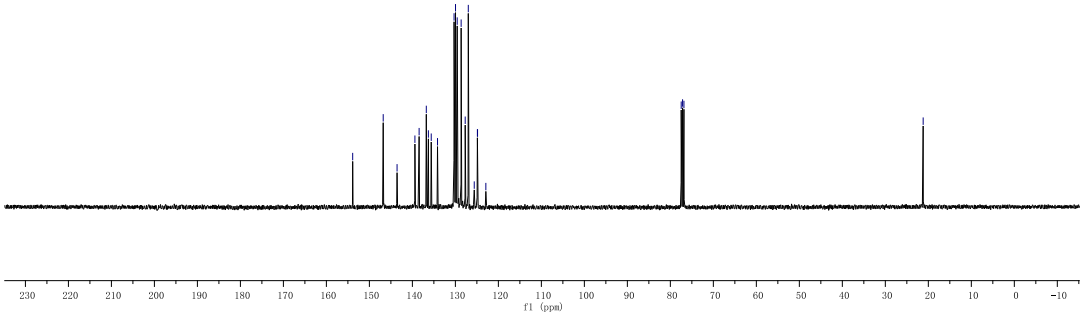
Compound **13**. *3-Phenyl-5-p-tolyl-2-(4-(trifluoromethyl)phenyl)pyridine*




$^{1}$H NMR(400MHz, CDCl) δ = 8.92 (s, 1H), 7.89 (s, 1H), 7.56– 7.45 (m, 6H), 7.27 (m, 5H), 7.20 (d, *J* = 2.8 Hz, 2H).

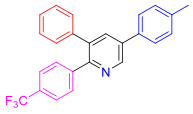

$^{13}$C NMR(101MHz, CDCl) δ = 153.88, 146.78, 143.56, 139.41, 138.43, 136.76, 136.28, 135.61, 134.15, 130.30, 129.97, 129.58, 128.66, 127.71, 127.00, 125.61, 124.88, 124.84, 122.91, 21.20.

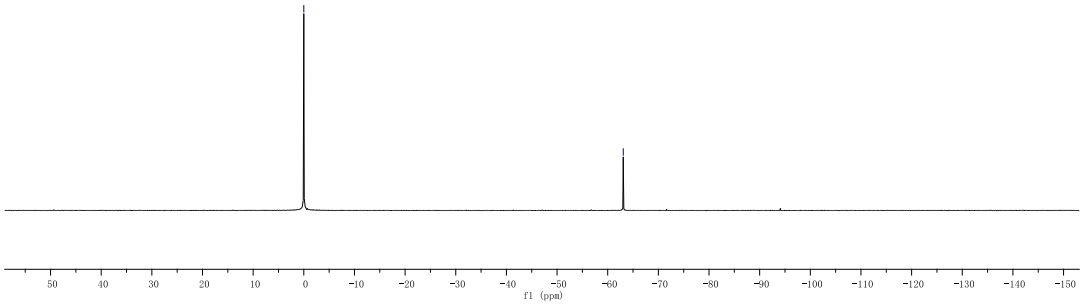


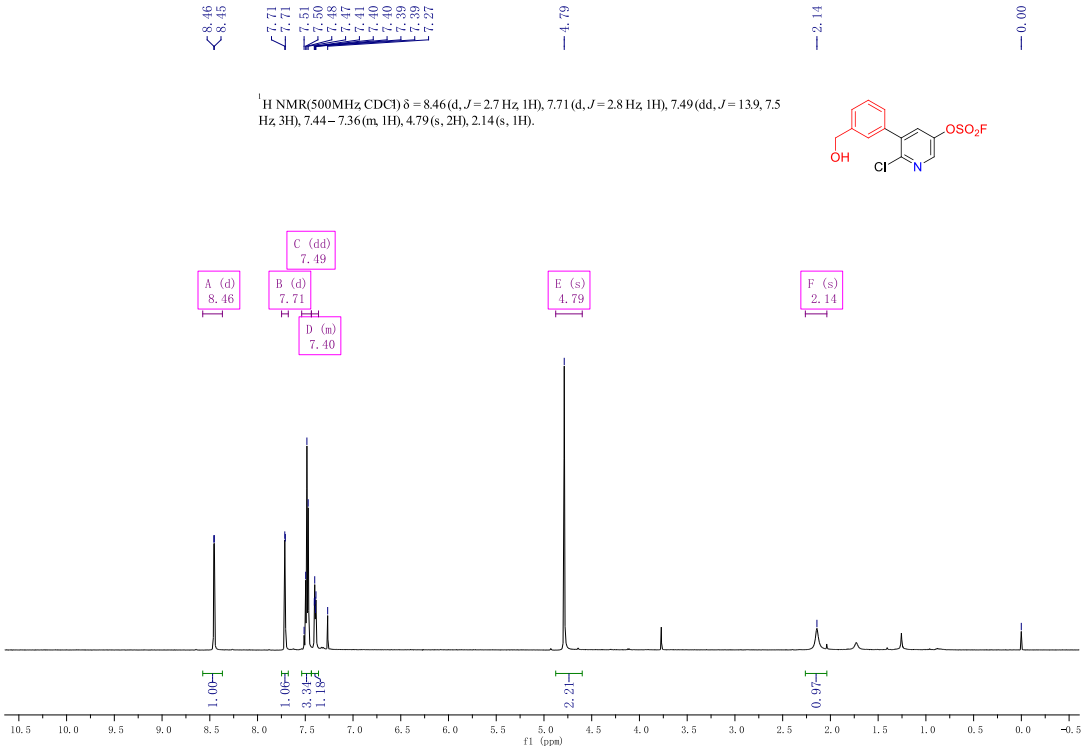


$^{19}$F NMR(377MHz, CDCl) δ = -63.07.



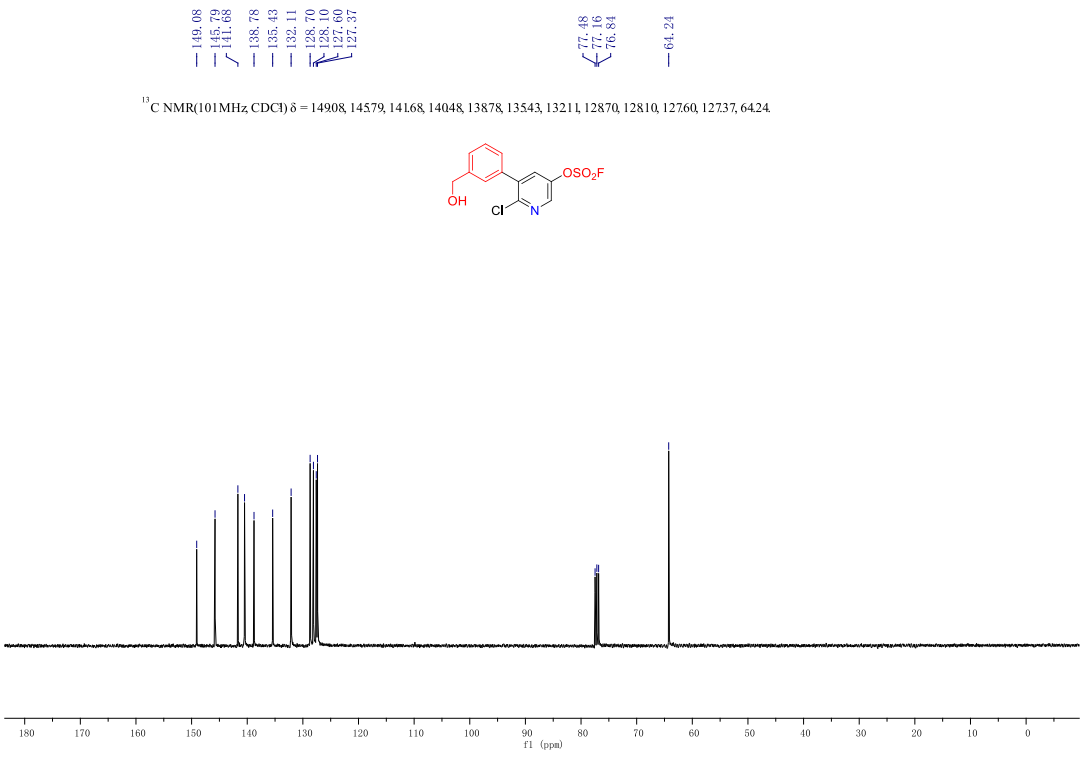



Compound **14**. *6-Chloro-5-(3-(hydroxymethyl)phenyl)pyridin-3-yl fluorosulfate*

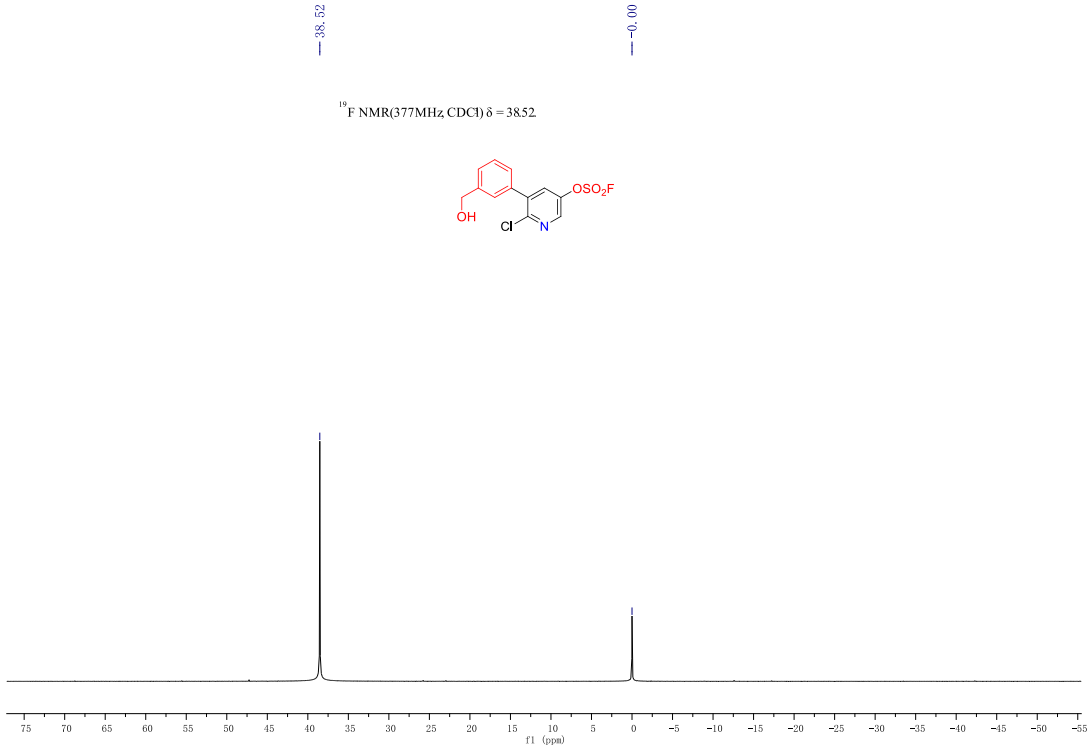



$^{1}$H NMR(500MHz, CDCl) δ = 8.46 (d, *J* = 2.7 Hz, 1H), 7.71 (d, *J* = 2.8 Hz, 1H), 7.49 (dd, *J* = 13.9, 7.5 Hz, 3H), 7.44 – 7.36 (m, 1H), 4.79 (s, 2H), 2.14 (s, 1H).



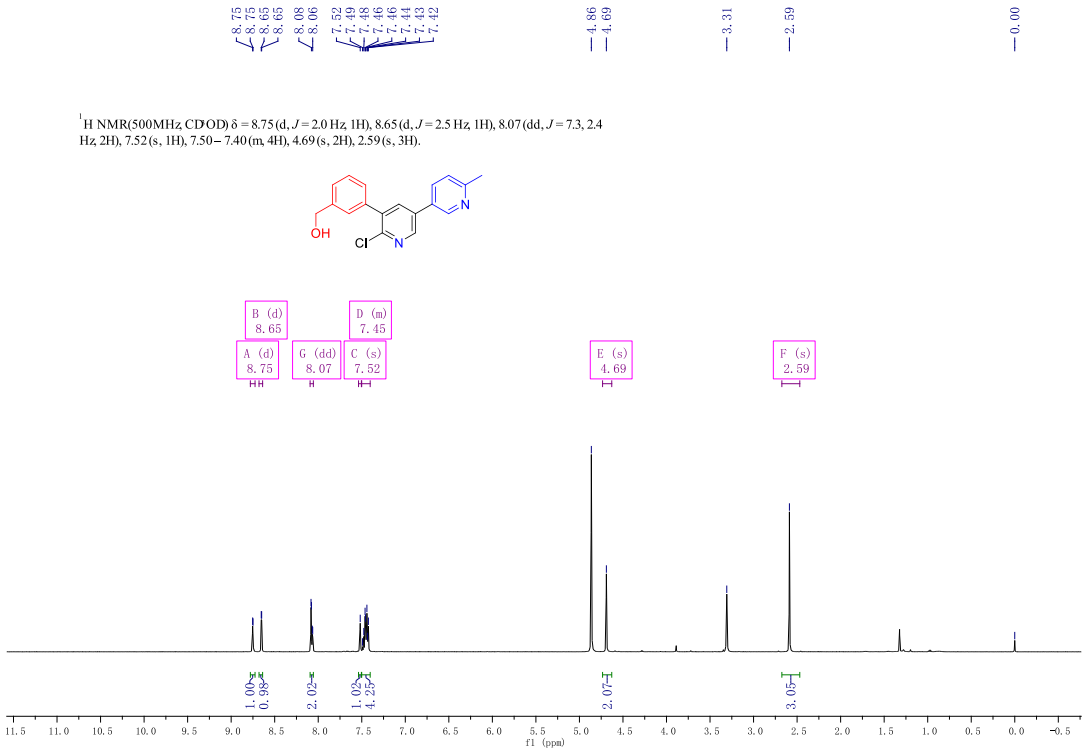




$^{13}$C NMR(101MHz, CDCl) δ = 149.08, 145.79, 141.68, 140.48, 138.78, 135.43, 132.11, 128.70, 128.10, 127.60, 127.37, 64.24.

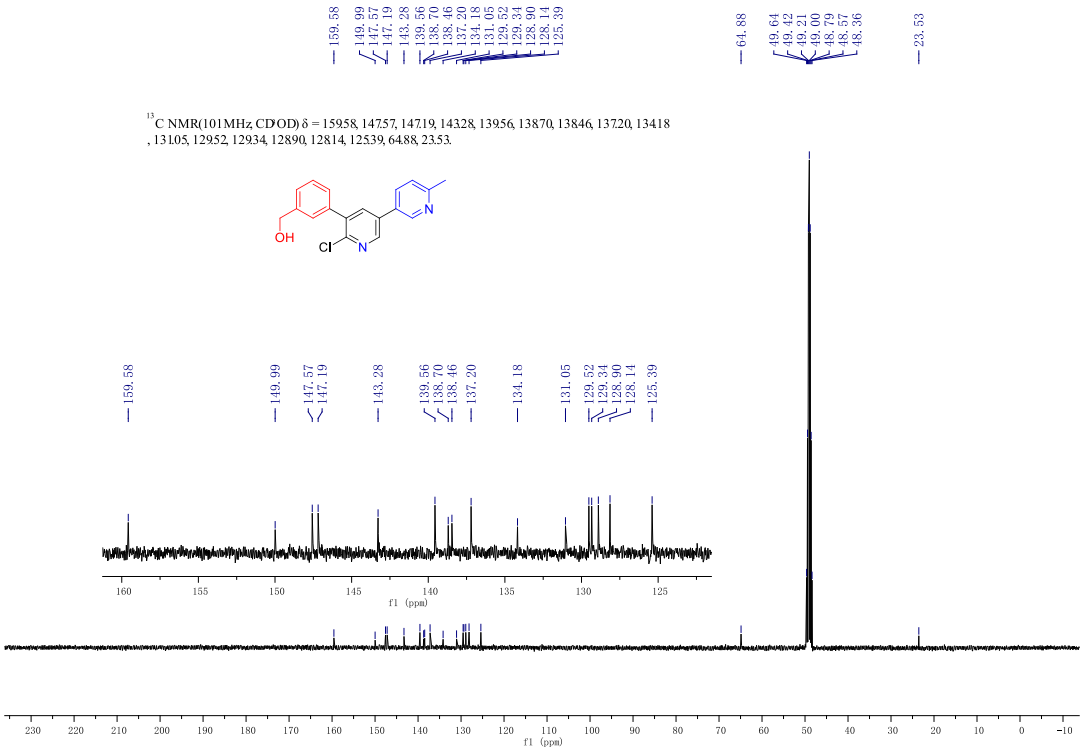



$^{19}$F NMR(377MHz, CDCl$_3$) δ = 38.52.

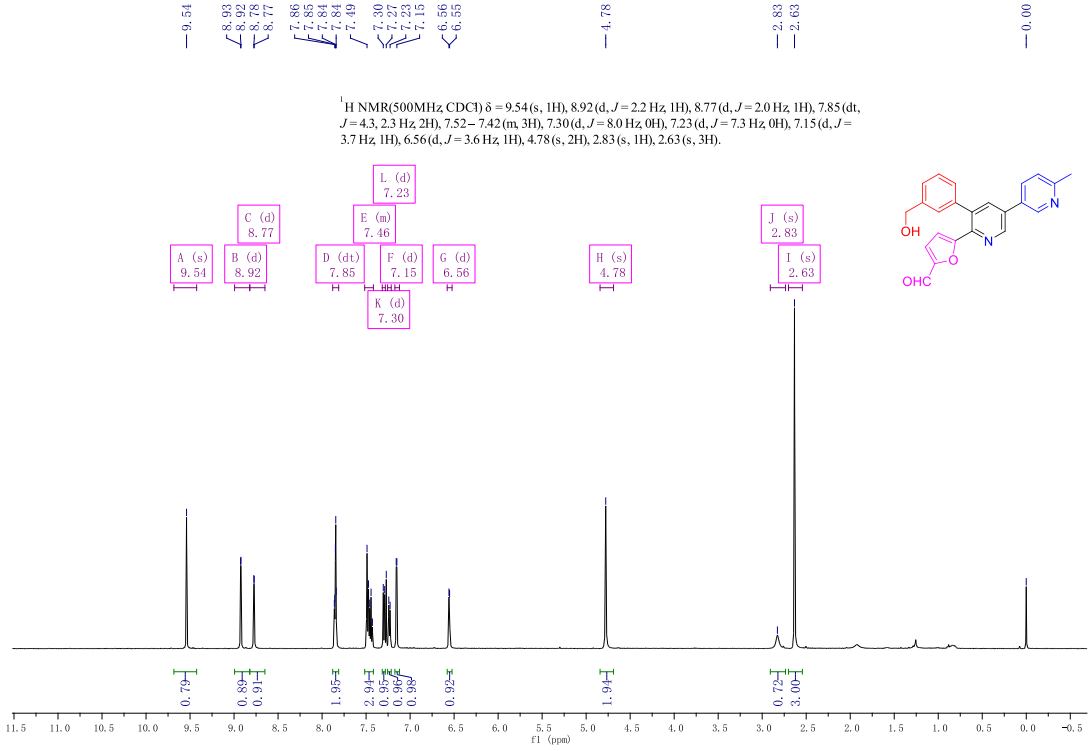
Compound **15**. *(3-(6-Chloro-6'-methyl-3,3'-bipyridin-5-yl)phenyl)methanol*

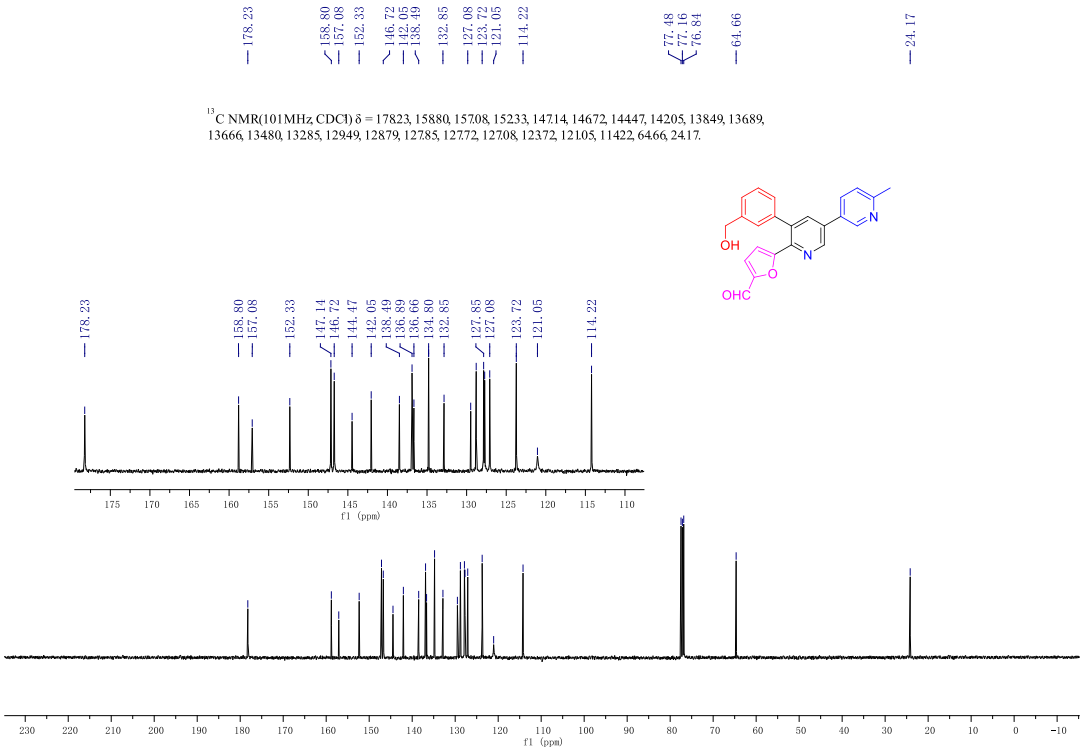



$^1$H NMR(500MHz, CD$_3$OD) δ = 8.75 (d, *J* = 2.0 Hz, 1H), 8.65 (d, *J* = 2.5 Hz, 1H), 8.07 (dd, *J* = 7.3, 2.4 Hz, 2H), 7.52 (s, 1H), 7.50 – 7.40 (m, 4H), 4.69 (s, 2H), 2.59 (s, 3H).



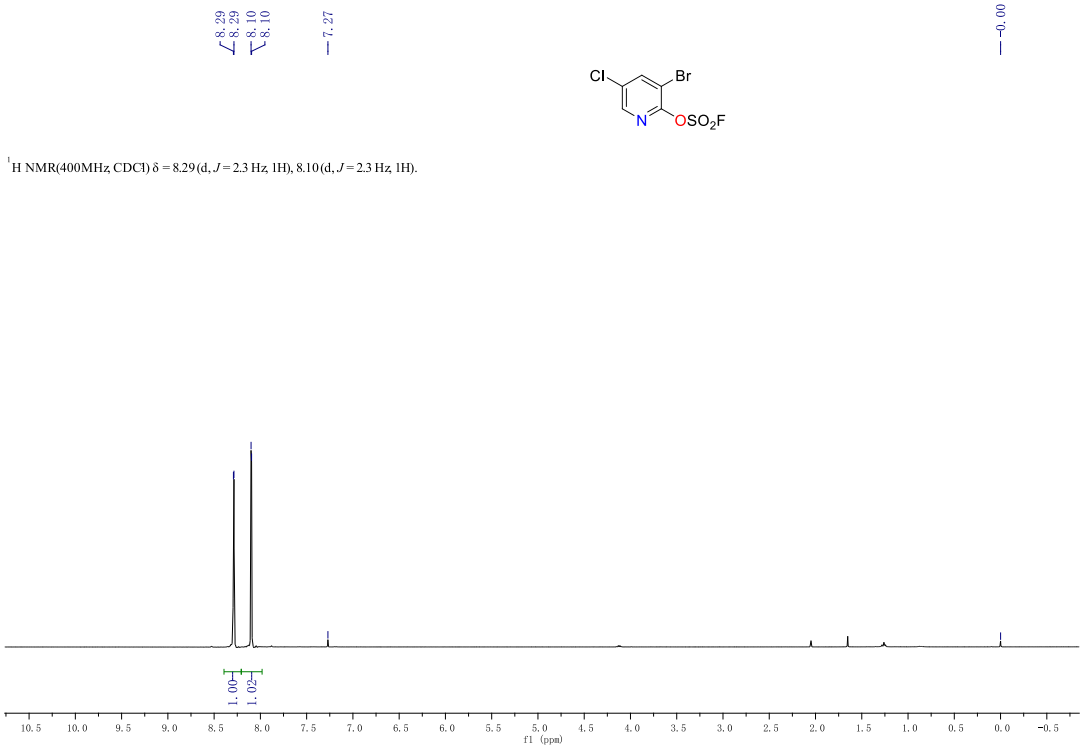

Compound **16**. *5-(5-(3-(Hydroxymethyl)phenyl)-6'-methyl-3,3'-bipyridin- 6-yl)furan-2-carbaldehyde*





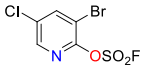

$^{13}$C NMR(101MHz, CDCl) δ = 178.23, 158.80, 157.08, 152.33, 147.14, 146.72, 144.47, 142.05, 138.49, 136.89, 136.66, 134.80, 132.85, 127.85, 127.72, 127.08, 123.72, 121.05, 114.22, 64.66, 24.17.

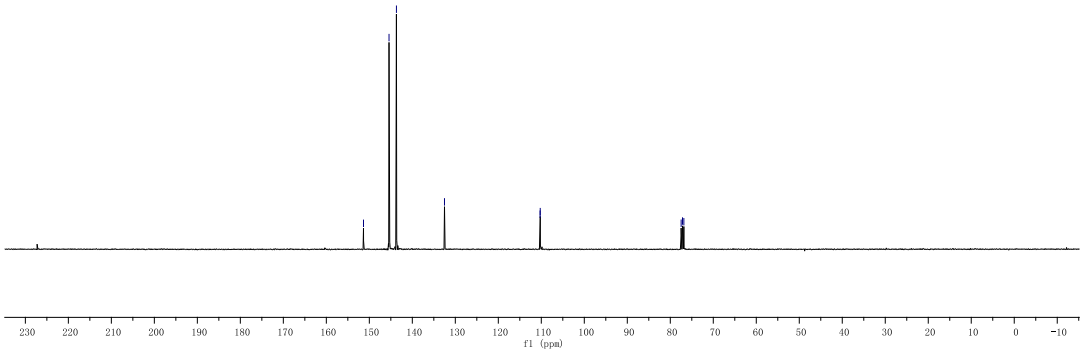
Compound **18**. *3-Bromo-5-chloropyridin-2-yl fluorosulfate*




$^{1}$H NMR(400MHz, CDCl) δ = 8.29 (d, *J* = 2.3 Hz, 1H), 8.10 (d, *J* = 2.3 Hz, 1H).

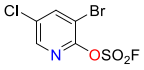

$^{13}$C NMR(101MHz, CDCl) δ = 151.36, 145.42, 143.69, 132.52, 110.26 (d, $J$ = 3.3 Hz).

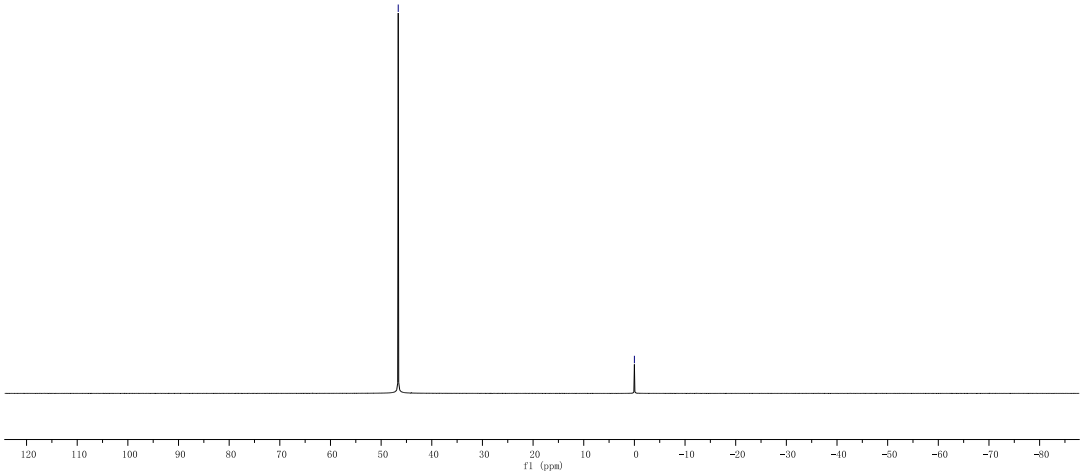




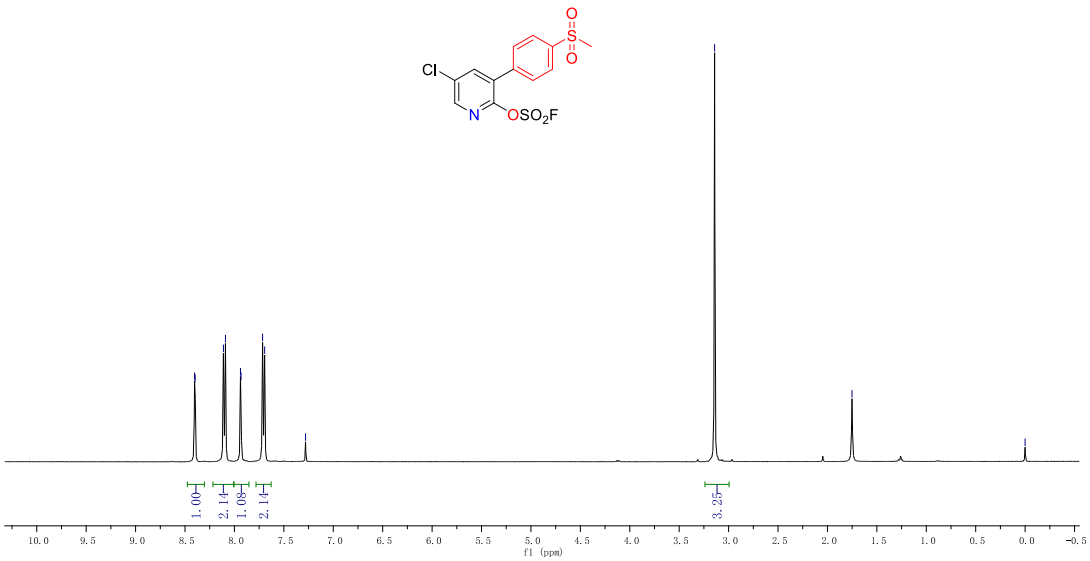
$^{19}$F NMR(377MHz, CDCl) δ = 46.62.



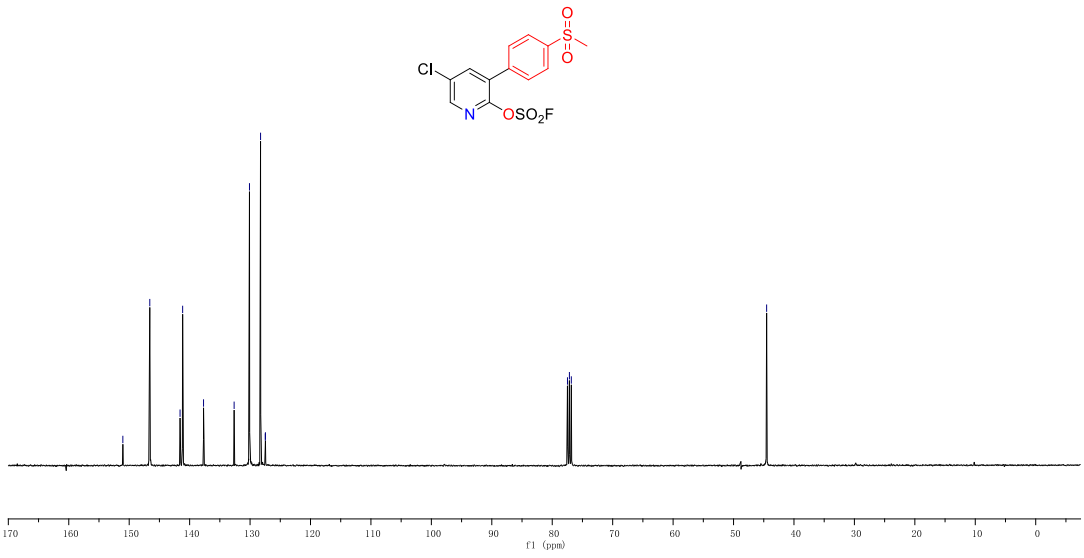
Compound **19**. *5-chloro-3-(4-(methylsulfonyl)phenyl)pyridin-2-yl fluorosulfate*

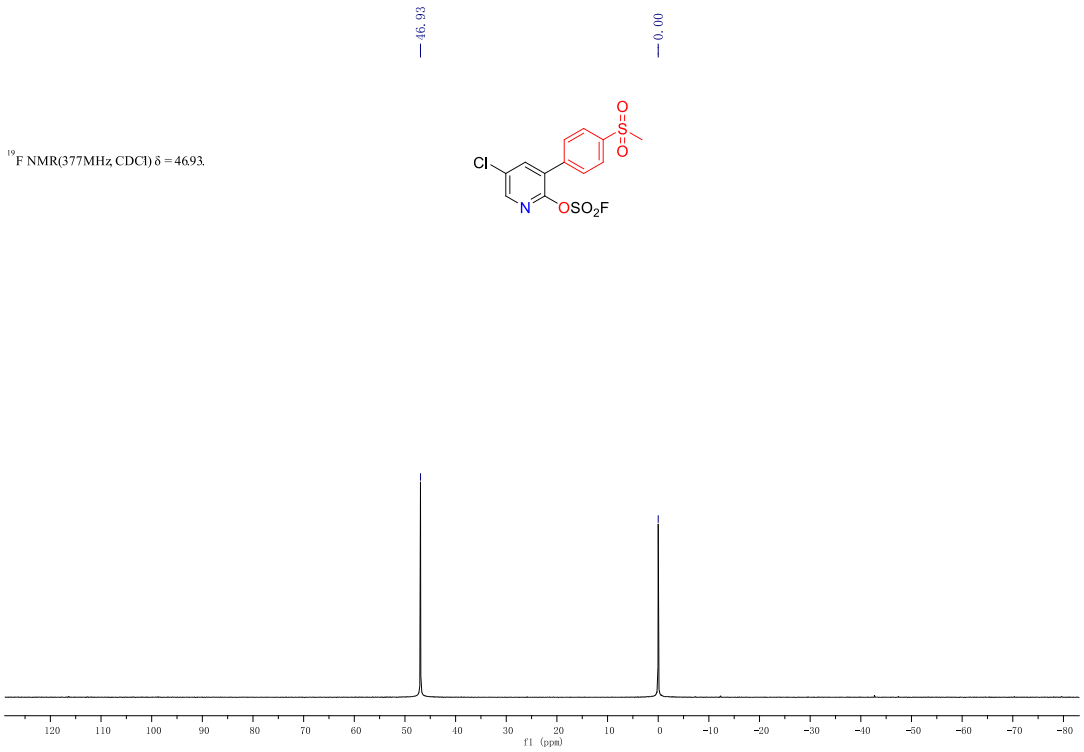

$^{1}$H NMR(400MHz, CDCl) δ = 8.40 (d, *J* = 2.3 Hz, 1H), 8.10 (d, *J* = 8.3 Hz, 2H), 7.94 (d, *J* = 2.3 Hz, 1H), 7.70 (d, *J* = 8.3 Hz, 2H), 3.14 (s, 3H).





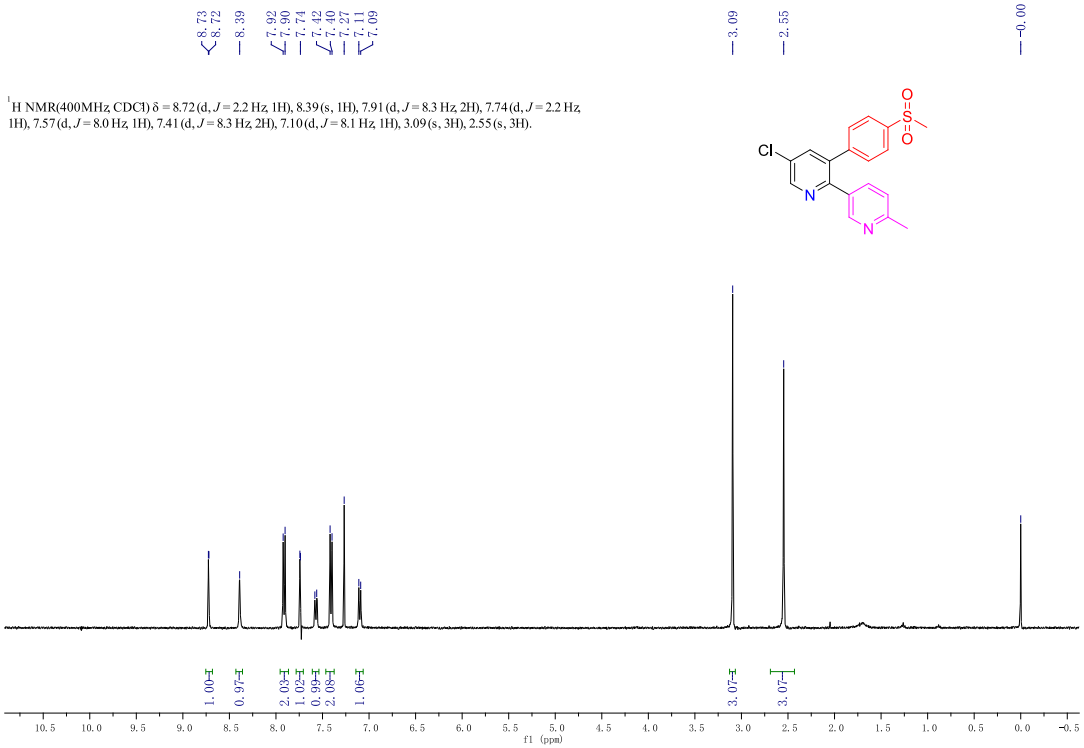
$^{13}$C NMR(101MHz, CDCl) δ = 151.05, 146.59, 141.58, 141.16, 137.70, 132.64, 130.10, 128.26, 127.47 (d, *J* = 2.3 Hz), 44.52.






$^{19}$F NMR(377MHz, CDCl) δ = 46.93.

**Etoricoxib**. *5-chloro-6'-methyl-3-(4-(methylsulfonyl)phenyl)-2,3'-bipyridine*




$^{1}$H NMR(400MHz, CDCl) δ = 8.72 (d, *J* = 2.2 Hz, 1H), 8.39 (s, 1H), 7.91 (d, *J* = 8.3 Hz, 2H), 7.74 (d, *J* = 2.2 Hz, 1H), 7.57 (d, *J* = 8.0 Hz, 1H), 7.41 (d, *J* = 8.3 Hz, 2H), 7.10 (d, *J* = 8.1 Hz, 1H), 3.09 (s, 3H), 2.55 (s, 3H).