

Supplementary Materials

Iodine-Mediated One-Pot Synthesis of Imidazo[1,5-*a*]Pyridines

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1. General Information

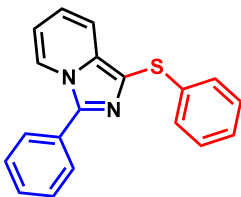
All starting materials were purchased from commercial suppliers and used without further purification unless otherwise stated. Yields refer to isolated compounds estimated to be >95 % pure as determined by ¹H NMR and capillary GC analysis. NMR spectra were recorded on a Bruker AM400 or Bruker AM600 NMR instrument in CDCl₃ using TMS as an internal standard. Chemical shifts are given in ppm and coupling constants (J) are given in Hz. All melting points were determined on a RY-1G melting point instrument without correction. High-resolution mass spectra (HRMS) were recorded on a Finnigan MAT 95Q or Finnigan 90 mass instrument (ESI). TLC was performed using aluminum plates coated with SiO₂ (Merck 60, F-254) and visualized with UV light at 254 nm. Column chromatography was performed on silica gel (150–300 mesh) with PE (petroleum ether)-EA (ethyl acetate) as eluent.

2. Typical procedure (TP) for 3-sulfinylimidazo[1,5-*a*]pyridines

A mixture of pyridin-2-ylmethanamine (**1a**, 1 mmol), benzaldehyde (**2a**, 0.5 mmol), and iodine (0.1 mmol) in DMF (3 mL) were added into the reaction tube, then TBHP (1.0 eq., based on **2a**) was added, the mixture was stirred at 100 °C for 2 hours. Then sodium benzenesulfite (**3a**, 1 mmol), iodine (0.5 mmol), PPh₃ (2.0 eq., based on **2a**) was added, the mixture was stirred at 100 °C and monitored by TLC until the starting material (**1a** or **2a**) was consumed. The reaction was then quenched with saturated Na₂S₂O₃ solution (about 5 mL), extracted with ethyl acetate. The original solution was dried with anhydrous Na₂SO₄ and evaporated in vacuo. The crude product was purified by column chromatography to give **4a**.

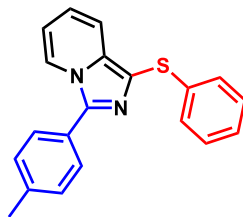
3. Analytical data for all compounds

3-phenyl-1-(phenylthio)imidazo[1,5-a]pyridine (4a)



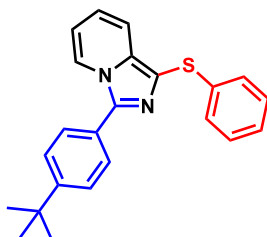
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 5:1) to give the target compound **4a**, 104 mg (yield: 69%), a yellow oil. ^1H NMR (400 MHz, CDCl_3) δ (ppm): 8.32 (d, $J = 7.2$ Hz, 1H), 7.85 – 7.83 (m, 2H), 7.65 (d, $J = 9.1$ Hz, 1H), 7.55 – 7.51 (m, 2H), 7.46 (t, $J = 7.4$ Hz, 1H), 7.23 – 7.17 (m, 4H), 7.09 (t, $J = 6.9$ Hz, 1H), 6.87 (dd, $J = 9.2, 6.4$ Hz, 1H), 6.67 (t, $J = 6.8$ Hz, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 139.3, 138.4, 135.1, 129.5, 129.2, 129.0, 128.8, 128.3, 127.1, 125.5, 122.1, 121.1, 120.1, 118.5, 113.9. HRMS (ESI) m/z $[(M + H)^+]$ Calcd for $\text{C}_{19}\text{H}_{15}\text{N}_2\text{S}^+$ (303.0950), found 303.0953.

1-(phenylthio)-3-(p-tolyl)imidazo[1,5-a]pyridine (4b)



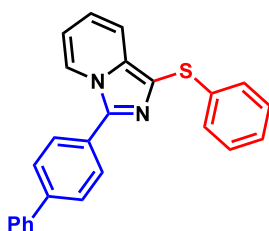
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4b**, 72 mg (yield: 46%), a white solid. M.P.: 142-146 °C. ^1H NMR (400 MHz, CDCl_3) δ (ppm): 8.29 (d, $J = 7.2$ Hz, 1H), 7.74 – 7.72 (m, 2H), 7.64 (d, $J = 9.2$ Hz, 1H), 7.35 – 7.33 (m, 2H), 7.23 – 7.16 (m, 4H), 7.08 (t, $J = 7.0$ Hz, 1H), 6.85 (dd, $J = 9.2, 6.4$ Hz, 1H), 6.65 (t, $J = 6.8$ Hz, 1H), 2.43 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 139.5, 139.3, 138.4, 135.0, 129.7, 128.8, 128.2, 127.1, 126.6, 125.5, 122.2, 121.0, 119.7, 118.5, 113.8, 21.5. HRMS (ESI) m/z $[(M + H)^+]$ Calcd for $\text{C}_{20}\text{H}_{17}\text{N}_2\text{S}^+$ (317.1107), found 317.1104.

3-(4-(tert-butyl)phenyl)-1-(phenylthio)imidazo[1,5-a]pyridine (4c)



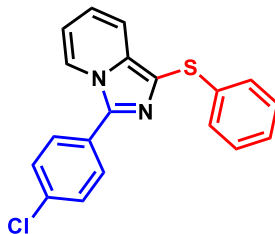
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4c**. 82 mg (yield: 46%), a green solid. M.P.: 140-148 °C. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.31 (d, *J* = 7.2 Hz, 1H), 7.79 – 7.77 (m, 2H), 7.62 (d, *J* = 9.2 Hz, 1H), 7.56 – 7.54 (m, 2H), 7.23 – 7.16 (m, 4H), 7.07 (t, *J* = 7.1 Hz, 1H), 6.82 (dd, *J* = 9.2, 6.4 Hz, 1H), 6.62 (t, *J* = 6.8 Hz, 1H), 1.38 (s, 9H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 152.4, 139.5, 138.5, 135.0, 128.8, 128.0, 127.0, 126.7, 126.0, 125.5, 122.2, 121.0, 119.8, 118.4, 113.7, 34.9, 31.3. HRMS (ESI) *m/z* [(M + H)⁺] Calcd for C₂₃H₂₃N₂S⁺ (359.1576), found 359.1572.

3-([1,1'-biphenyl]-4-yl)-1-(phenylthio)imidazo[1,5-a]pyridine (4d)



According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4d**. 84 mg (yield: 44%), a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.39 (d, *J* = 7.3 Hz, 1H), 7.96 (s, 1H), 7.94 (s, 1H), 7.80 (s, 1H), 7.77 (s, 1H), 7.70-7.67 (m, 3H), 7.52-7.48 (m, 2H), 7.41 (t, *J* = 7.3 Hz, 1H), 7.28-7.20 (m, 4H), 7.12 (t, *J* = 7.1 Hz, 1H), 6.90 (dd, *J* = 9.2, 6.4 Hz, 1H), 6.71 (t, *J* = 6.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 141.8, 140.3, 139.0, 138.4, 135.2, 129.0, 128.9, 128.6, 128.4, 127.8, 127.7, 127.1, 127.1, 125.6, 122.2, 121.2, 120.3, 118.5, 114.0. HRMS (ESI) *m/z* [(M + H)⁺] Calcd for C₂₅H₁₉N₂S⁺ (379.1263), found 379.1260.

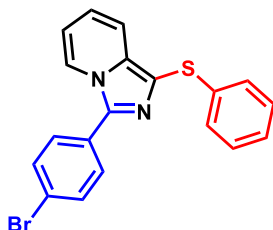
3-(4-chlorophenyl)-1-(phenylthio)imidazo[1,5-a]pyridine (4e)



According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4e**. 121 mg (yield: 72%), a yellow solid. M.P.: 104-1110 °C. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.25 (d, *J* = 7.2 Hz, 1H), 7.79 (s, 1H), 7.77 (s, 1H), 7.65 (d, *J* = 9.1 Hz, 1H), 7.50 (s, 1H), 7.48 (s,

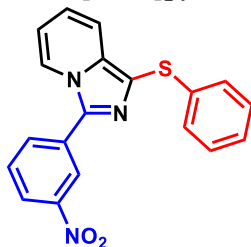
1H), 7.22 - 7.17 (m, 4H), 7.09 (t, $J = 6.7$ Hz, 1H), 6.88 (dd, $J = 9.2, 6.5$ Hz, 1H), 6.69 (t, $J = 6.8$ Hz, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 138.1, 135.3, 135.0, 129.4, 129.3, 128.9, 128.0, 127.2, 125.6, 122.4, 121.9, 121.3, 120.5, 118.6, 114.3. HRMS (ESI) m/z $[(M + H)^+]$ Calcd for $\text{C}_{19}\text{H}_{14}\text{ClN}_2\text{S}^+$ (337.0561), found 337.0565.

3-(4-bromophenyl)-1-(phenylthio)imidazo[1,5-a]pyridine (4f)



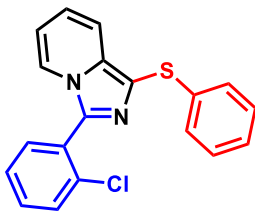
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4f**. 95 mg (yield: 50%), a yellow solid. M.P.: 118-126 °C. ^1H NMR (400 MHz, CDCl_3) δ (ppm): 8.25 (d, $J = 7.2$ Hz, 1H), 7.73 - 7.70 (m, 2H), 7.65 - 7.73 (m, 3H), 7.22 - 7.16 (m, 4H), 7.09 (t, $J = 6.7$ Hz, 1H), 6.88 (dd, $J = 9.0, 6.6$ Hz, 1H), 6.69 (t, $J = 6.8$ Hz, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 138.1, 135.3, 132.3, 129.6, 128.9, 128.5, 127.2, 125.6, 123.2, 121.9, 121.3, 120.6, 118.6, 114.3. HRMS (ESI) m/z $[(M + H)^+]$ Calcd for $\text{C}_{19}\text{H}_{13}\text{BrN}_2\text{S}^+$ (381.0056), found 381.0053.

3-(3-nitrophenyl)-1-(phenylthio)imidazo[1,5-a]pyridine (4g)



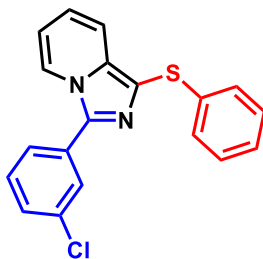
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4g**. 105 mg (yield: 61%), a yellow solid. M.P.: 116-120 °C. ^1H NMR (400 MHz, CDCl_3) δ (ppm): 8.70 (s, 1H), 8.34 (d, $J = 7.5$ Hz, 1H), 8.27 - 8.21 (m, 2H), 7.72 - 7.68 (m, 2H), 7.22 - 7.16 (m, 4H), 7.09 (t, $J = 6.6$ Hz, 1H), 6.95 (dd, $J = 8.9, 6.7$ Hz, 1H), 6.79 (t, $J = 6.8$ Hz, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 148.6, 137.8, 136.6, 135.7, 134.0, 131.3, 130.3, 128.9, 127.3, 125.8, 123.5, 122.3, 121.9, 121.6, 121.5, 118.7, 115.1. HRMS (ESI) m/z $[(M + H)^+]$ Calcd for $\text{C}_{19}\text{H}_{14}\text{N}_3\text{O}_2\text{S}^+$ (348.0801), found 348.0805.

3-(2-chlorophenyl)-1-(phenylthio)imidazo[1,5-a]pyridine (4h)



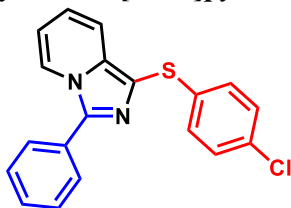
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4h**. 67 mg (yield: 40%), a yellow oil. ^1H NMR (400 MHz, CDCl_3) δ (ppm): 7.69 – 7.65 (m, 3H), 7.55 (d, J = 7.7 Hz, 1H), 7.48 – 7.40 (m, 2H), 7.20 – 7.19 (m, 4H), 7.11 – 7.06 (m, 1H), 6.92 (dd, J = 9.9, 6.6 Hz, 1H), 6.69 (t, J = 7.3 Hz, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 138.5, 136.9, 134.7, 134.3, 133.4, 131.1, 130.0, 128.8, 128.8, 127.3, 127.0, 125.5, 122.9, 121.3, 119.6, 118.1, 113.5. HRMS (ESI) m/z $[(M + H)^+]$ Calcd for $\text{C}_{19}\text{H}_{14}\text{ClN}_2\text{S}^+$ (337.0561), found 337.0564.

3-(3-chlorophenyl)-1-(phenylthio)imidazo[1,5-a]pyridine (4i)



According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4i**. 69 mg (yield: 41%), a yellow oil. ^1H NMR (400 MHz, CDCl_3) δ (ppm): 8.32 (d, J = 7.2 Hz, 1H), 7.86 (s, 1H), 7.74 (d, J = 7.3 Hz, 1H), 7.68 (d, J = 9.2 Hz, 1H), 7.49 – 7.44 (m, 2H), 7.24 – 7.17 (m, 4H), 7.12 – 7.08 (m, 1H), 6.91 (dd, J = 9.1, 6.4 Hz, 1H), 6.74 (t, J = 6.8 Hz, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 137.9, 137.7, 135.3, 135.1, 131.0, 130.3, 129.3, 128.9, 128.2, 127.4, 126.2, 125.7, 121.9, 121.5, 118.7, 114.5. HRMS (ESI) m/z $[(M + H)^+]$ Calcd for $\text{C}_{19}\text{H}_{14}\text{ClN}_2\text{S}^+$ (337.0561), found 337.0565.

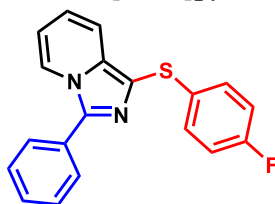
1-((4-chlorophenyl)thio)-3-phenylimidazo[1,5-a]pyridine (4j)



According to TP, the residue was purified by flash chromatography on silica gel

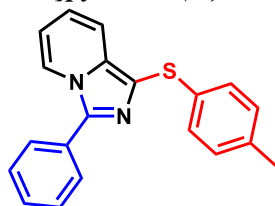
(petroleum ether/ethyl acetate = 20:1) to give the target compound **4j**. 101 mg (yield: 60%), a white solid. M.P.: 104-110 °C. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.32 (d, *J* = 7.3 Hz, 1H), 7.84 – 7.82 (m, 2H), 7.64 (d, *J* = 9.2 Hz, 1H), 7.56 – 7.52 (m, 2H), 7.47 (t, *J* = 7.3 Hz, 1H), 7.15 (s, 4H), 6.90 (dd, *J* = 9.1, 6.4 Hz, 1H), 6.69 (t, *J* = 6.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 139.4, 136.9, 135.0, 131.5, 129.3, 129.1, 128.9, 128.5, 128.3, 122.2, 121.5, 119.5, 118.3, 114.1. HRMS (ESI) *m/z* [(*M* + *H*)⁺] Calcd for C₁₉H₁₄ClN₂S⁺ (337.0561), found 337.0563.

1-((4-fluorophenyl)thio)-3-phenylimidazo[1,5-a]pyridine (4k)



According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4k**. 104 mg (yield: 65%), a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.32 (d, *J* = 7.2 Hz, 1H), 7.85 – 7.83 (m, 2H), 7.67 (d, *J* = 9.2 Hz, 1H), 7.56 – 7.52 (m, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.28 – 7.25 (m, 2H), 6.94 – 6.87 (m, 3H), 6.68 (t, *J* = 6.8 Hz, 1H) ppm. ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 161.4 [d, *J*(C-F) = 244.0 Hz], 139.3, 134.9, 133.2, 129.5, 129.5 [d, *J*(C-F) = 8.0 Hz], 129.2, 129.1, 128.3, 122.1, 121.3, 120.5, 118.3, 115.9 [d, *J*(C-F) = 21.0 Hz], 113.9. ¹⁹F NMR (377 MHz, CDCl₃) δ -117.0. HRMS (ESI) *m/z* [(*M* + *H*)⁺] Calcd for C₁₉H₁₄FN₂S⁺ (321.0856), found 321.0853.

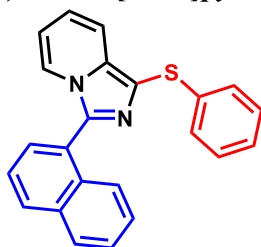
3-phenyl-1-(p-tolylthio)imidazo[1,5-a]pyridine (4l)



According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4l**. 82 mg (yield: 52%), a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.29 (d, *J* = 7.2 Hz, 1H), 7.84 – 7.82 (m, 2H), 7.64 (d, *J* = 9.2 Hz, 1H), 7.54 – 7.50 (m, 2H), 7.44 (t, *J* = 7.4 Hz, 1H), 7.18 – 7.16 (m, 2H), 7.02 – 7.00 (m, 2H), 6.84 (dd, *J* = 9.2, 6.4 Hz, 1H), 6.64 (t, *J* = 6.8 Hz, 1H), 2.25 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 139.1, 136.5, 135.5, 134.8, 134.6, 129.6, 129.6, 129.1, 129.0, 128.3, 127.8, 122.0, 121.0, 118.5, 113.9, 21.0. HRMS (ESI)

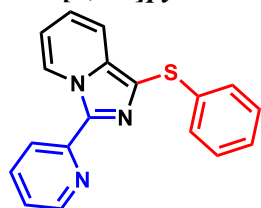
$m/z [(M + H)^+]$ Calcd for $C_{20}H_{17}N_2S^+$ (317.1107), found 317.1104.

3-(naphthalen-1-yl)-1-(phenylthio)imidazo[1,5-a]pyridine (4m)



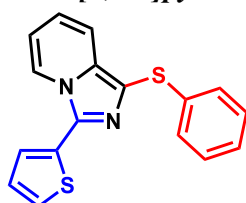
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4m**. 109 mg (yield: 62%), a yellow oil. 1H NMR (400 MHz, $CDCl_3$) δ (ppm): 8.01 (d, J = 8.2 Hz, 1H), 7.95 (d, J = 8.1 Hz, 1H), 7.79 (d, J = 7.1 Hz, 1H), 7.74 – 7.70 (m, 3H), 7.63 – 7.59 (m, 1H), 7.54 (t, J = 7.5 Hz, 1H), 7.48 (t, J = 7.6 Hz, 1H), 7.31 – 7.29 (m, 2H), 7.24 – 7.20 (m, 2H), 7.11 (t, J = 7.3 Hz, 1H), 6.89 (dd, J = 9.6, 6.4 Hz, 1H), 6.58 – 6.54 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 138.6, 138.1, 134.7, 134.0, 131.8, 130.3, 129.0, 128.9, 128.7, 127.2, 126.6, 126.5, 125.5, 125.4, 125.3, 122.5, 121.3, 119.8, 118.3, 113.5. HRMS (ESI) $m/z [(M + H)^+]$ Calcd for $C_{23}H_{17}N_2S^+$ (353.1107), found 353.1104.

1-(phenylthio)-3-(pyridin-2-yl)imidazo[1,5-a]pyridine (4n)



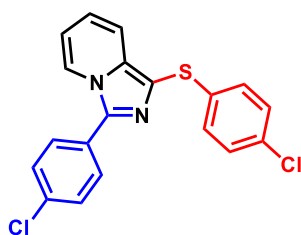
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4n**. 110 mg (yield: 73%), a white solid. M.P.: 100-110 °C. 1H NMR (400 MHz, $CDCl_3$) δ (ppm): 10.00 (d, J = 7.3 Hz, 1H), 8.61 (d, J = 4.0 Hz, 1H), 8.43 (d, J = 8.1 Hz, 1H), 7.73 (t, J = 7.8 Hz, 1H), 7.64 (d, J = 9.1 Hz, 1H), 7.20 – 7.15 (m, 5H), 7.09 – 7.0 (m, 1H), 6.93 (dd, J = 9.0, 6.5 Hz, 1H), 6.76 (t, J = 6.9 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ (ppm): 150.6, 148.1, 138.3, 136.6, 136.4, 136.3, 128.9, 126.9, 126.8, 125.5, 122.4, 122.2, 120.3, 117.6, 114.2. HRMS (ESI) $m/z [(M + H)^+]$ Calcd for $C_{18}H_{14}N_3S^+$ (304.0903), found 304.0906.

1-(phenylthio)-3-(thiophen-2-yl)imidazo[1,5-a]pyridine (4o)



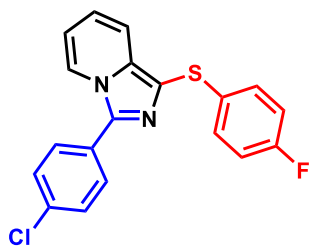
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4o**. 49 mg (yield: 32%), a yellow solid. M.P.: 112-116 °C. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.40 (d, *J* = 7.2 Hz, 1H), 7.65 (d, *J* = 9.1 Hz, 1H), 7.60 (d, *J* = 3.7 Hz, 1H), 7.45 (d, *J* = 5.1 Hz, 1H), 7.21 – 7.16 (m, 5H), 7.10 – 7.07 (m, 1H), 6.89 (dd, *J* = 9.1, 6.4 Hz, 1H), 6.76 (t, *J* = 6.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 138.2, 135.1, 134.0, 131.5, 128.8, 127.7, 127.1, 126.6, 125.8, 125.6, 122.4, 121.1, 120.5, 118.5, 114.4. HRMS (ESI) *m/z* [(*M* + *H*)⁺] Calcd for C₁₇H₁₃N₂S₂⁺ (309.0515), found 309.0518.

3-(4-chlorophenyl)-1-((4-chlorophenyl)thio)imidazo[1,5-*a*]pyridine (4p)



According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 5:1) to give the target compound **4p**. 138 mg (yield: 74%), a yellow solid. M.P.: 140-148 °C. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.26 (d, *J* = 7.3 Hz, 1H), 7.78 – 7.76 (m, 2H), 7.64 (d, *J* = 9.2 Hz, 1H), 7.51 – 7.49 (m, 2H), 7.14 (s, 4H), 6.91 (dd, *J* = 9.2, 6.5 Hz, 1H), 6.71 (t, *J* = 6.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 138.3, 136.7, 135.3, 135.2, 131.5, 129.4, 129.4, 128.9, 128.5, 127.9, 121.9, 121.6, 112.0, 118.4, 114.3. HRMS (ESI) *m/z* [(*M* + *H*)⁺] Calcd for C₁₉H₁₃Cl₂N₂S⁺ (371.0171), found 371.0175.

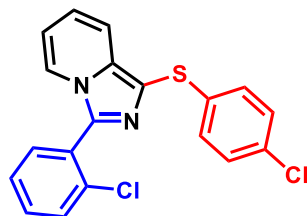
3-(4-chlorophenyl)-1-((4-fluorophenyl)thio)imidazo[1,5-*a*]pyridine (4q)



According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4q**. 122 mg (yield: 69%), a white oil. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.27 (d, *J* = 7.2 Hz, 1H), 7.81 (s, 1H), 7.79 (s, 1H), 7.69 (d, *J* = 9.2 Hz, 1H), 7.54 (s, 1H), 7.52 (s, 1H), 7.29 – 7.25 (m, 2H), 6.95 – 6.91 (m, 3H), 6.73 (t, *J* = 6.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 161.5

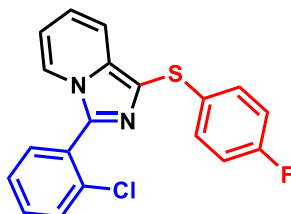
[d, $J(\text{C-F}) = 244.0$ Hz], 138.1, 135.2, 135.0, 132.9, 129.7 [d, $J(\text{C-F}) = 7.0$ Hz], 129.5, 129.4, 127.8, 121.9, 121.5, 120.9, 118.5, 115.9 [d, $J(\text{C-F}) = 22.0$ Hz], 114.3. ^{19}F NMR (377 MHz, CDCl_3) δ -116.7. HRMS (ESI) m/z $[(\text{M} + \text{H})^+]$ Calcd for $\text{C}_{19}\text{H}_{13}\text{ClFN}_2\text{S}^+$ (355.0467), found 355.0465.

3-(2-chlorophenyl)-1-((4-chlorophenyl)thio)imidazo[1,5-a]pyridine (4r)



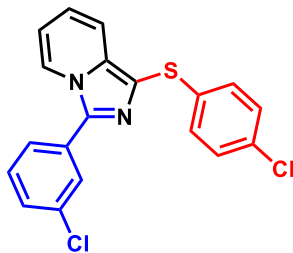
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 5:1) to give the target compound **4r**. 145 mg (yield: 78%), a yellow solid. M.P.: 150-152 °C. ^1H NMR (400 MHz, CDCl_3) δ (ppm): 7.69 – 7.64 (m, 3H), 7.55 (d, $J = 7.8$ Hz, 1H), 7.49 – 7.40 (m, 2H), 7.15 – 7.12 (m, 4H), 6.94 (dd, $J = 9.1$, 6.5 Hz, 1H), 6.70 (t, $J = 6.7$ Hz, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 137.1, 134.7, 134.3, 133.3, 131.4, 131.3, 130.0, 128.9, 128.6, 128.3, 127.3, 123.0, 121.7, 119.1, 117.9, 113.6. HRMS (ESI) m/z $[(\text{M} + \text{H})^+]$ Calcd for $\text{C}_{19}\text{H}_{13}\text{Cl}_2\text{N}_2\text{S}^+$ (371.0171), found 371.0174.

3-(2-chlorophenyl)-1-((4-fluorophenyl)thio)imidazo[1,5-a]pyridine (4s)



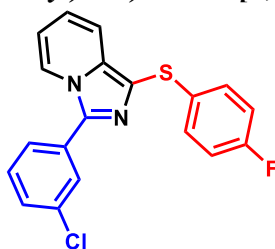
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4s**. 130 mg (yield: 73%), a white solid. M.P.: 80-92°C. ^1H NMR (400 MHz, CDCl_3) δ (ppm): 7.68 – 7.62 (m, 3H), 7.54 (s, 1H), 7.53 (s, 1H), 7.47 – 7.39 (m, 2H), 7.24 - 7.21 (m, 2H), 6.94 - 6.87 (m, 3H), 6.69 – 6.66 (m, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 161.4 [d, $J(\text{C-F}) = 244.0$ Hz], 136.9, 134.5, 134.3, 133.3, 131.2, 130.0, 129.3 [d, $J(\text{C-F}) = 8.0$ Hz], 128.7, 127.3, 122.9, 121.5, 120.0, 118.0, 115.9 [d, $J(\text{C-F}) = 22.0$ Hz], 113.5. ^{19}F NMR (377 MHz, CDCl_3) δ -117.1. HRMS (ESI) m/z $[(\text{M} + \text{H})^+]$ Calcd for $\text{C}_{19}\text{H}_{13}\text{ClFN}_2\text{S}^+$ (355.0467), found 355.0464.

3-(3-chlorophenyl)-1-((4-chlorophenyl)thio)imidazo[1,5-a]pyridine(4t)



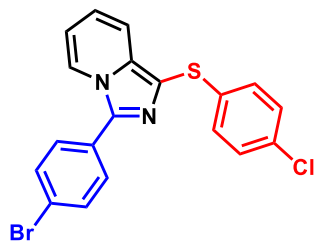
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4t**. 150 mg (yield: 81%), a yellow solid. M.P.: 98-102 °C. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.30 (d, *J* = 7.2 Hz, 1H), 7.84 (s, 1H), 7.72 (d, *J* = 7.3 Hz, 1H), 7.64 (d, *J* = 9.2 Hz, 1H), 7.48 – 7.41 (m, 2H), 7.17 – 7.12 (m, 4H), 6.92 (dd, *J* = 9.2, 6.5 Hz, 1H), 6.73 (t, *J* = 6.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 137.9, 136.7, 135.4, 135.1, 131.6, 131.1, 130.4, 129.3, 128.9, 128.5, 128.2, 126.1, 122.0, 121.8, 120.2, 118.4, 114.5. HRMS (ESI) *m/z* [(M + H)⁺] Calcd for C₁₉H₁₃ClN₂S⁺ (371.0171), found 371.0175.

3-(3-chlorophenyl)-1-((4-fluorophenyl)thio)imidazo[1,5-a]pyridine (4u)



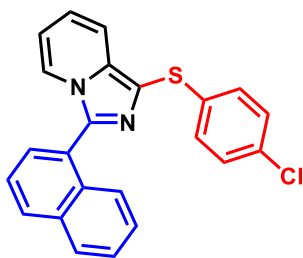
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4u**. 126 mg (yield: 71%), a yellow solid. M.P.: 98-100°C. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.30 (d, *J* = 7.3 Hz, 1H), 7.85 (s, 1H), 7.74 – 7.67 (m, 2H), 7.49 – 7.42 (m, 2H), 7.27 – 7.24 (m, 2H), 6.95 – 6.89 (m, 3H), 6.74 (t, *J* = 6.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 160.5 [d, *J*(C-F) = 243.0 Hz], 137.7, 135.1, 132.9, 131.1, 130.3, 129.7 [d, *J*(C-F) = 8.0 Hz], 129.3, 128.2, 126.1, 121.9, 121.6, 121.1, 118.5, 115.9 [d, *J*(C-F) = 23.0 Hz], 114.4. ¹⁹F NMR (377 MHz, CDCl₃) δ -116.7. HRMS (ESI) *m/z* [(M + H)⁺] Calcd for C₁₉H₁₃ClFN₂S⁺ (355.0467), found 355.0463.

3-(4-bromophenyl)-1-((4-chlorophenyl)thio)imidazo[1,5-a]pyridine (4v)



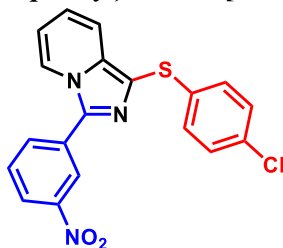
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4v**. 133 mg (yield: 64%), a white solid. M.P.:150-156°C. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.26 (d, *J* = 7.2 Hz, 1H), 7.72 (s, 1H), 7.70 (s, 1H), 7.66 – 7.62 (m, 3H), 7.14 (s, 4H), 6.91 (dd, *J* = 9.2, 6.5 Hz, 1H), 6.71 (t, *J* = 6.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 138.3, 136.7, 135.3, 132.3, 131.5, 129.6, 128.9, 128.5, 128.3, 123.4, 121.9, 121.6, 120.0, 118.4, 114.4. HRMS (ESI) *m/z* [(*M* + *H*)⁺] Calcd for C₁₉H₁₃BrClN₂S⁺ (414.9666), found 414.9669.

1-((4-chlorophenyl)thio)-3-(naphthalen-1-yl)imidazo[1,5-a]pyridine (4w)



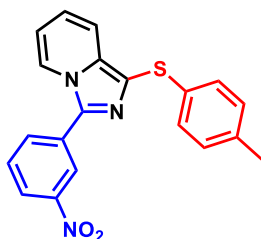
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4w**. 140 mg (yield: 72%), a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.02 (d, *J* = 8.2 Hz, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.78 (d, *J* = 7.1 Hz, 1H), 7.73 – 7.67 (m, 3H), 7.64 – 7.60 (m, 1H), 7.55 (t, *J* = 7.5 Hz, 1H), 7.50 – 7.46 (m, 1H), 7.24 – 7.17 (m, 4H), 6.92 (dd, *J* = 9.2, 6.4 Hz, 1H), 6.59 (t, *J* = 6.7 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 138.3, 137.0, 134.7, 134.0, 131.7, 131.5, 130.4, 129.0, 128.9, 128.7, 128.6, 127.3, 126.5, 126.3, 125.3, 125.3, 122.6, 121.6, 119.3, 118.1, 113.6. HRMS (ESI) *m/z* [(*M* + *H*)⁺] Calcd for C₂₃H₁₆ClN₂S⁺ (387.0717), found 387.0720.

1-((4-chlorophenyl)thio)-3-(3-nitrophenyl)imidazo[1,5-a]pyridine (4x)



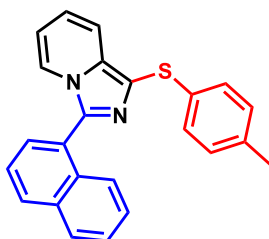
According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4x**. 144 mg (yield: 75%), a yellow solid. M.P.:140-144°C. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.68 (s, 1H), 8.34 (d, *J* = 7.2 Hz, 1H), 8.26 (d, *J* = 8.2 Hz, 1H), 8.20 (d, *J* = 8.1 Hz, 1H), 7.72 – 7.65 (m, 2H), 7.13 (s, 4H), 6.97 (dd, *J* = 9.2, 6.5 Hz, 1H), 6.81 (t, *J* = 6.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 148.6, 136.7, 136.4, 135.7, 134.0, 131.7, 131.2, 130.3, 129.0, 128.6, 123.6, 122.4, 122.2, 121.7, 120.9, 118.5, 115.1. HRMS (ESI) *m/z* [(*M* + *H*)⁺] Calcd for C₁₉H₁₃ClN₃O₂S⁺ (382.0412), found 382.0416.

3-(3-nitrophenyl)-1-(p-tolylthio)imidazo[1,5-a]pyridine (4y)



According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4y**. 120 mg (yield: 67%), a yellow solid. M.P.:140-144°C. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.70 (s, 1H), 8.33 (d, *J* = 7.2 Hz, 1H), 8.28 – 7.26 (m, 2H), 7.71 – 7.68 (m, 2H), 7.18 (s, 1H), 7.16 (s, 1H), 7.02 – 7.01 (m, 2H), 6.94 (dd, *J* = 9.2, 6.4 Hz, 1H), 6.78 (t, *J* = 6.8 Hz, 1H), 2.25 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ (ppm): 148.6, 136.3, 135.9, 135.4, 134.0, 133.9, 131.3, 130.2, 129.7, 128.1, 123.4, 122.5, 122.3, 121.7, 121.5, 118.8, 115.0, 21.0. HRMS (ESI) *m/z* [(*M* + *H*)⁺] Calcd for C₂₀H₁₆N₃O₂S⁺ (362.0958), found 362.0955.

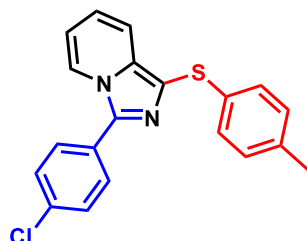
3-(naphthalen-1-yl)-1-(p-tolylthio)imidazo[1,5-a]pyridine (4z)



According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4z**. 78 mg (yield: 43%), a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ (ppm): 8.03 (d, *J* = 8.2 Hz, 1H), 7.97 (d, *J* = 7.5 Hz, 1H), 7.80 (d, *J* = 7.1 Hz, 1H), 7.75 – 7.71 (m, 3H), 7.65 – 7.61 (m, 1H), 7.56 (t, *J* = 7.5 Hz, 1H), 7.49 (t, *J* = 7.6 Hz, 1H), 7.28 (s, 1H), 7.26 (s, 1H), 7.08 (s, 1H), 7.06 (s, 1H),

6.90 (dd, $J = 9.1, 6.3$ Hz, 1H), 6.59 – 6.56 (m, 1H), 2.30 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 137.8, 135.6, 134.7, 134.4, 134.0, 131.7, 130.3, 129.6, 129.0, 128.7, 128.0, 127.2, 126.5, 126.4, 125.4, 125.3, 122.5, 121.1, 120.7, 118.4, 113.5, 21.0. HRMS (ESI) m/z $[(M + H)^+]$ Calcd for $\text{C}_{24}\text{H}_{19}\text{N}_2\text{S}^+$ (367.1263), found 367.1266.

3-(4-chlorophenyl)-1-(p-tolylthio)imidazo[1,5-a]pyridine (4za)

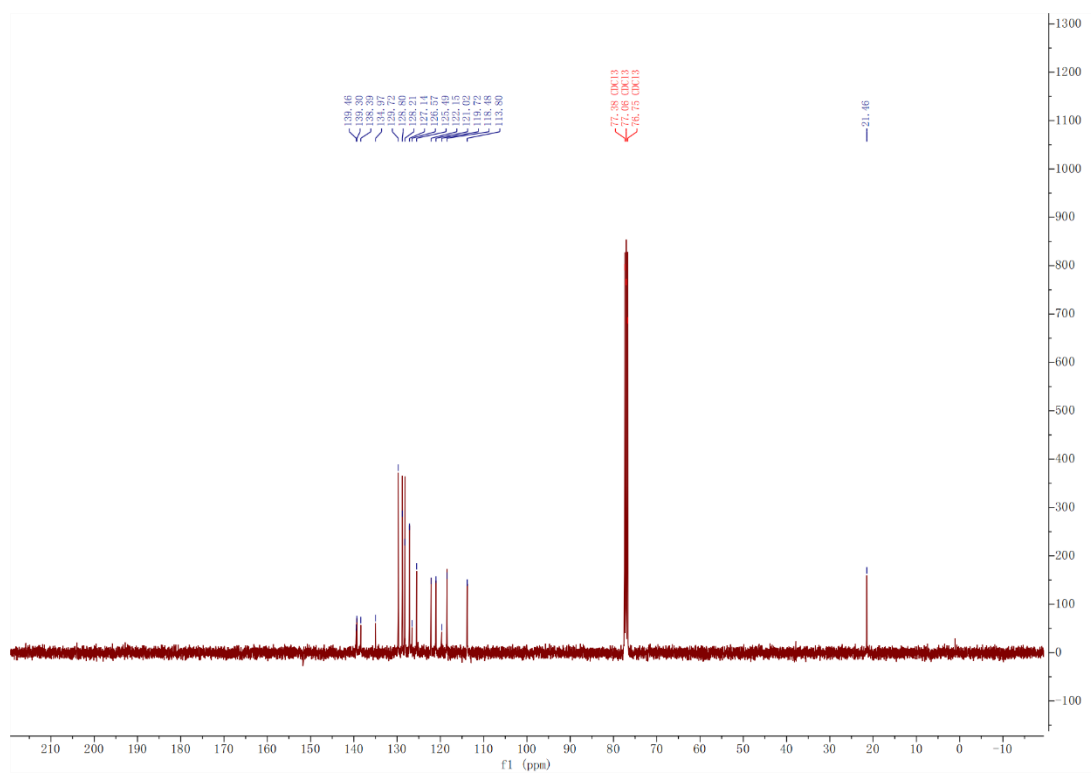
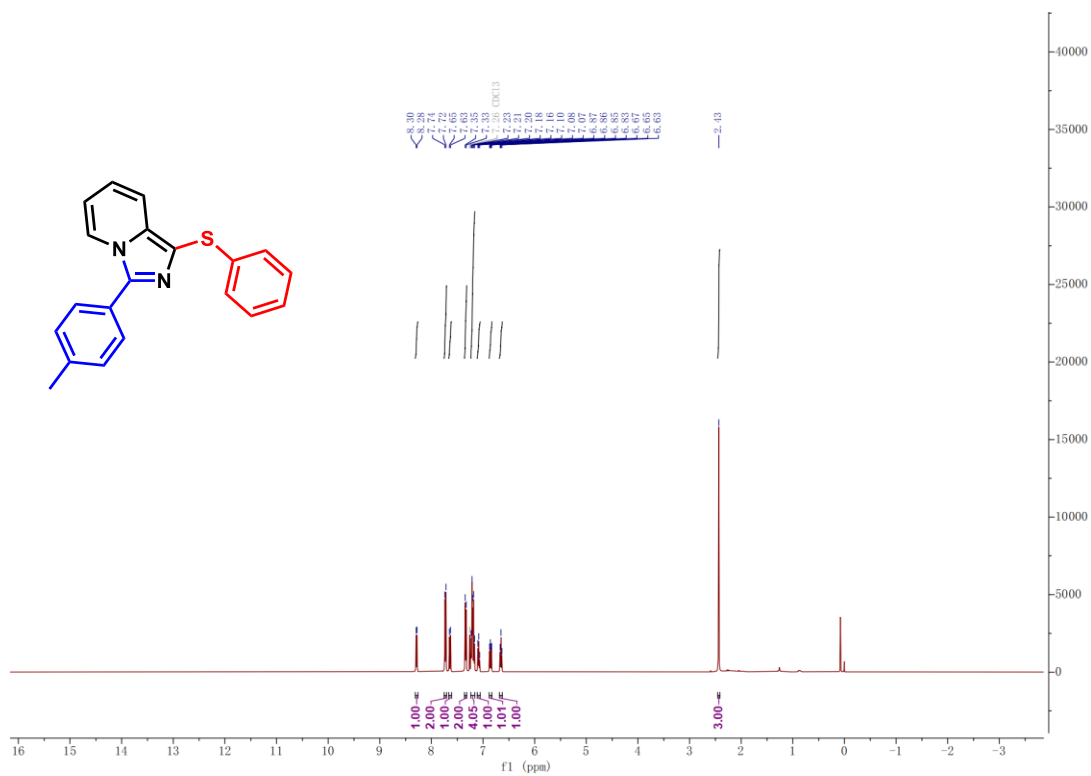


According to TP, the residue was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate = 20:1) to give the target compound **4za**. 120 mg (yield: 68%), a yellow oil. ^1H NMR (400 MHz, CDCl_3) δ (ppm): 8.22 (d, $J = 7.3$ Hz, 1H), 7.77 (m, 1H), 7.75 (m, 1H), 7.64 (d, $J = 9.1$ Hz, 1H), 7.48 (s, 1H), 7.46 (s, 1H), 7.16 (s, 1H), 7.14 (s, 1H), 7.01 (s, 1H), 6.99 (s, 1H), 6.85 (dd, $J = 9.2, 6.4$ Hz, 1H), 6.66 (t, $J = 6.8$ Hz, 1H), 2.24 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ (ppm): 137.9, 135.7, 135.0, 134.9, 134.4, 129.6, 129.4, 129.3, 128.1, 127.8, 121.8, 121.4, 121.1, 118.6, 114.2, 21.0. HRMS (ESI) m/z $[(M + H)^+]$ Calcd for $\text{C}_{20}\text{H}_{16}\text{ClN}_2\text{S}^+$ (351.0717), found 351.0714.

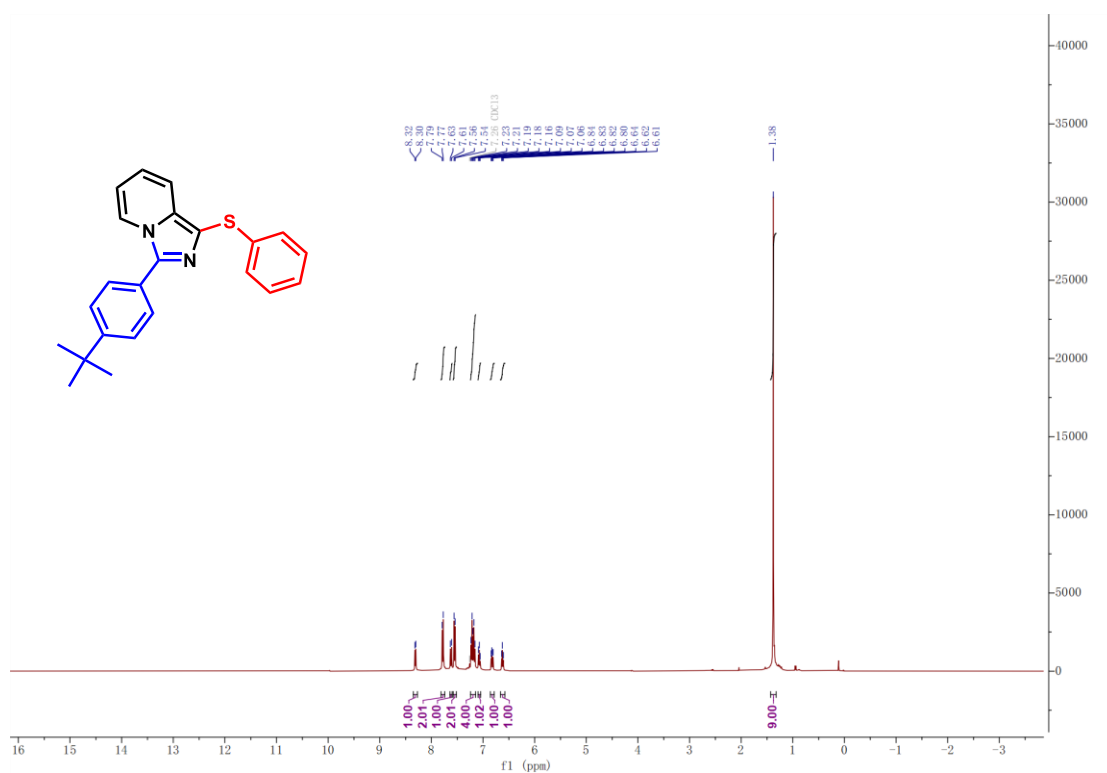
3-phenyl-1-(phenylthio)imidazo[1,5-a]pyridine (4a)



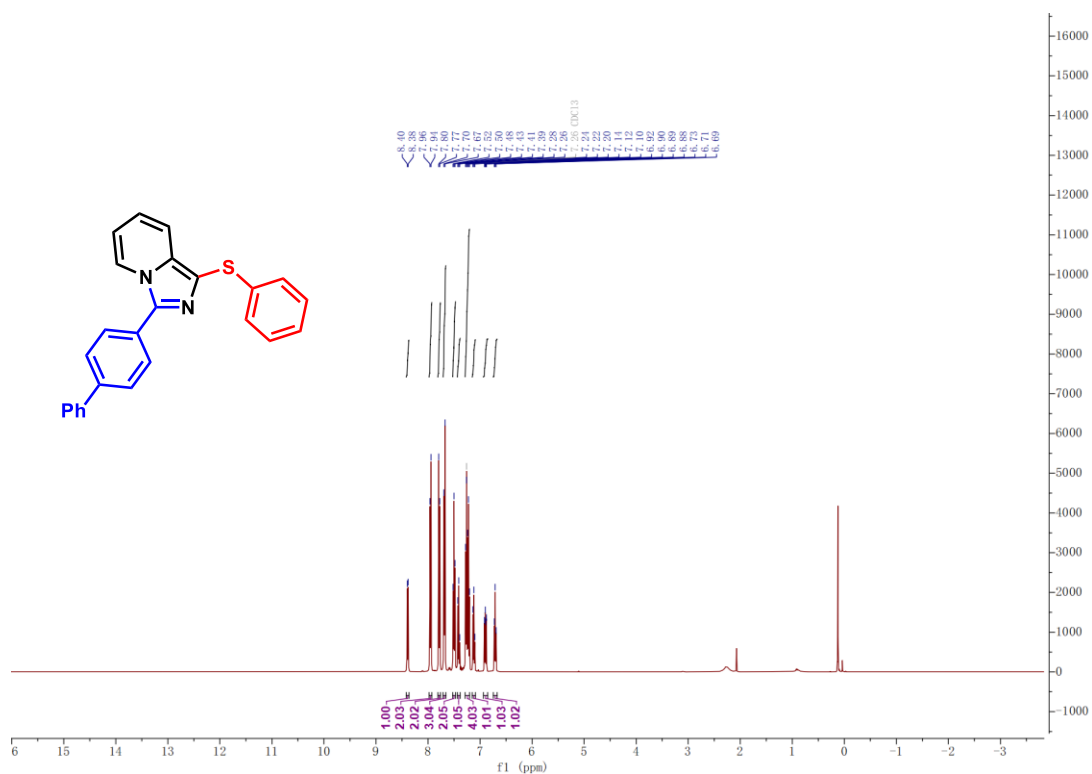
1-(phenylthio)-3-(p-tolyl)imidazo[1,5-a]pyridine(4b)



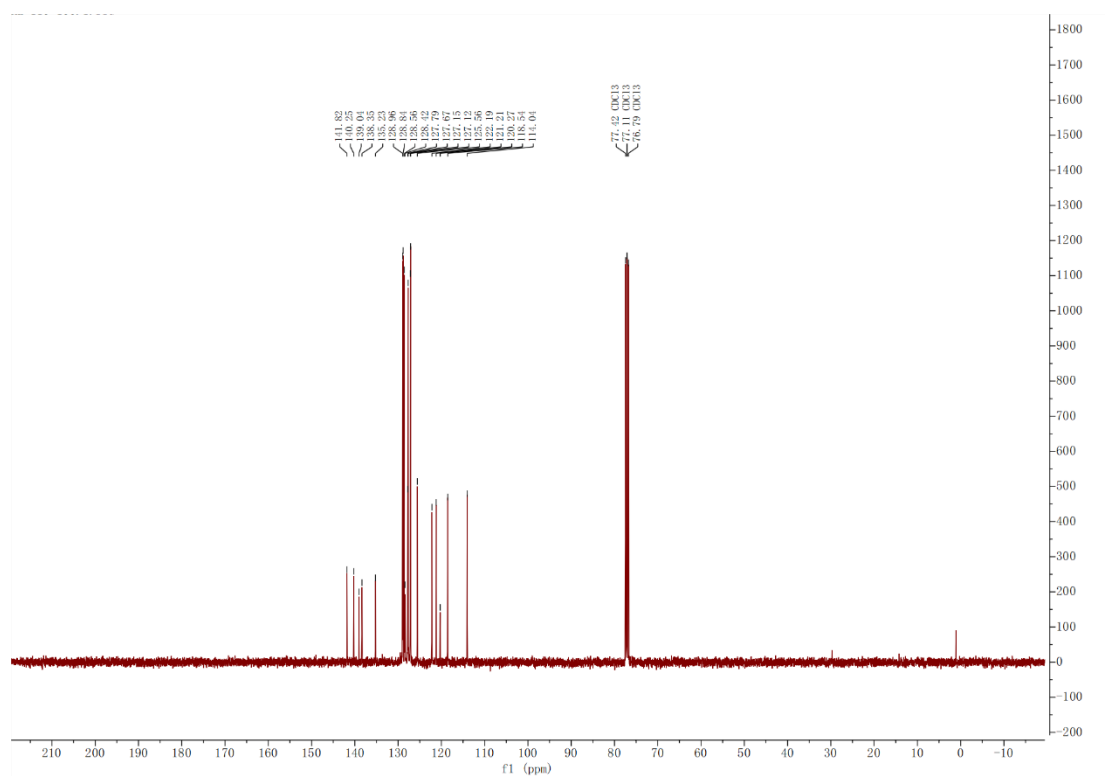
3-(4-(tert-butyl)phenyl)-1-(phenylthio)imidazo[1,5-a]pyridine(4c)



3-([1,1'-biphenyl]-4-yl)-1-(phenylthio)imidazo[1,5-a]pyridine(4d)

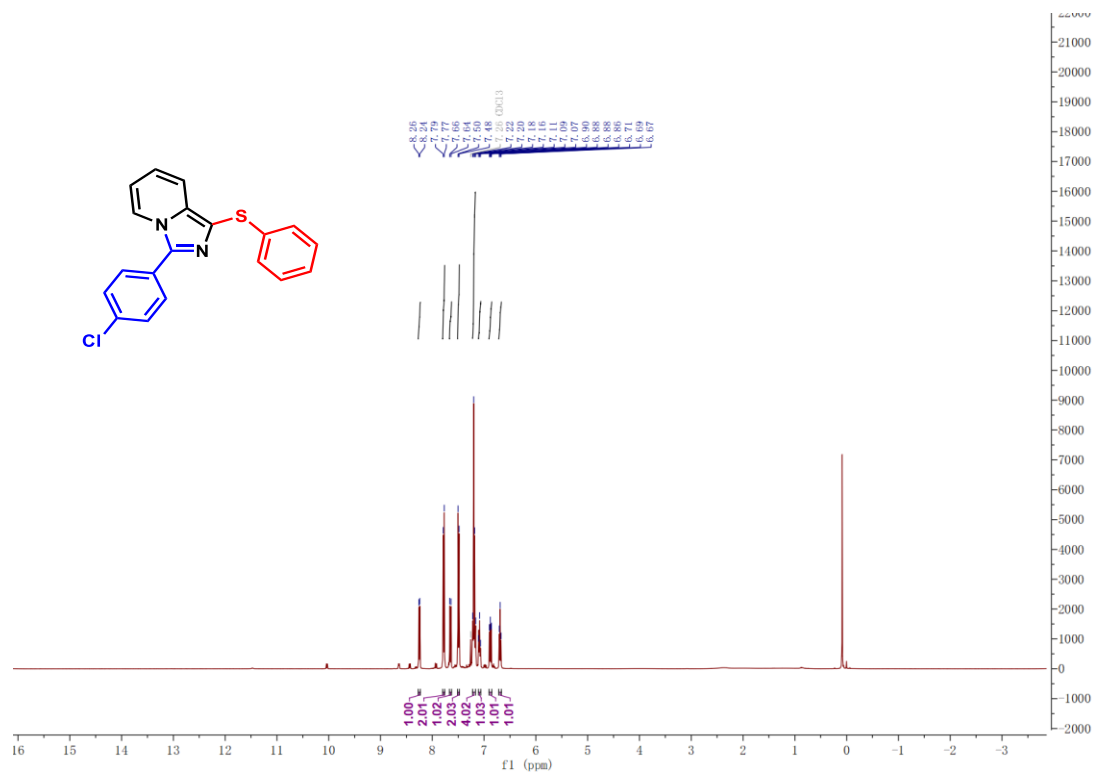


¹H NMR spectrum of 4d

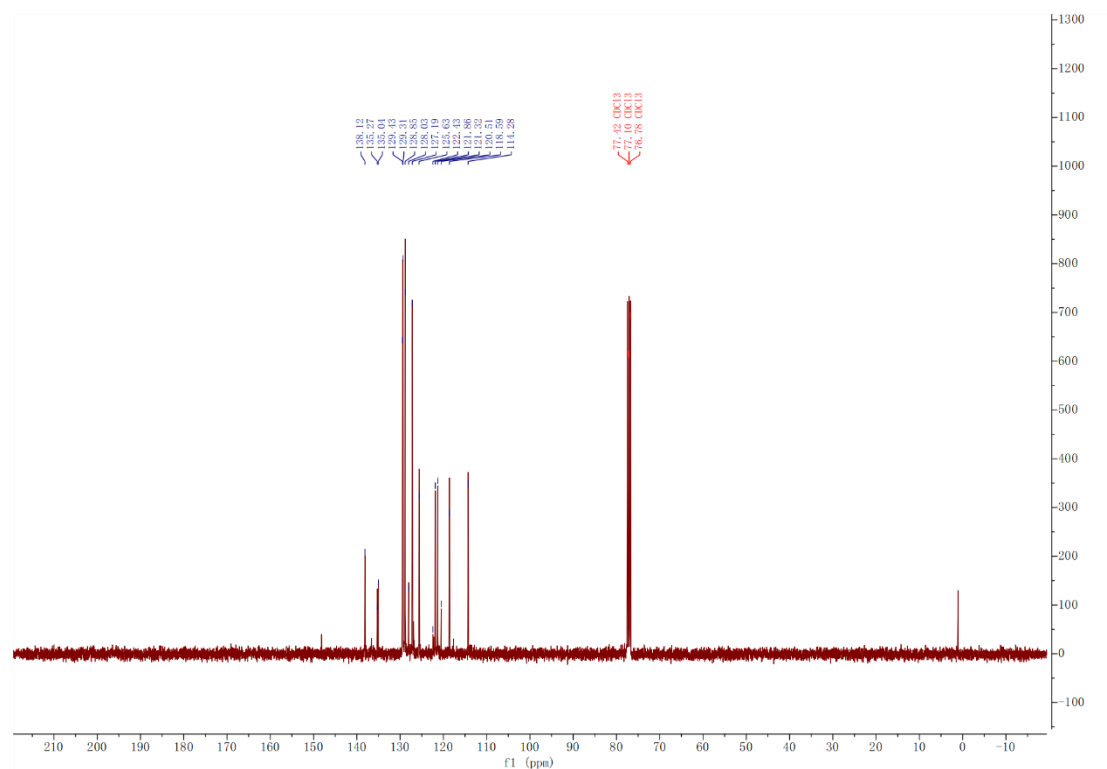


¹³C NMR spectrum of 4d

3-(4-chlorophenyl)-1-(phenylthio)imidazo[1,5-a]pyridine(4e)

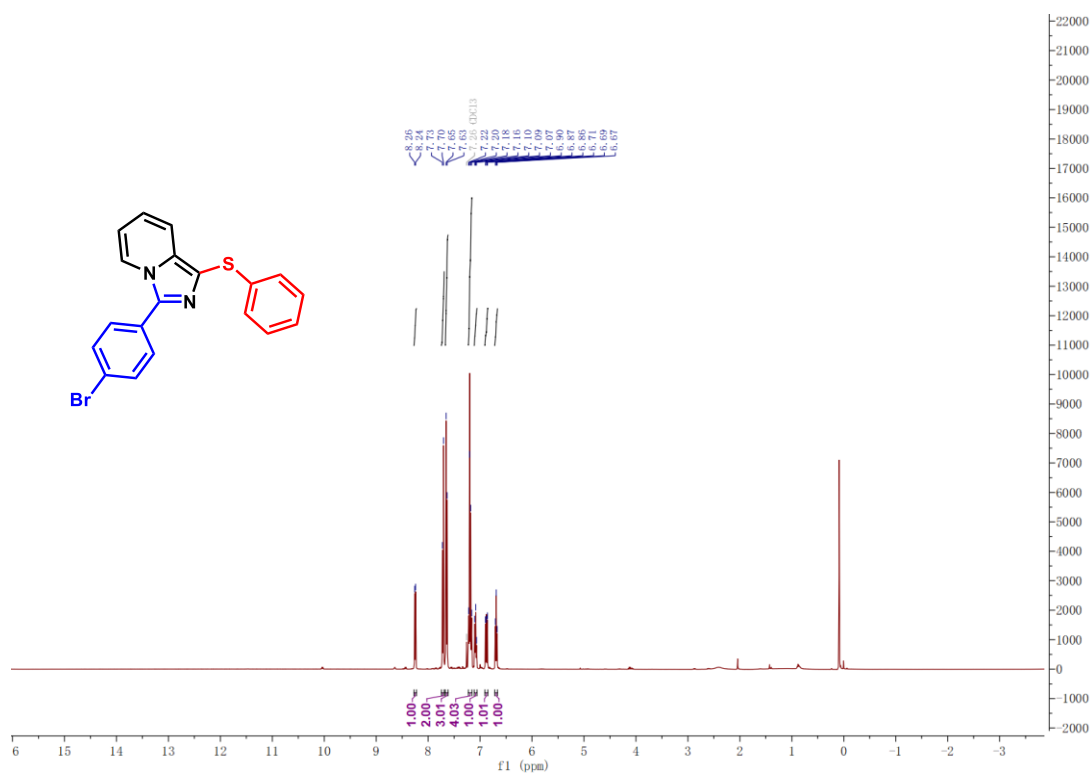


¹H NMR spectrum of 4e

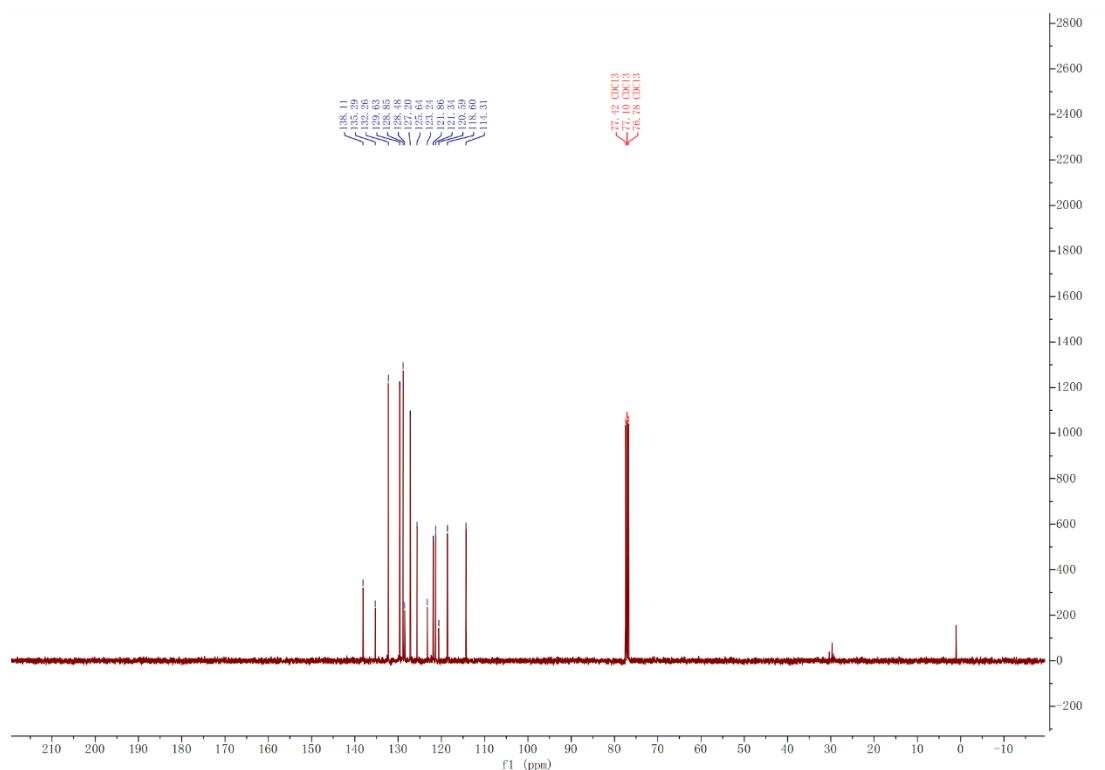


¹³C NMR spectrum of 4e

3-(4-bromophenyl)-1-(phenylthio)imidazo[1,5-a]pyridine(4f)

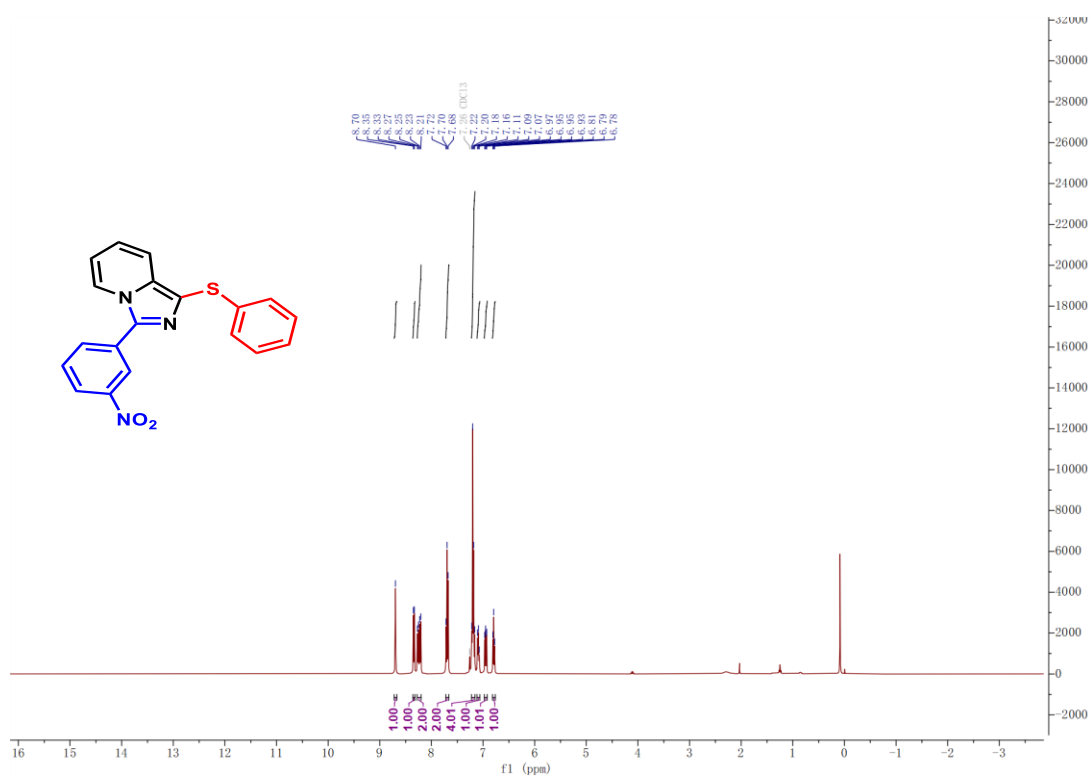


¹H NMR spectrum of 4f

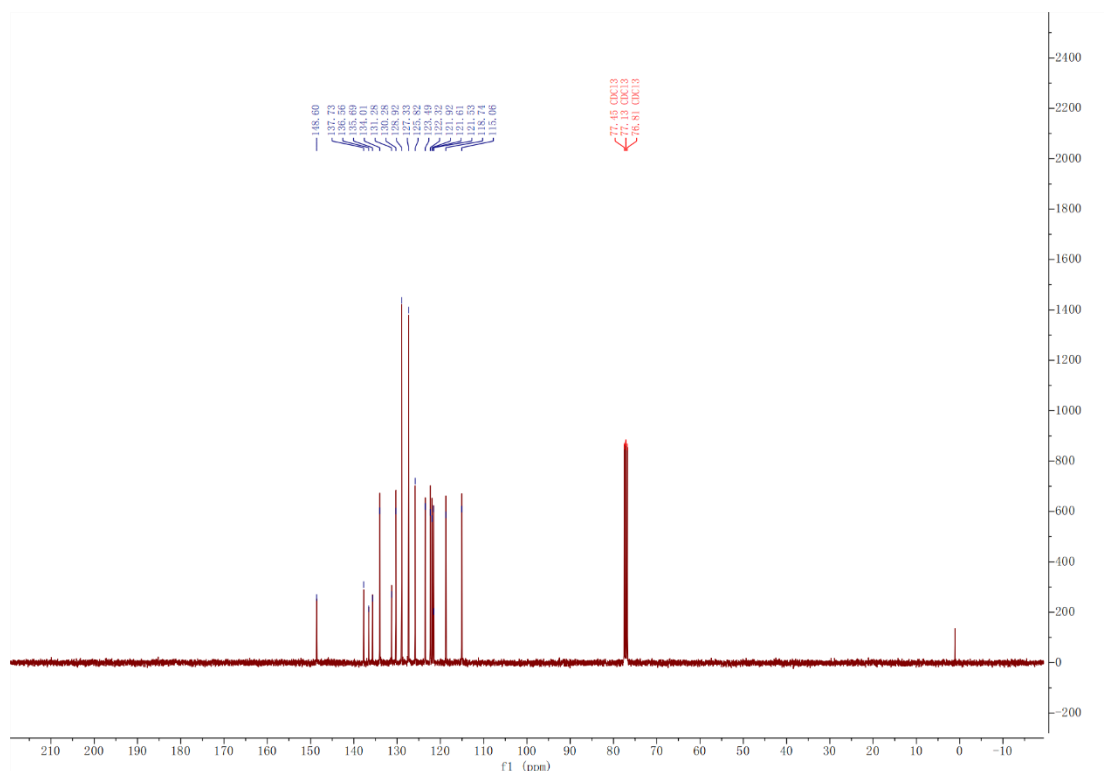


¹³C NMR spectrum of 4f

3-(3-nitrophenyl)-1-(phenylthio)imidazo[1,5-a]pyridine(4g)

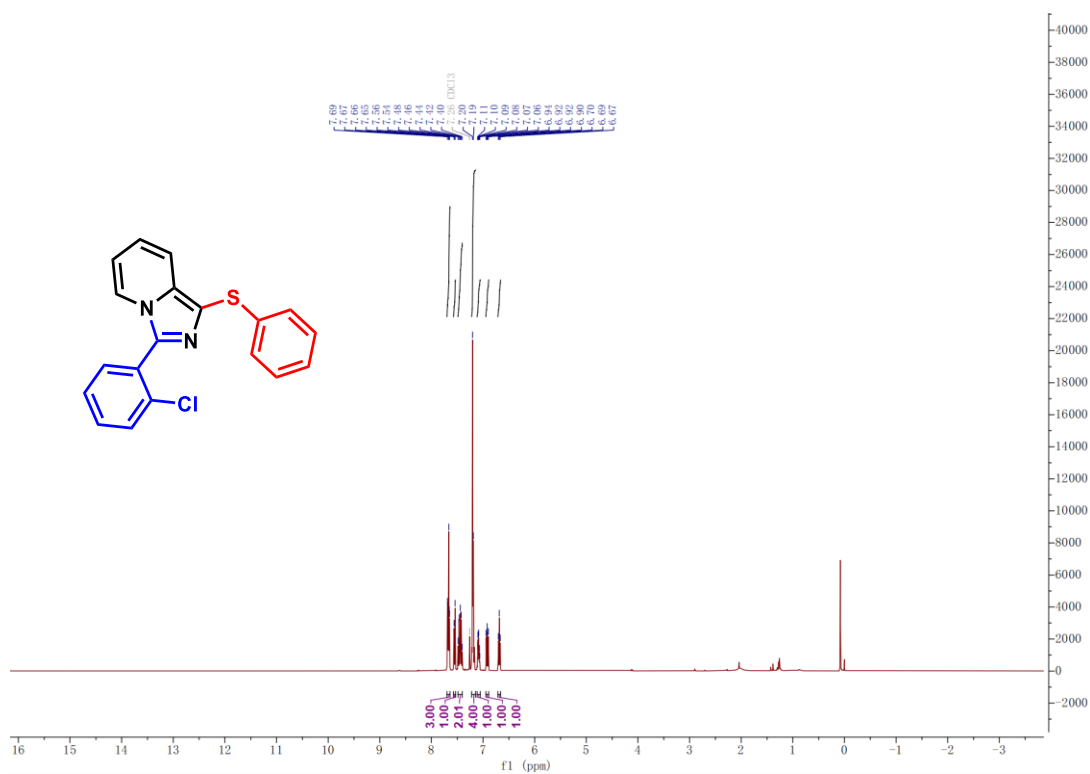


¹H NMR spectrum of 4g

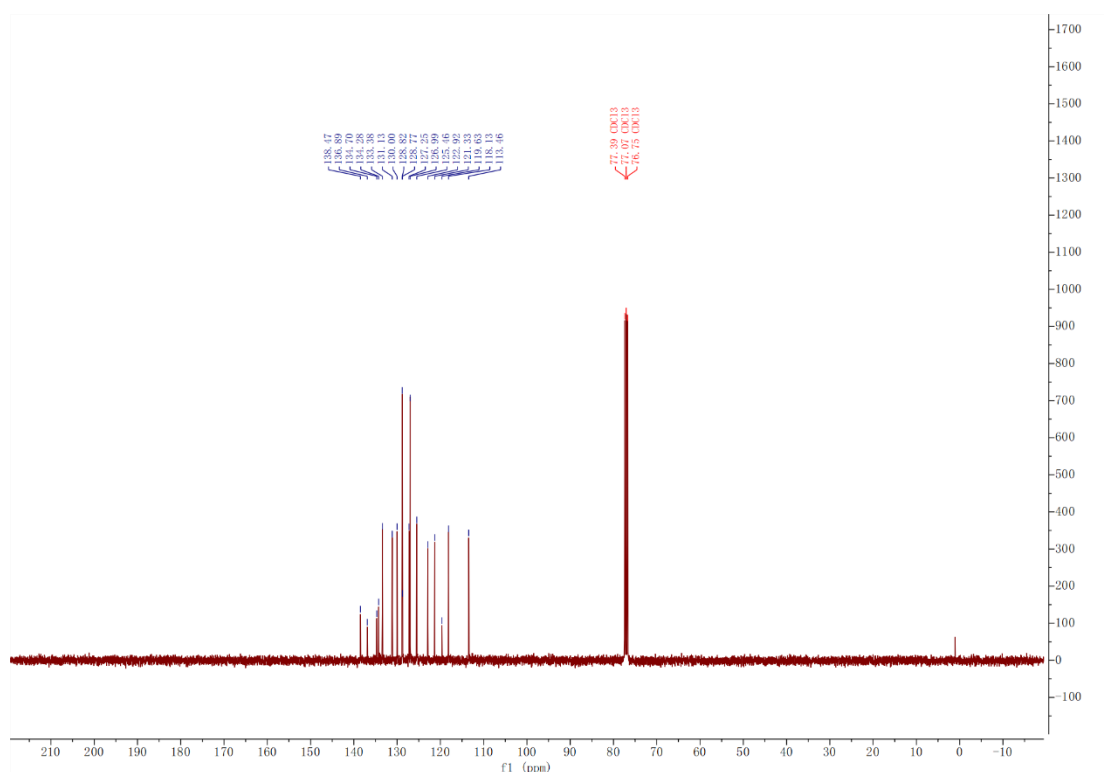


¹³C NMR spectrum of 4g

3-(2-chlorophenyl)-1-(phenylthio)imidazo[1,5-a]pyridine(4h)

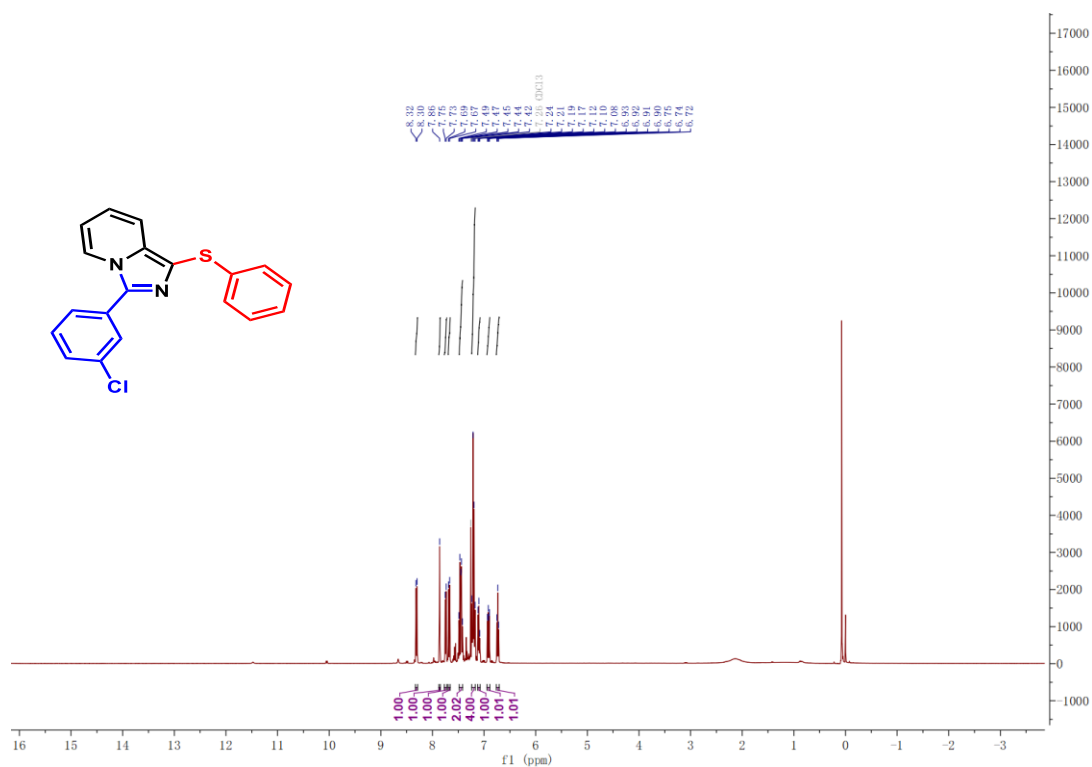


¹H NMR spectrum of 4h

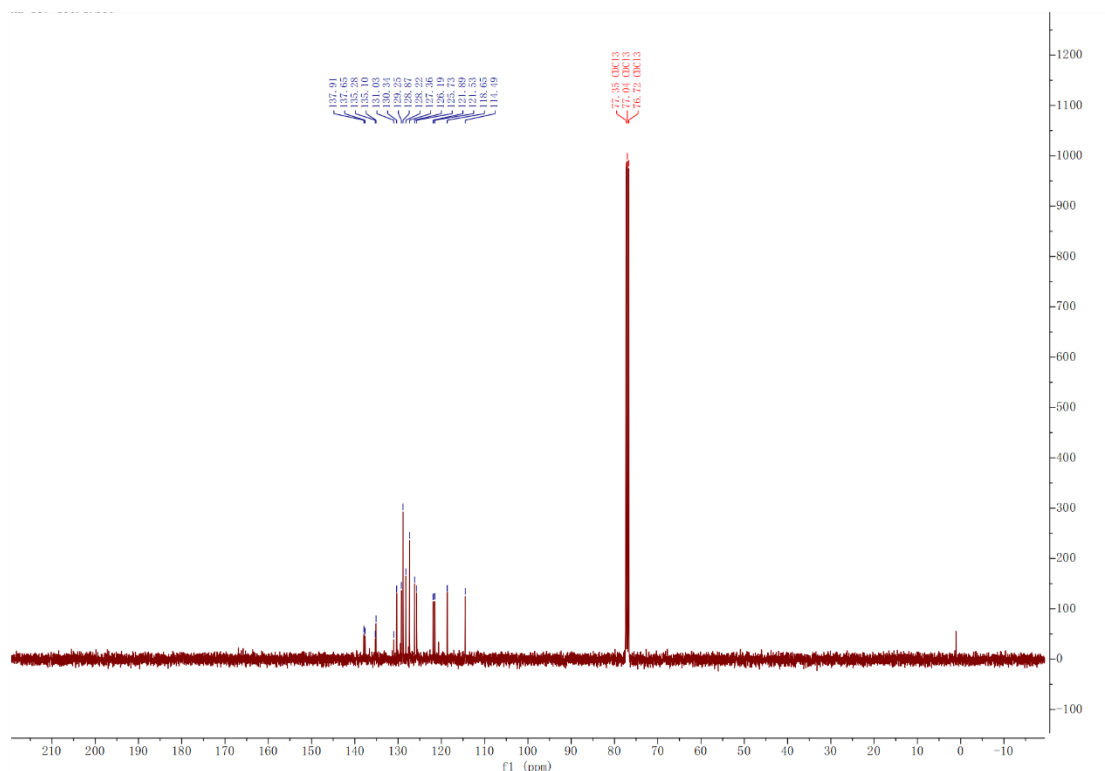


^{13}C NMR spectrum of 4h

3-(3-chlorophenyl)-1-(phenylthio)imidazo[1,5-a]pyridine(4i)

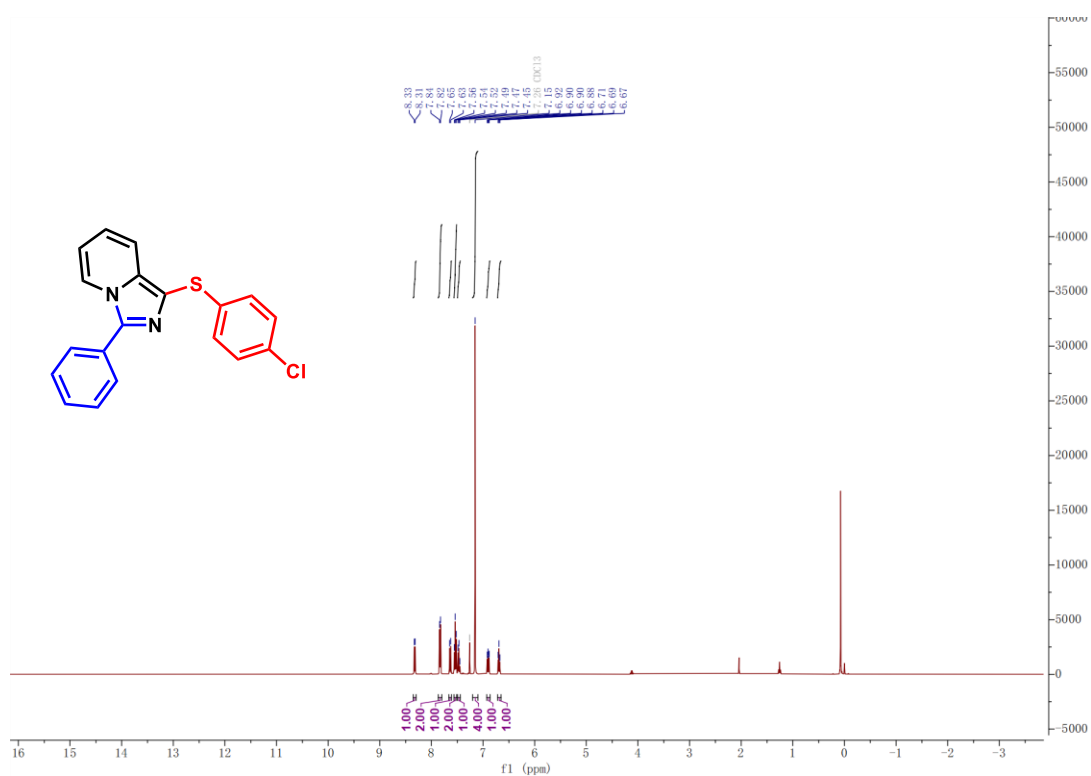


¹H NMR spectrum of 4i

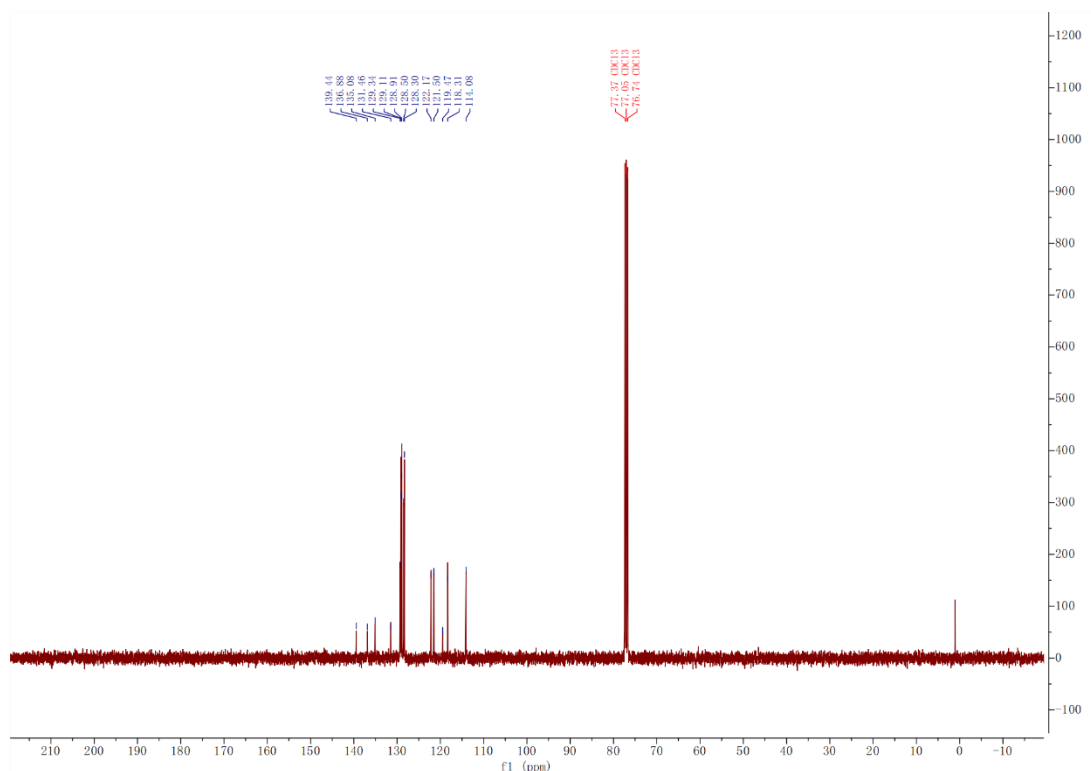


¹³C NMR spectrum of 4i

1-((4-chlorophenyl)thio)-3-phenylimidazo[1,5-a]pyridine(4j)

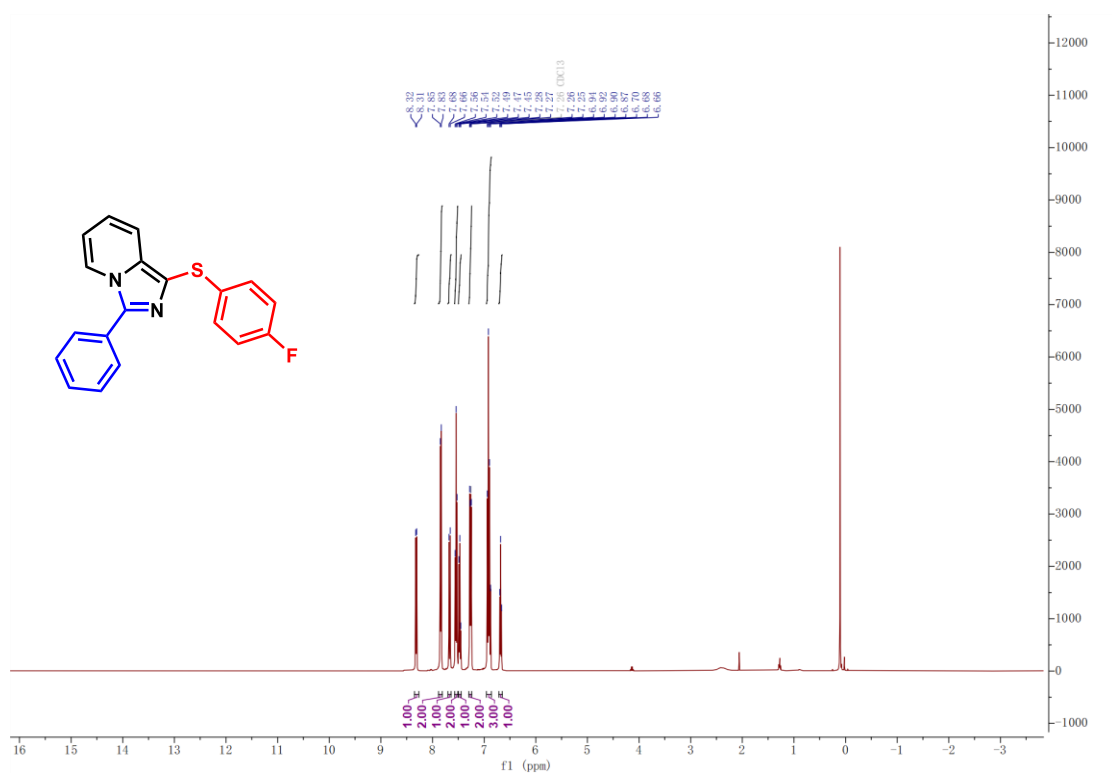


¹H NMR spectrum of 4j

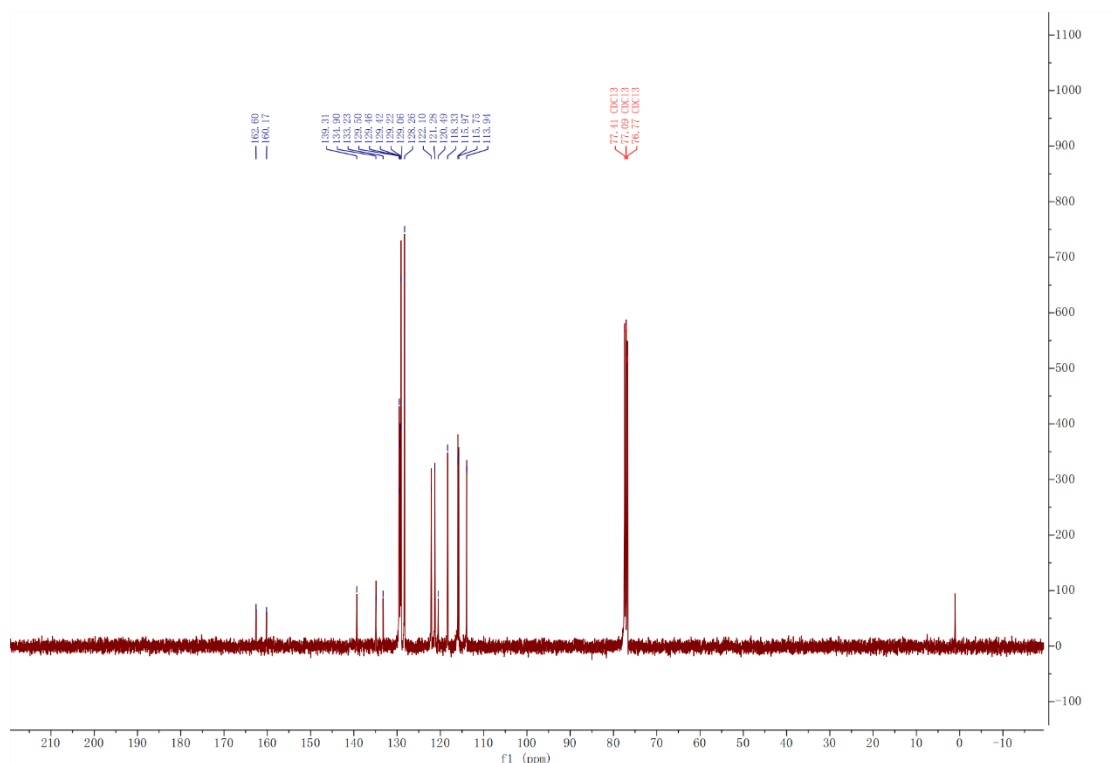


¹³C NMR spectrum of 4j

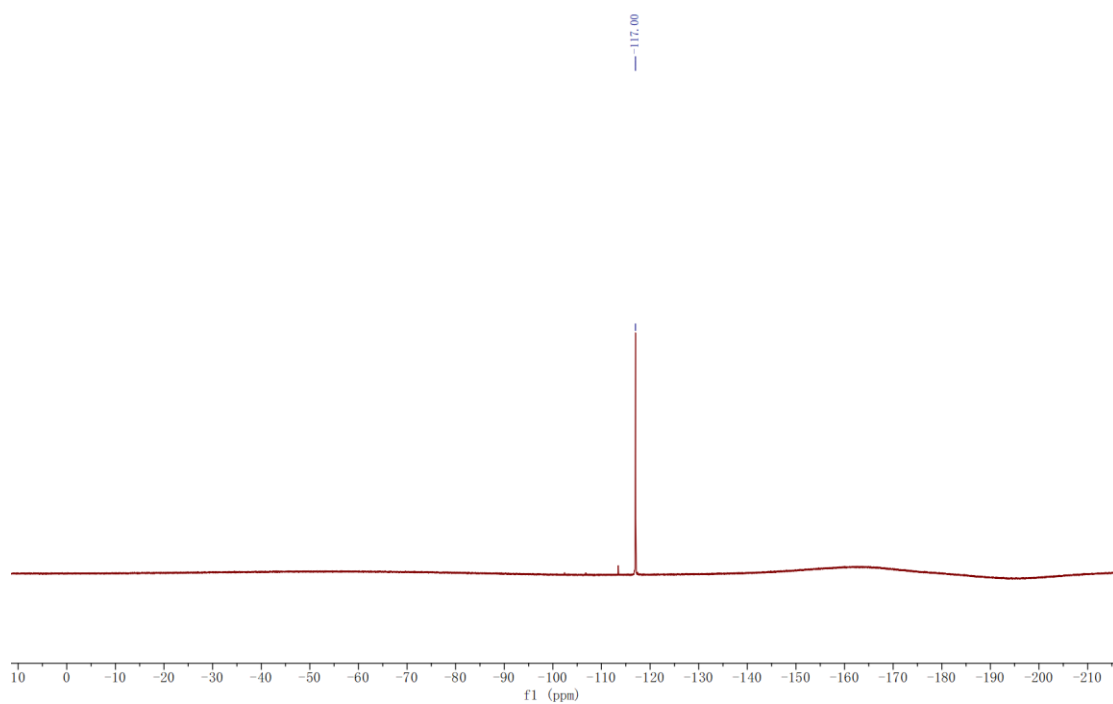
1-((4-fluorophenyl)thio)-3-phenylimidazo[1,5-a]pyridine(4k)



¹H NMR spectrum of 4k

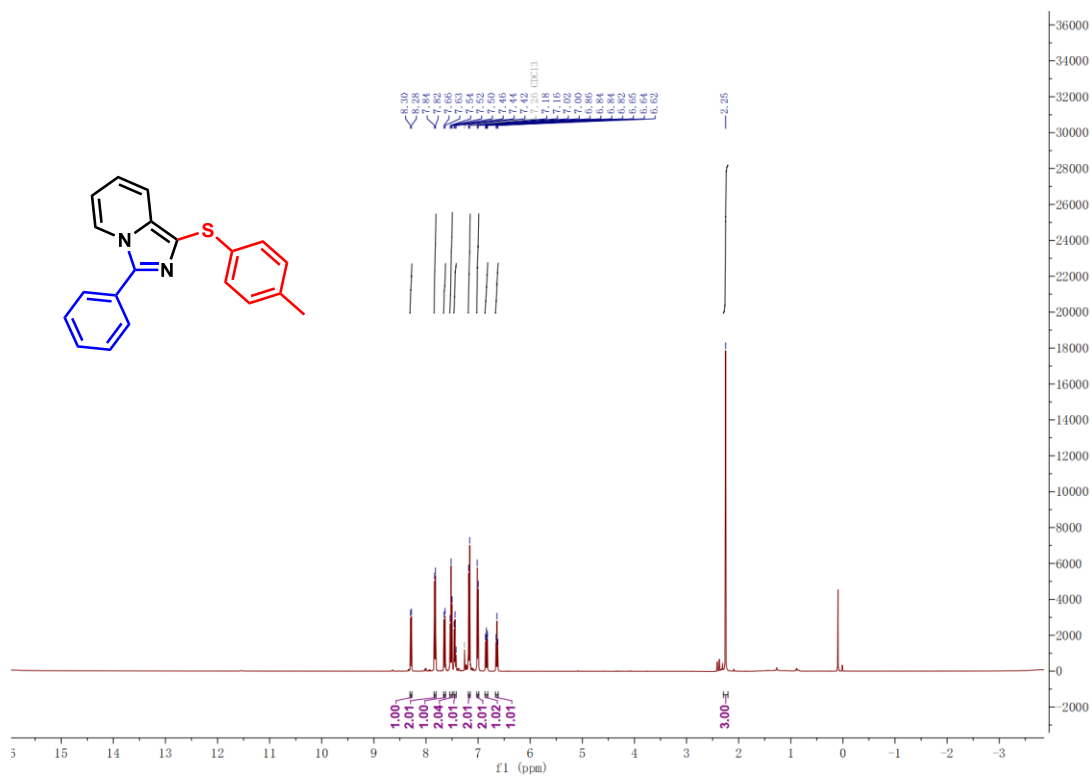


¹³C NMR spectrum of 4k

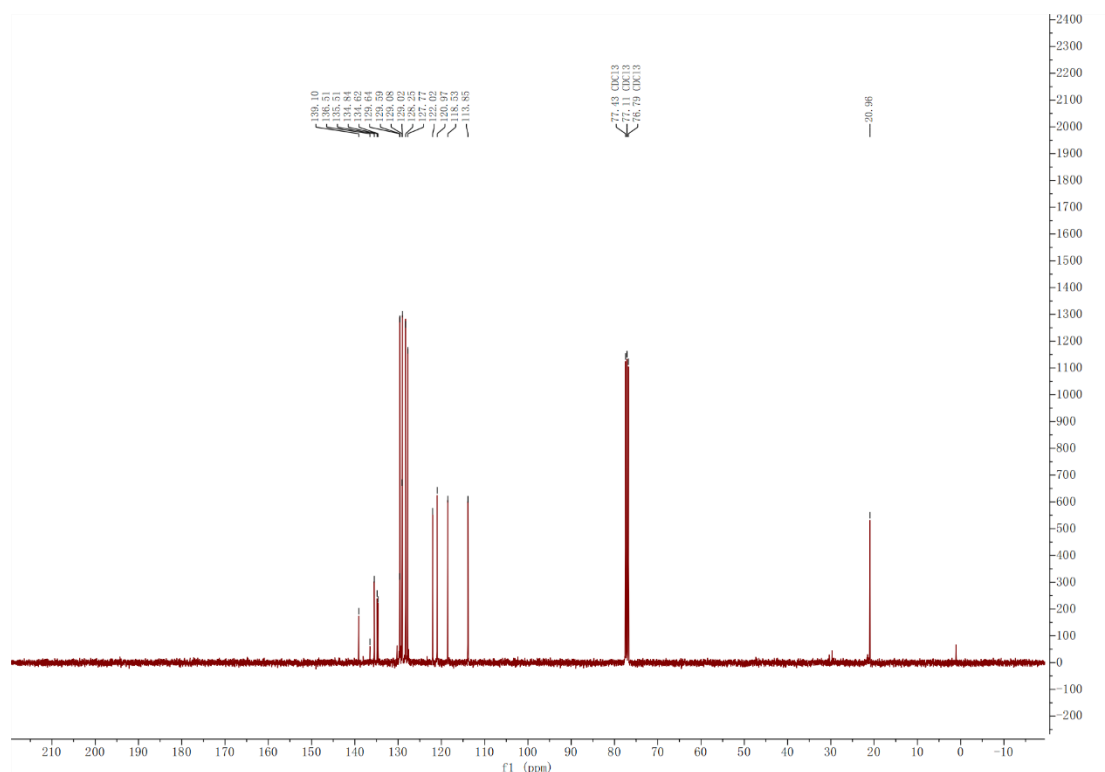


^{19}F NMR spectrum of 4k

3-phenyl-1-(p-tolylthio)imidazo[1,5-a]pyridine(4l)

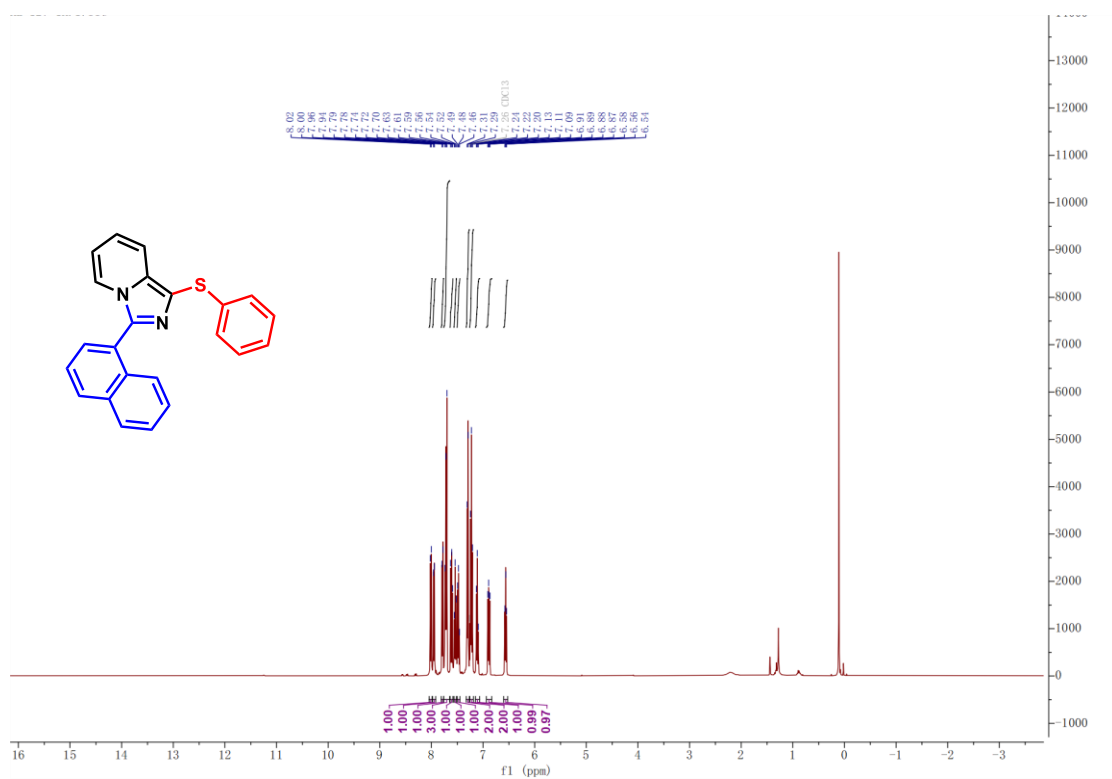


¹H NMR spectrum of 4l

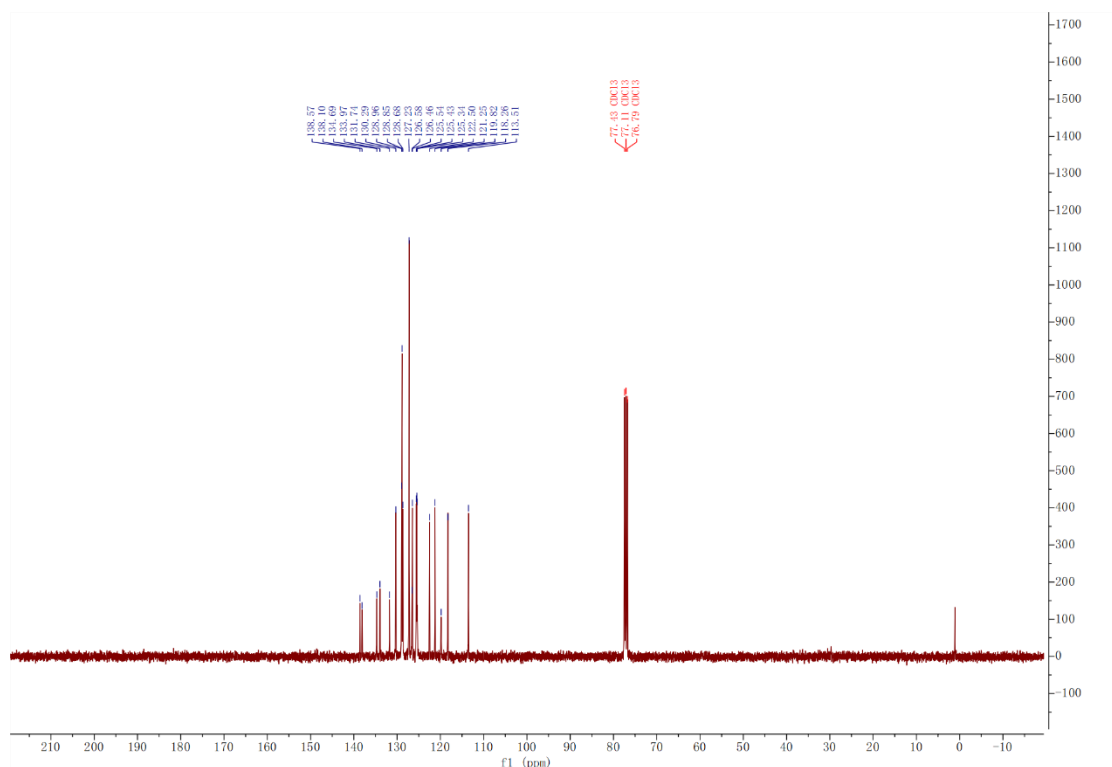


¹³C NMR spectrum of 4l

3-(naphthalen-1-yl)-1-(phenylthio)imidazo[1,5-a]pyridine (4m)

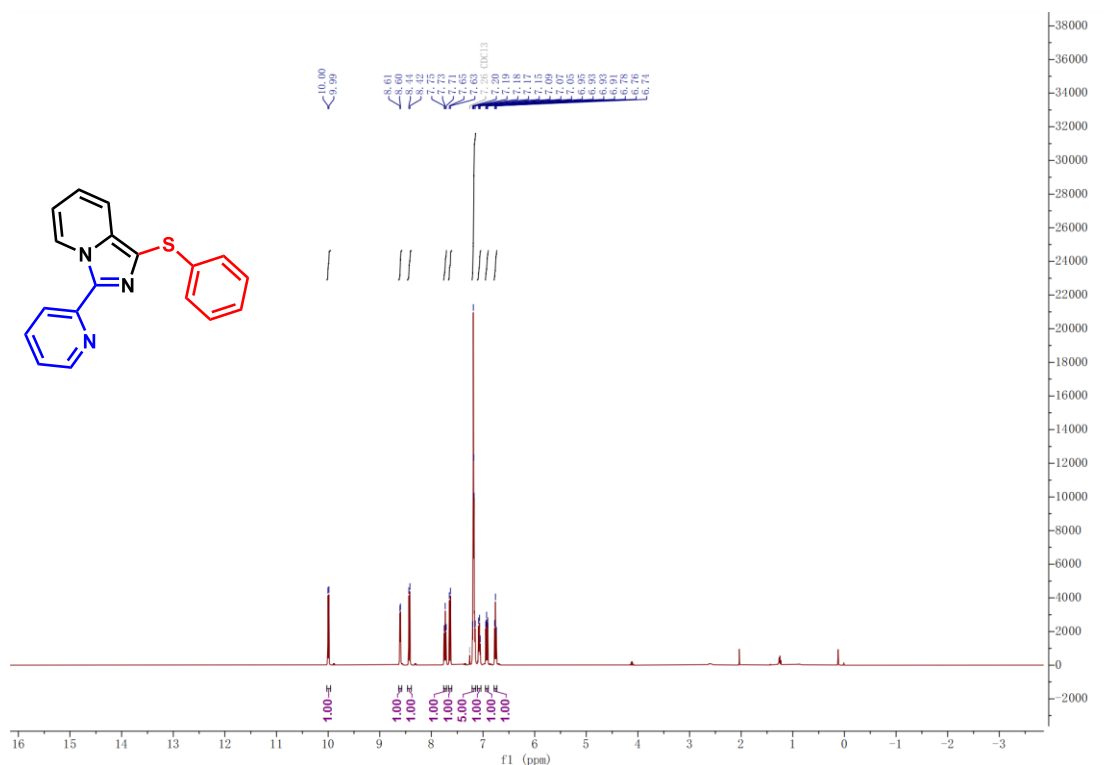


¹H NMR spectrum of 4m

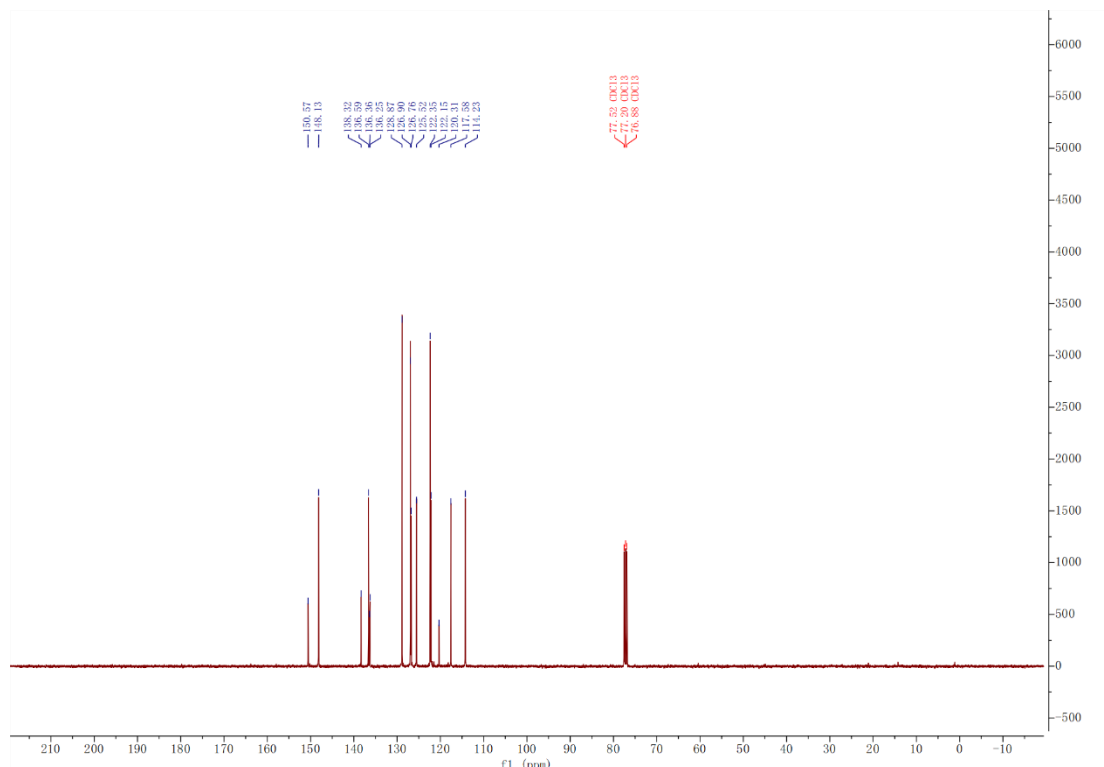


^{13}C NMR spectrum of 4m

1-(phenylthio)-3-(pyridin-2-yl)imidazo[1,5-a]pyridine(4n)

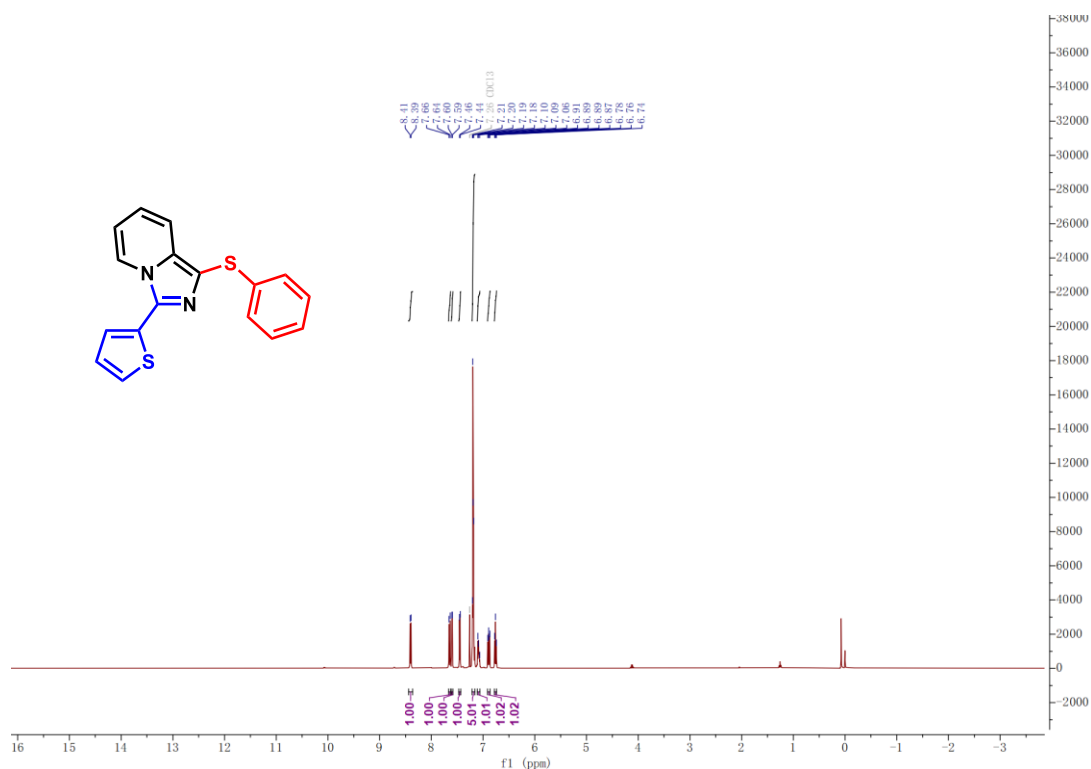


¹H NMR spectrum of 4n

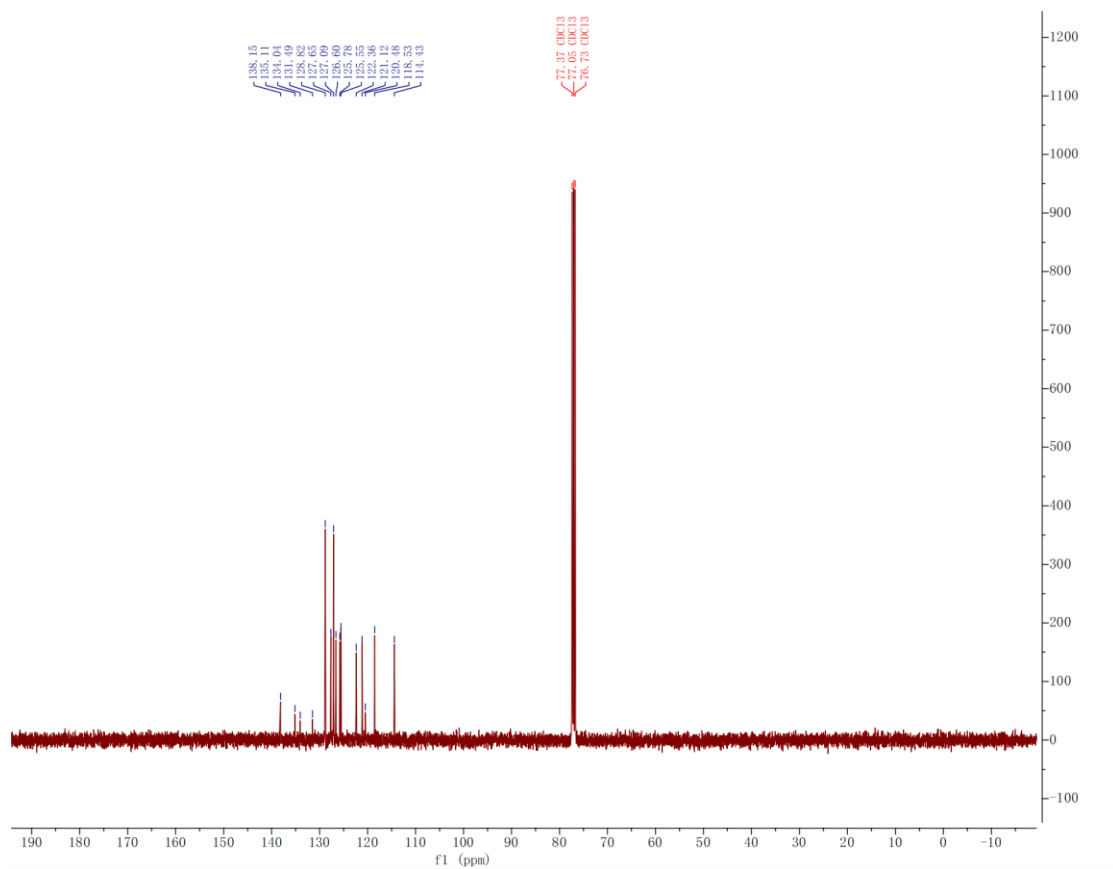


¹³C NMR spectrum of 4n

1-(phenylthio)-3-(thiophen-2-yl)imidazo[1,5-a]pyridine (4o)

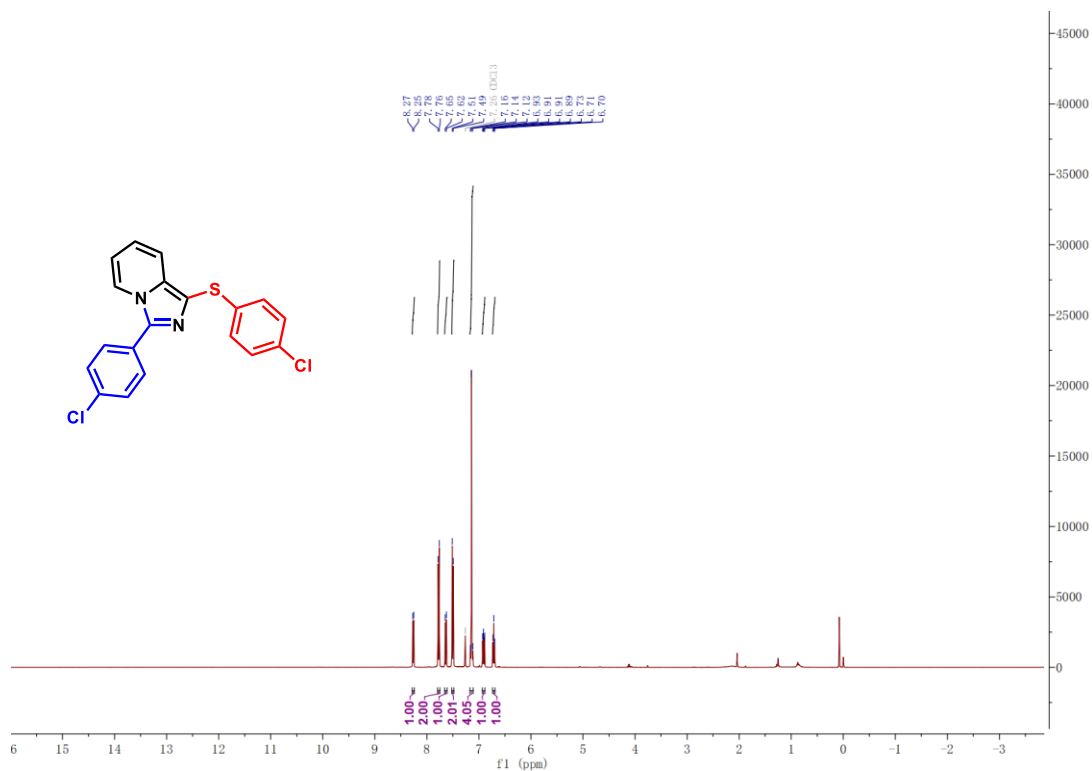


¹H NMR spectrum of 4o

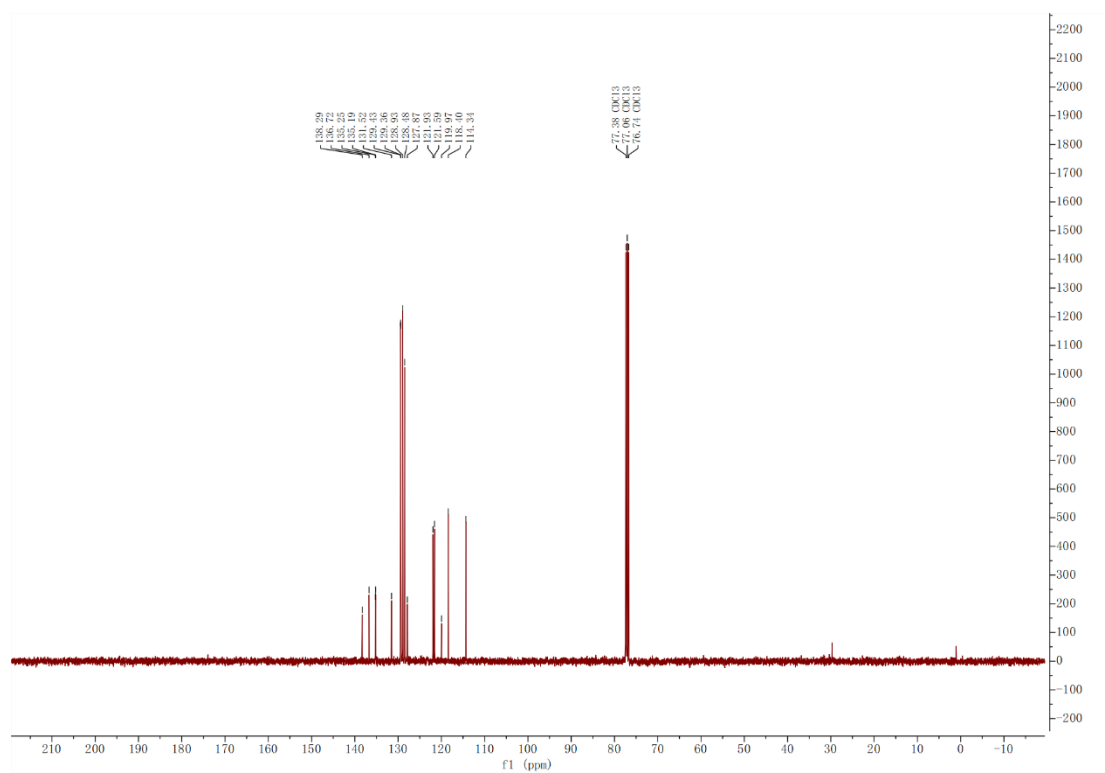


^{13}C NMR spectrum of 4o

3-(4-chlorophenyl)-1-((4-chlorophenyl)thio)imidazo[1,5-a]pyridine(4p)

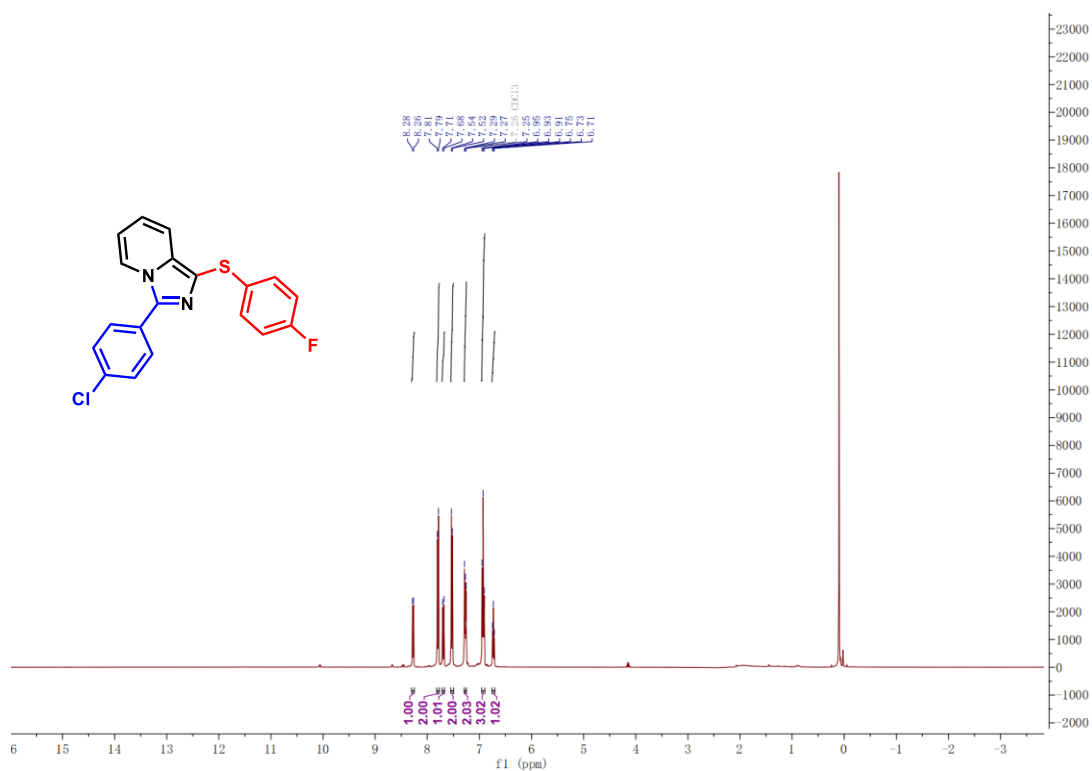


¹H NMR spectrum of 4p

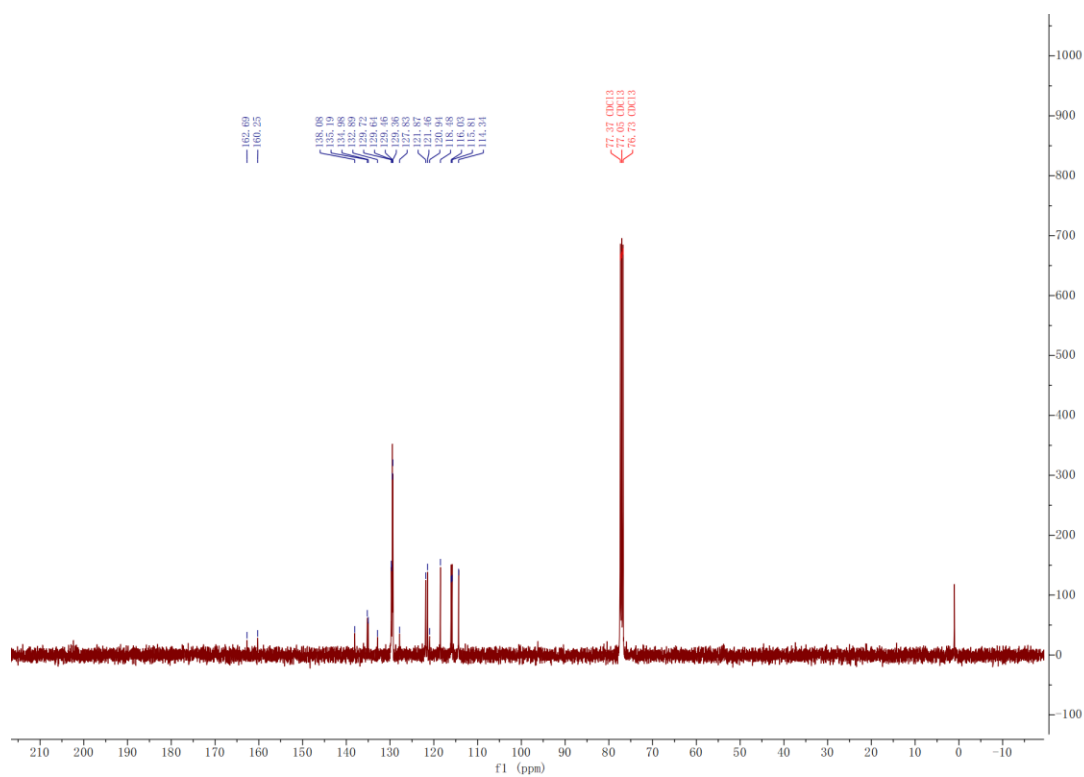


¹³C NMR spectrum of 4p

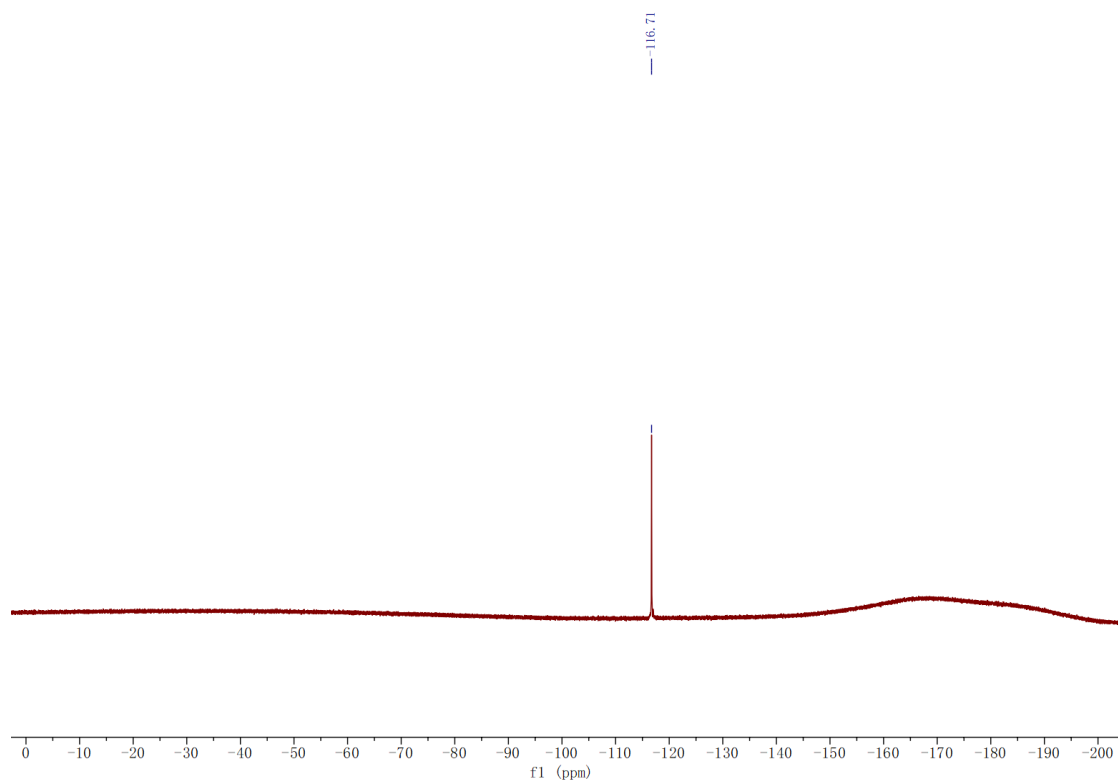
3-(4-chlorophenyl)-1-((4-fluorophenyl)thio)imidazo[1,5-a]pyridine(4q)



¹H NMR spectrum of 4q

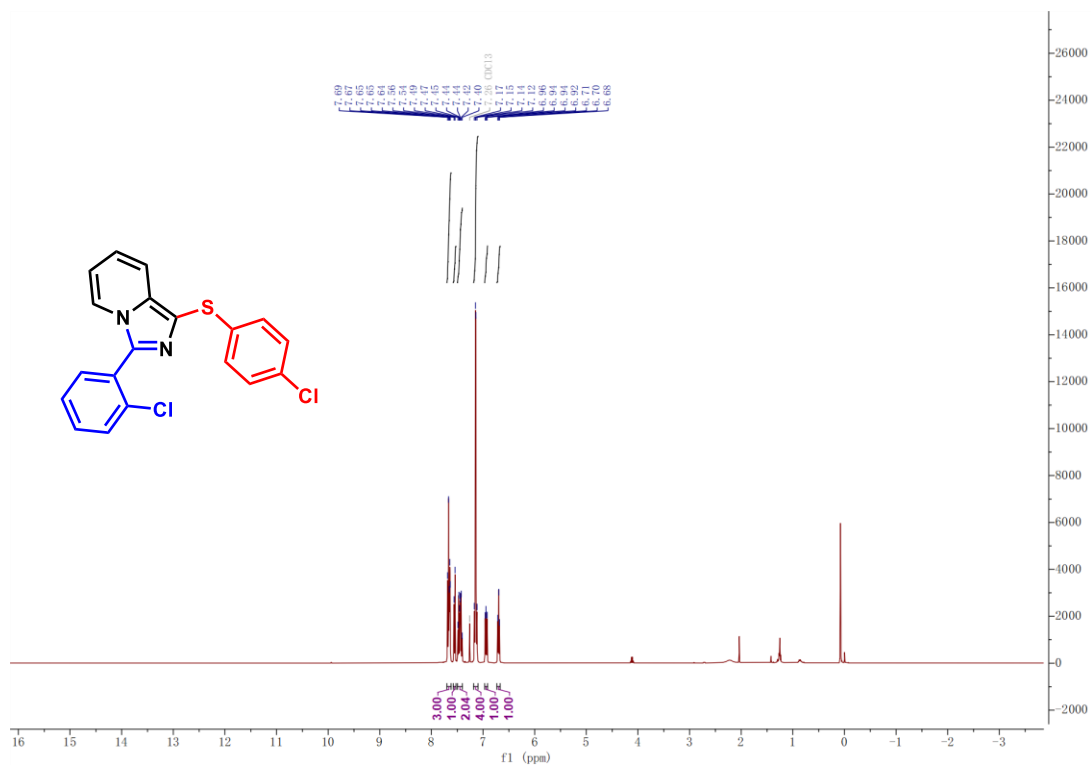


¹³C NMR spectrum of 4q

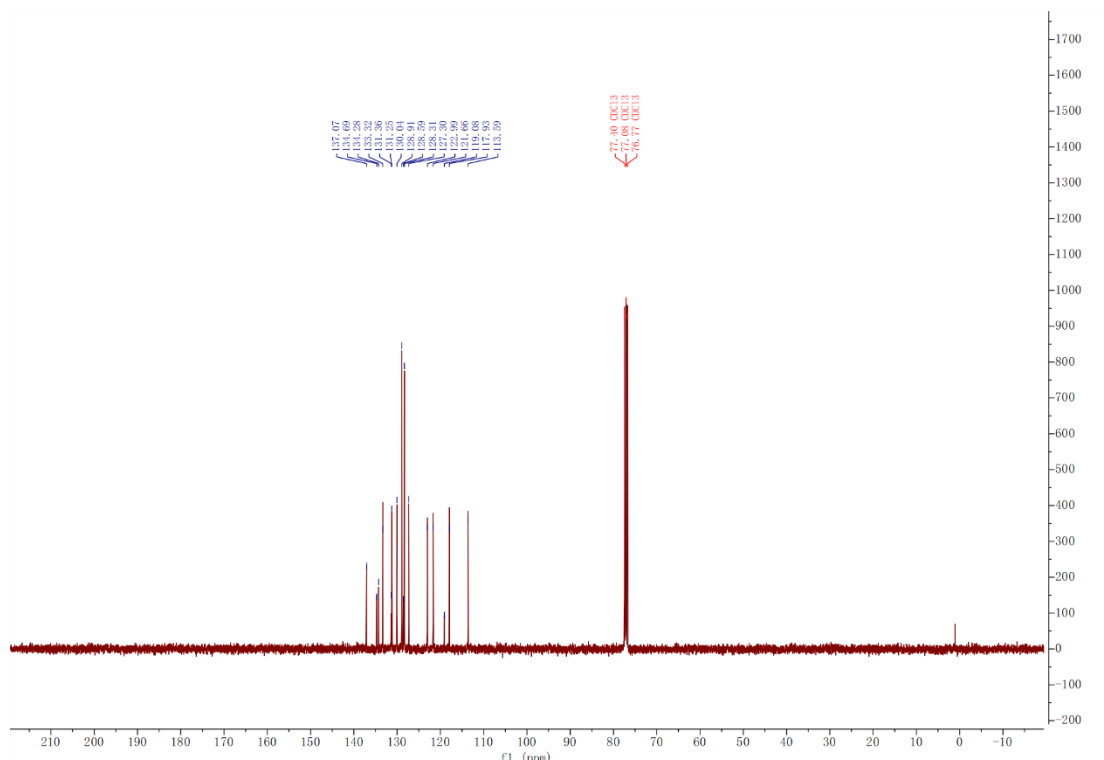


^{19}F NMR spectrum of 4q

3-(2-chlorophenyl)-1-((4-chlorophenyl)thio)imidazo[1,5-a]pyridine(4r)

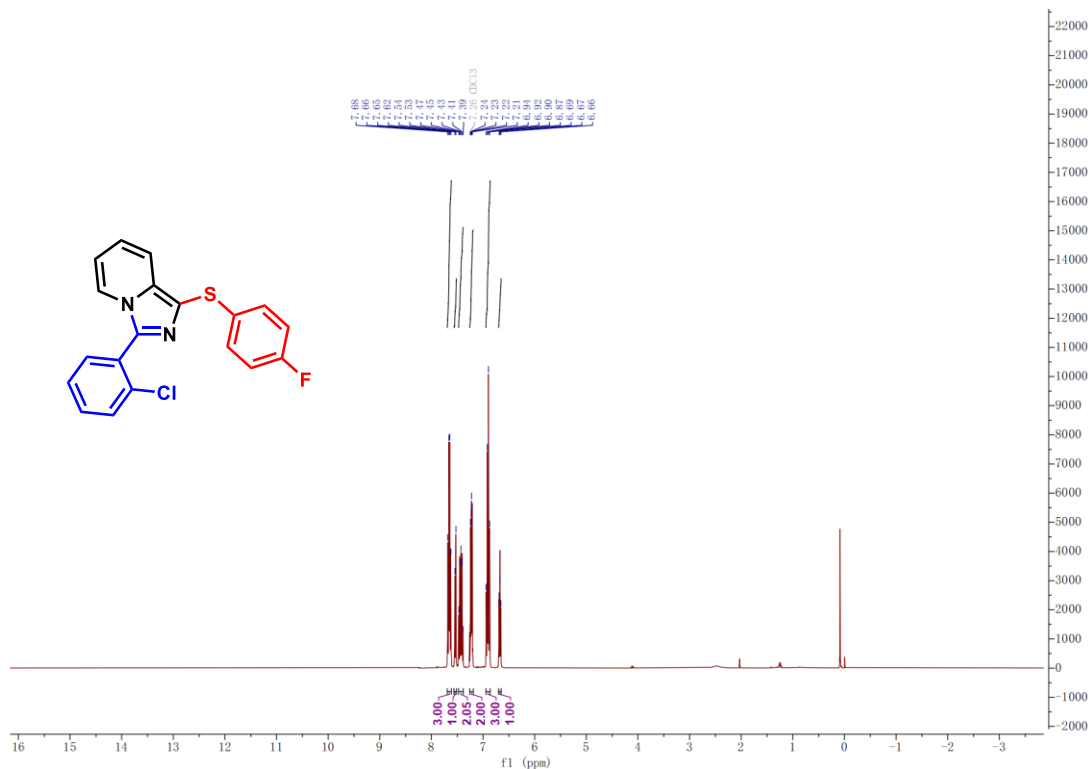


¹H NMR spectrum of 4r

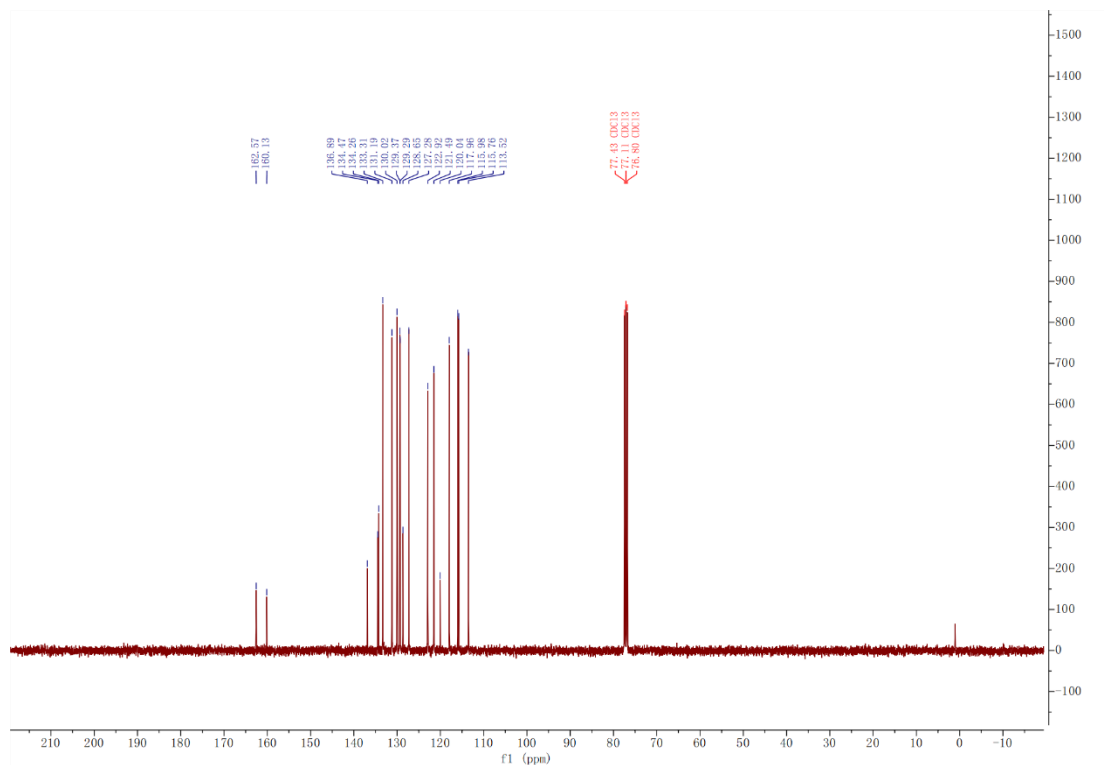


¹³C NMR spectrum of 4r

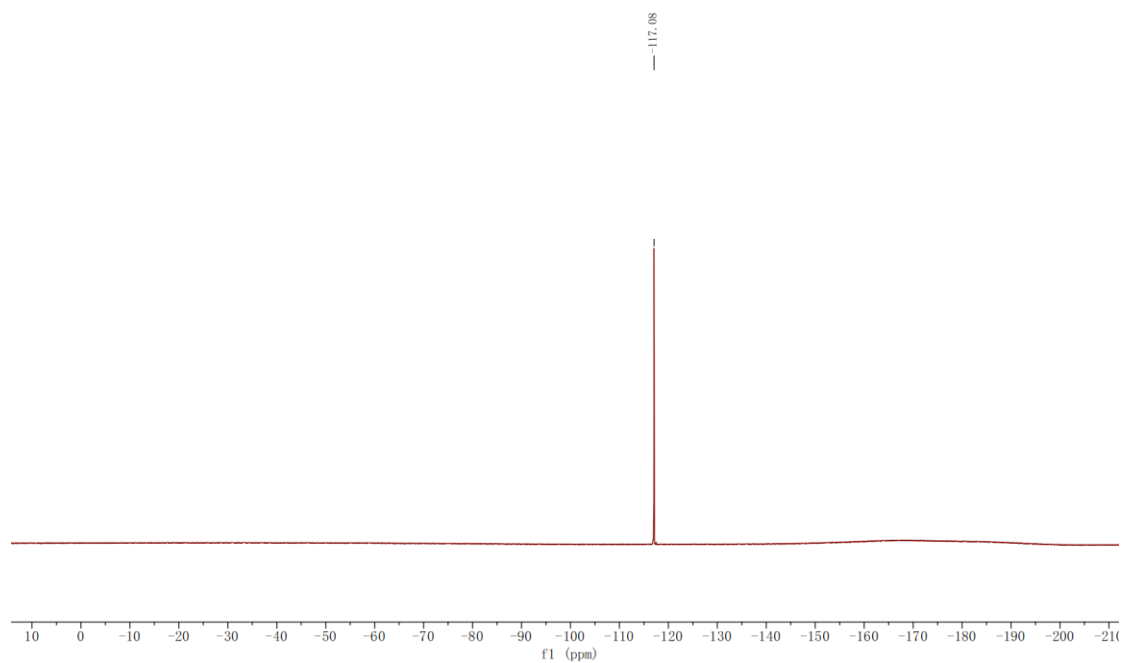
3-(2-chlorophenyl)-1-((4-fluorophenyl)thio)imidazo[1,5-a]pyridine (4s)



¹H NMR spectrum of 4s

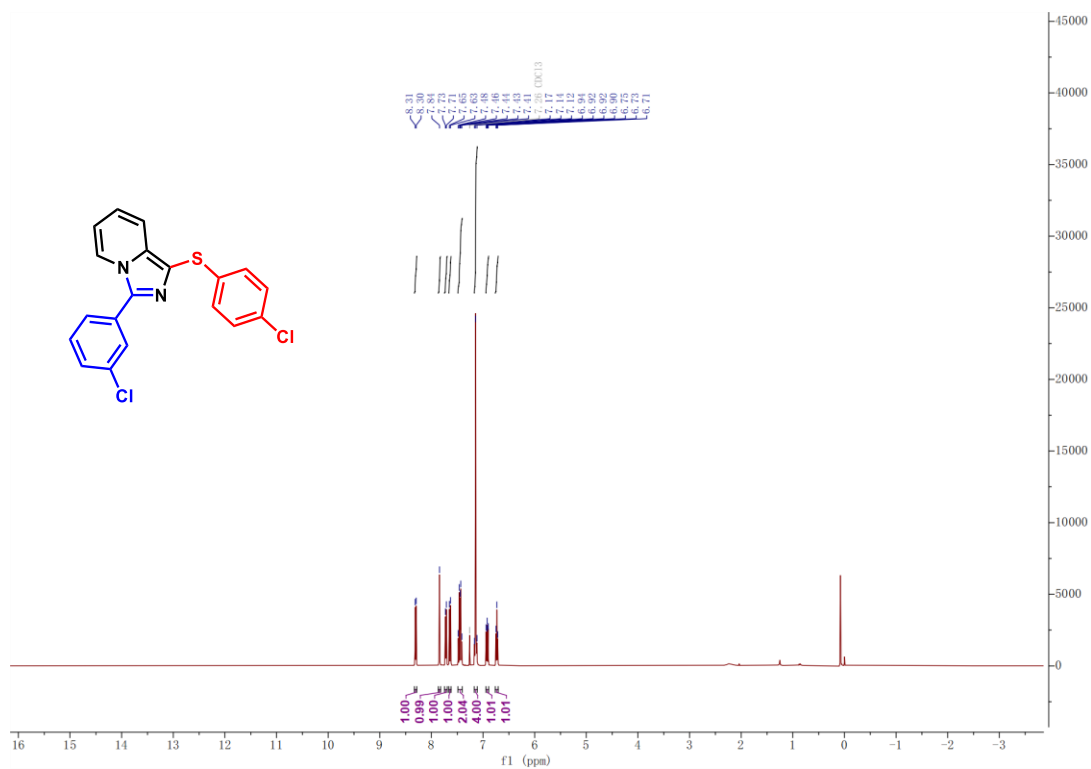


^{13}C NMR spectrum of 4s

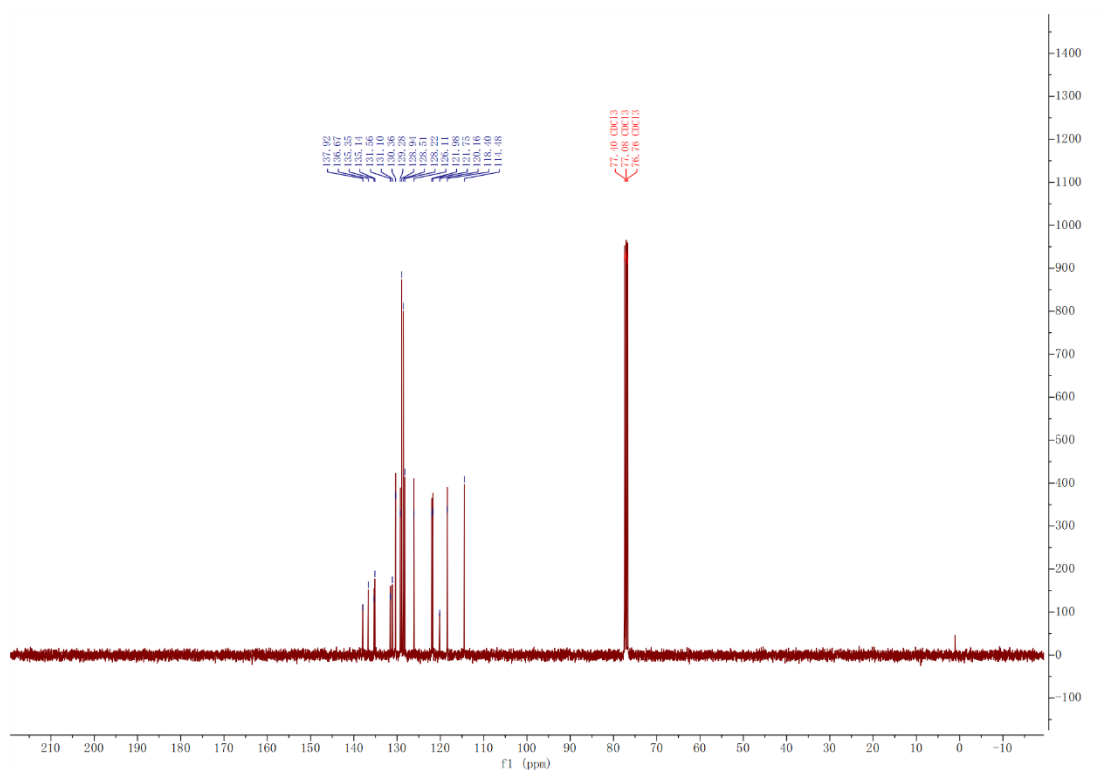


^{19}F NMR spectrum of 4s

3-(3-chlorophenyl)-1-((4-chlorophenyl)thio)imidazo[1,5-a]pyridine(4t)

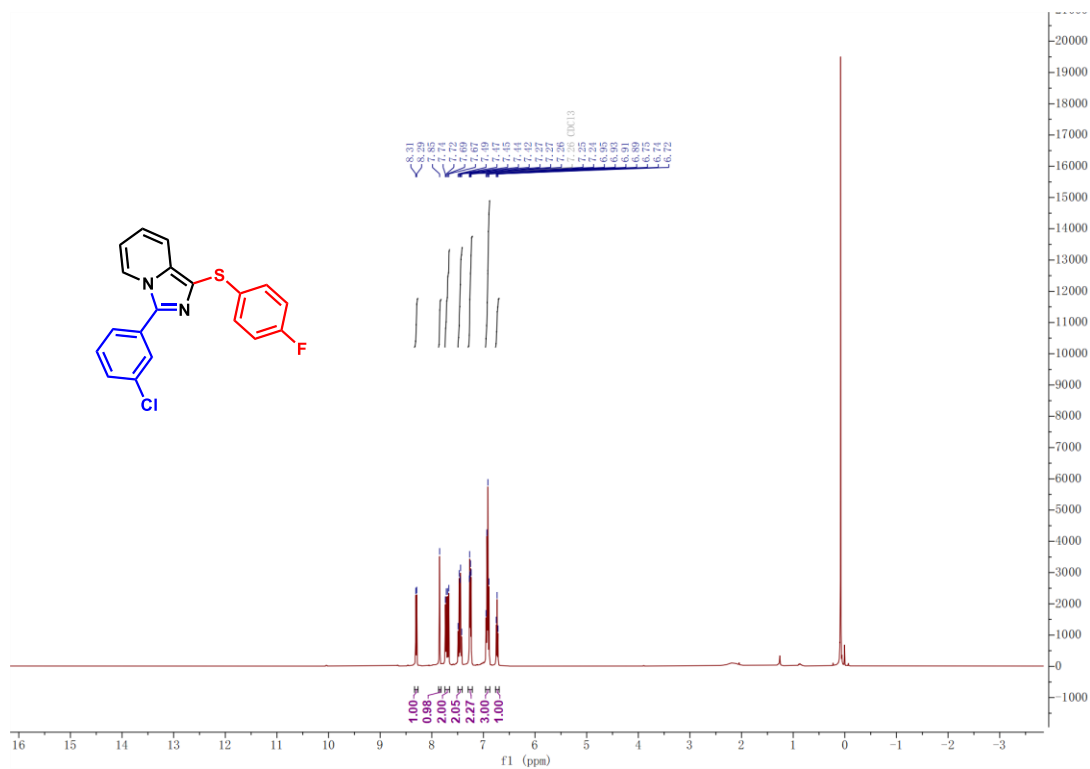


¹H NMR spectrum of 4t

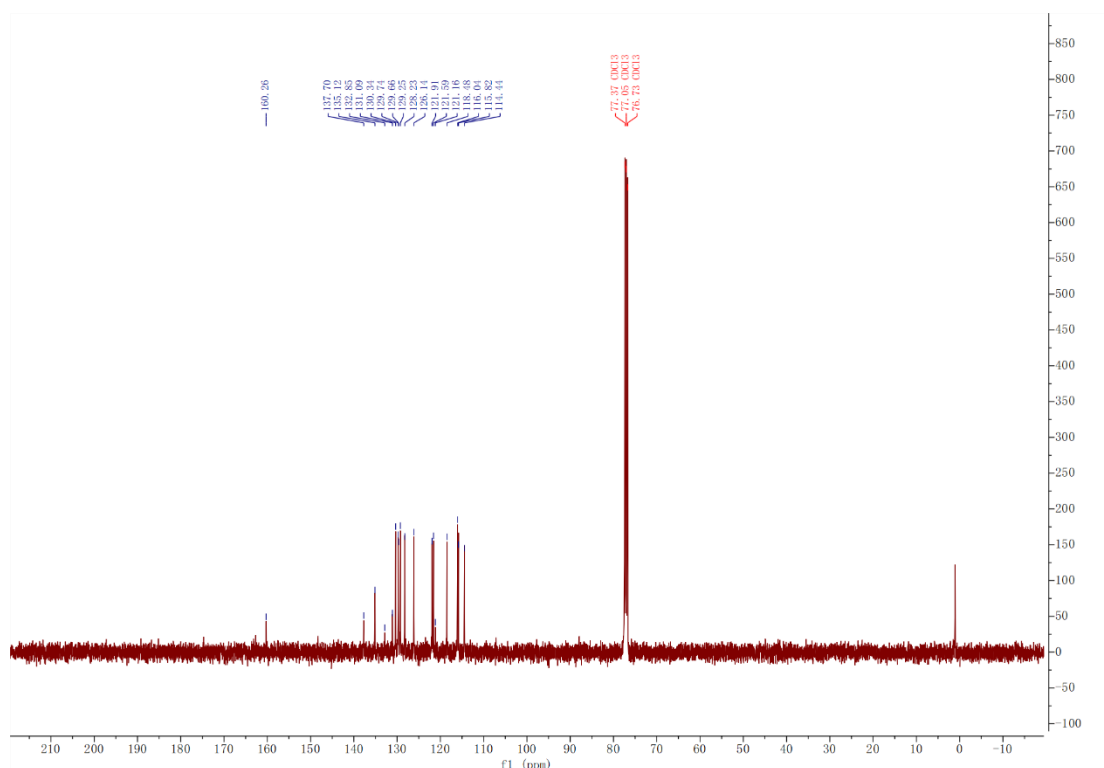


¹³C NMR spectrum of 4t

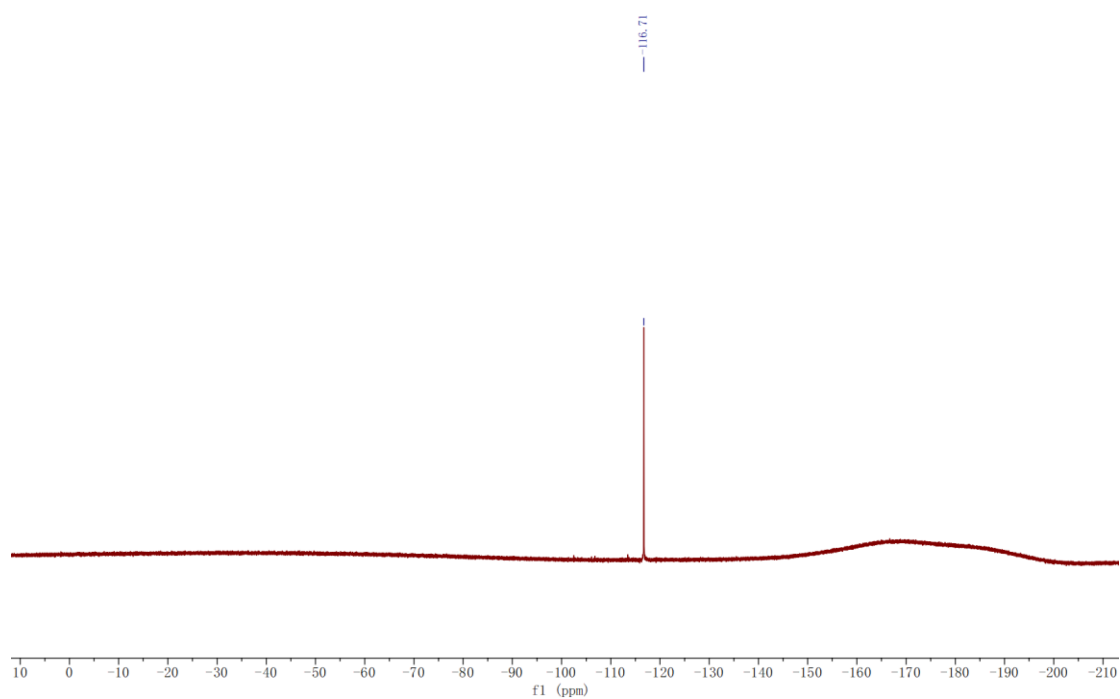
3-(3-chlorophenyl)-1-((4-fluorophenyl)thio)imidazo[1,5-a]pyridine(4u)



¹H NMR spectrum of 4u

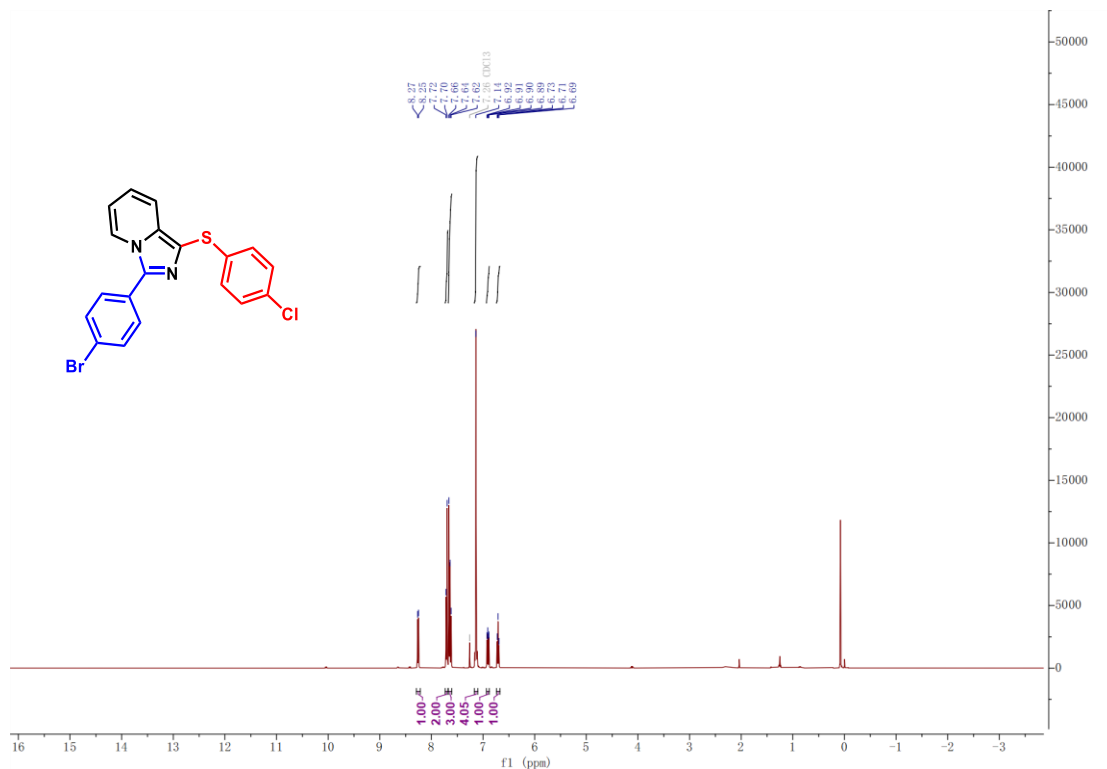


¹³C NMR spectrum of 4u

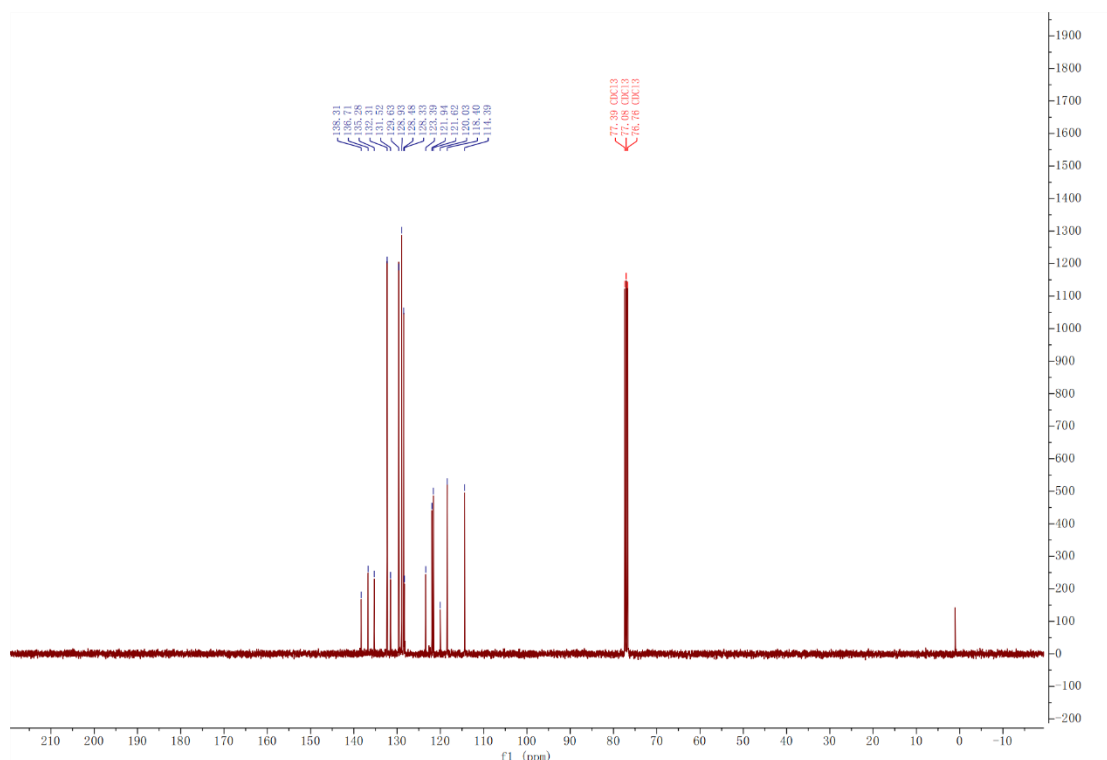


^{19}F NMR spectrum of 4u

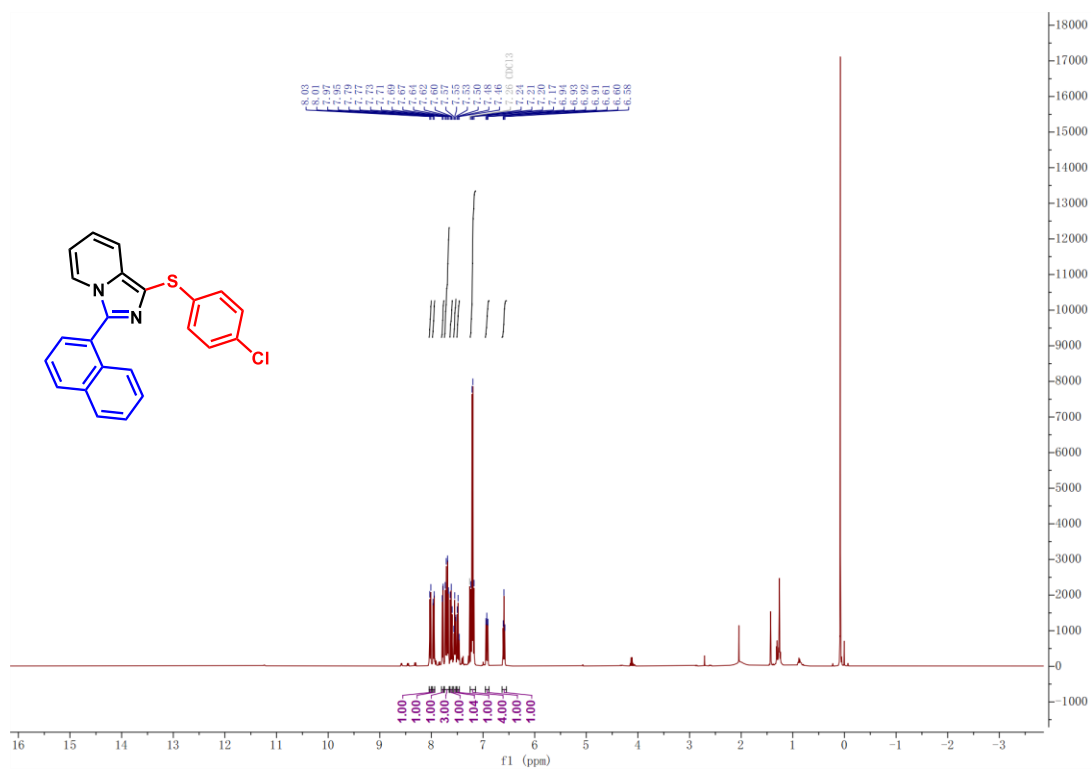
3-(4-bromophenyl)-1-((4-chlorophenyl)thio)imidazo[1,5-a]pyridine(4v)



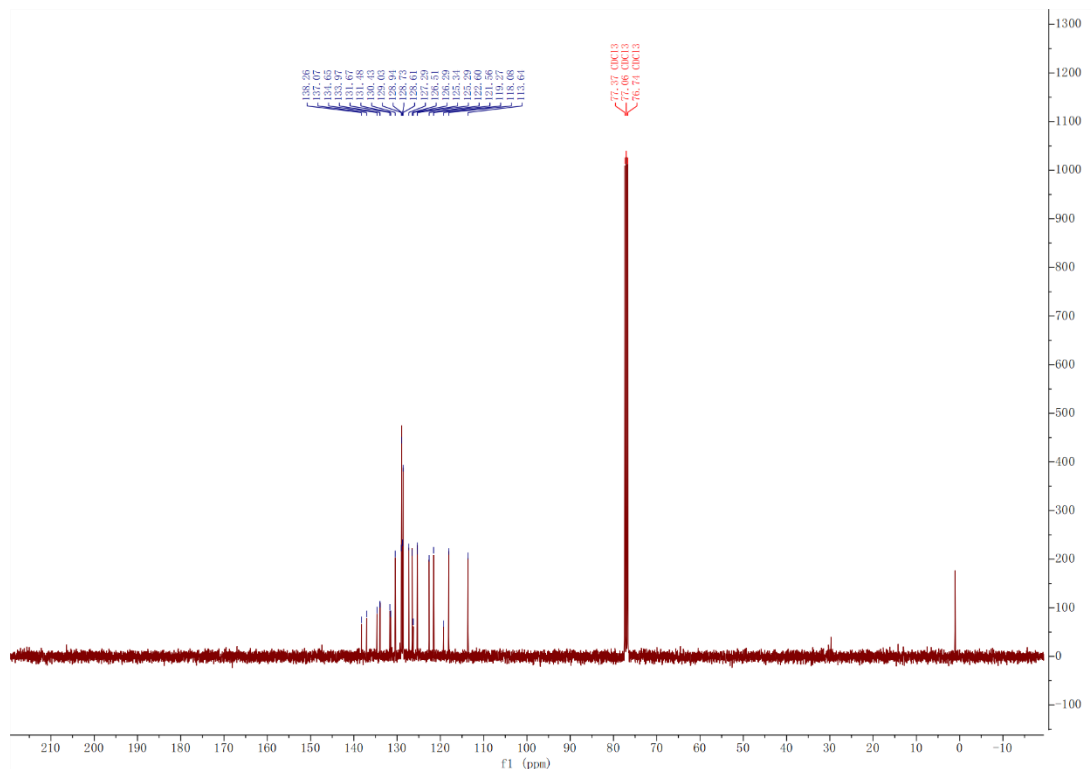
¹H NMR spectrum of 4v



1-((4-chlorophenyl)thio)-3-(naphthalen-1-yl)imidazo[1,5-a]pyridine(4w)



¹H NMR spectrum of 4w



Chemical structure: O=[N+]([O-])c1ccc(cc1)/N2C=NC(Sc3ccc(Cl)cc3)=C2

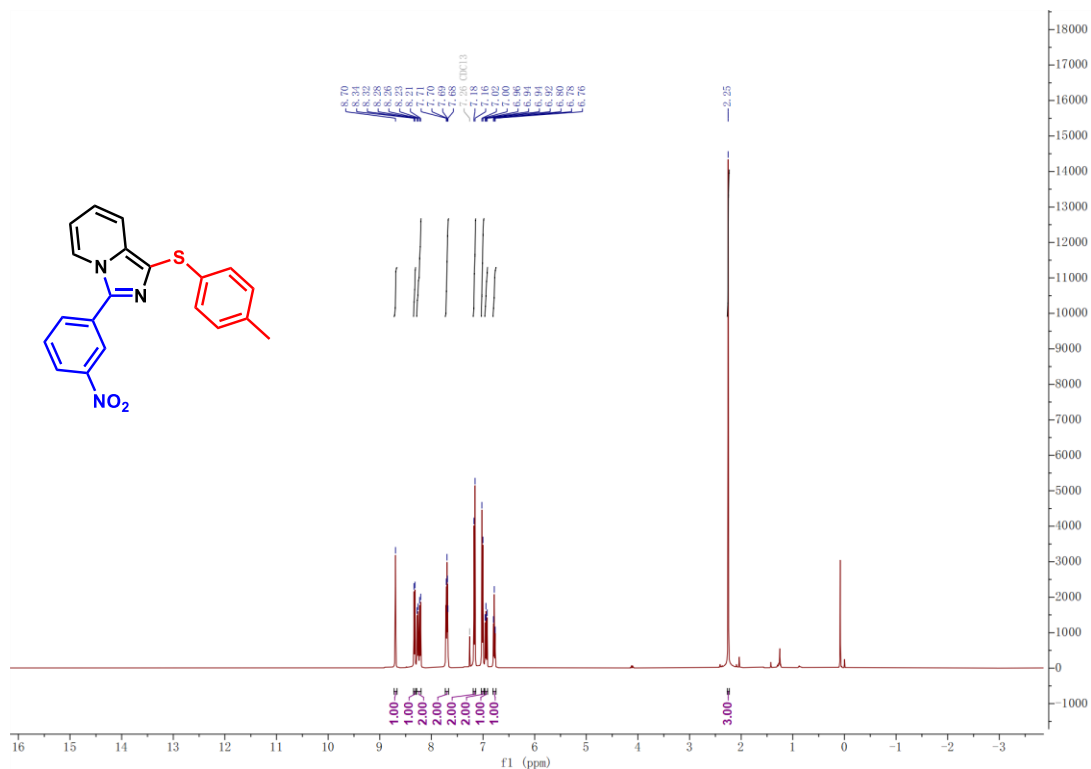
¹H NMR spectrum (CDCl₃) showing chemical shifts (ppm) on the x-axis and intensity on the y-axis. The spectrum displays several peaks corresponding to the structure, with integration values indicated below the peaks.

Chemical shifts (ppm): 8.69, 8.65, 8.61, 8.57, 8.55, 8.53, 8.51, 8.49, 8.47, 8.45, 8.43, 8.41, 8.39, 8.37, 8.35, 8.33, 8.31, 8.29, 8.27, 8.25, 8.23, 8.21, 8.19, 8.17, 8.15, 8.13, 8.11, 8.09, 8.07, 8.05, 8.03, 8.01, 7.99, 7.97, 7.95, 7.93, 7.91, 7.89, 7.87, 7.85, 7.83, 7.81, 7.79, 7.77, 7.75, 7.73, 7.71, 7.69, 7.67, 7.65, 7.63, 7.61, 7.59, 7.57, 7.55, 7.53, 7.51, 7.49, 7.47, 7.45, 7.43, 7.41, 7.39, 7.37, 7.35, 7.33, 7.31, 7.29, 7.27, 7.25, 7.23, 7.21, 7.19, 7.17, 7.15, 7.13, 7.11, 7.09, 7.07, 7.05, 7.03, 7.01, 6.99, 6.97, 6.95, 6.93, 6.91, 6.89, 6.87, 6.85, 6.83, 6.81, 6.79, 6.77, 6.75, 6.73, 6.71, 6.69, 6.67, 6.65, 6.63, 6.61, 6.59, 6.57, 6.55, 6.53, 6.51, 6.49, 6.47, 6.45, 6.43, 6.41, 6.39, 6.37, 6.35, 6.33, 6.31, 6.29, 6.27, 6.25, 6.23, 6.21, 6.19, 6.17, 6.15, 6.13, 6.11, 6.09, 6.07, 6.05, 6.03, 6.01, 5.99, 5.97, 5.95, 5.93, 5.91, 5.89, 5.87, 5.85, 5.83, 5.81, 5.79, 5.77, 5.75, 5.73, 5.71, 5.69, 5.67, 5.65, 5.63, 5.61, 5.59, 5.57, 5.55, 5.53, 5.51, 5.49, 5.47, 5.45, 5.43, 5.41, 5.39, 5.37, 5.35, 5.33, 5.31, 5.29, 5.27, 5.25, 5.23, 5.21, 5.19, 5.17, 5.15, 5.13, 5.11, 5.09, 5.07, 5.05, 5.03, 5.01, 4.99, 4.97, 4.95, 4.93, 4.91, 4.89, 4.87, 4.85, 4.83, 4.81, 4.79, 4.77, 4.75, 4.73, 4.71, 4.69, 4.67, 4.65, 4.63, 4.61, 4.59, 4.57, 4.55, 4.53, 4.51, 4.49, 4.47, 4.45, 4.43, 4.41, 4.39, 4.37, 4.35, 4.33, 4.31, 4.29, 4.27, 4.25, 4.23, 4.21, 4.19, 4.17, 4.15, 4.13, 4.11, 4.09, 4.07, 4.05, 4.03, 4.01, 3.99, 3.97, 3.95, 3.93, 3.91, 3.89, 3.87, 3.85, 3.83, 3.81, 3.79, 3.77, 3.75, 3.73, 3.71, 3.69, 3.67, 3.65, 3.63, 3.61, 3.59, 3.57, 3.55, 3.53, 3.51, 3.49, 3.47, 3.45, 3.43, 3.41, 3.39, 3.37, 3.35, 3.33, 3.31, 3.29, 3.27, 3.25, 3.23, 3.21, 3.19, 3.17, 3.15, 3.13, 3.11, 3.09, 3.07, 3.05, 3.03, 3.01, 2.99, 2.97, 2.95, 2.93, 2.91, 2.89, 2.87, 2.85, 2.83, 2.81, 2.79, 2.77, 2.75, 2.73, 2.71, 2.69, 2.67, 2.65, 2.63, 2.61, 2.59, 2.57, 2.55, 2.53, 2.51, 2.49, 2.47, 2.45, 2.43, 2.41, 2.39, 2.37, 2.35, 2.33, 2.31, 2.29, 2.27, 2.25, 2.23, 2.21, 2.19, 2.17, 2.15, 2.13, 2.11, 2.09, 2.07, 2.05, 2.03, 2.01, 1.99, 1.97, 1.95, 1.93, 1.91, 1.89, 1.87, 1.85, 1.83, 1.81, 1.79, 1.77, 1.75, 1.73, 1.71, 1.69, 1.67, 1.65, 1.63, 1.61, 1.59, 1.57, 1.55, 1.53, 1.51, 1.49, 1.47, 1.45, 1.43, 1.41, 1.39, 1.37, 1.35, 1.33, 1.31, 1.29, 1.27, 1.25, 1.23, 1.21, 1.19, 1.17, 1.15, 1.13, 1.11, 1.09, 1.07, 1.05, 1.03, 1.01, 0.99, 0.97, 0.95, 0.93, 0.91, 0.89, 0.87, 0.85, 0.83, 0.81, 0.79, 0.77, 0.75, 0.73, 0.71, 0.69, 0.67, 0.65, 0.63, 0.61, 0.59, 0.57, 0.55, 0.53, 0.51, 0.49, 0.47, 0.45, 0.43, 0.41, 0.39, 0.37, 0.35, 0.33, 0.31, 0.29, 0.27, 0.25, 0.23, 0.21, 0.19, 0.17, 0.15, 0.13, 0.11, 0.09, 0.07, 0.05, 0.03, 0.01, -0.01, -0.03, -0.05, -0.07, -0.09, -0.11, -0.13, -0.15, -0.17, -0.19, -0.21, -0.23, -0.25, -0.27, -0.29, -0.31, -0.33, -0.35, -0.37, -0.39, -0.41, -0.43, -0.45, -0.47, -0.49, -0.51, -0.53, -0.55, -0.57, -0.59, -0.61, -0.63, -0.65, -0.67, -0.69, -0.71, -0.73, -0.75, -0.77, -0.79, -0.81, -0.83, -0.85, -0.87, -0.89, -0.91, -0.93, -0.95, -0.97, -0.99, -1.01, -1.03, -1.05, -1.07, -1.09, -1.11, -1.13, -1.15, -1.17, -1.19, -1.21, -1.23, -1.25, -1.27, -1.29, -1.31, -1.33, -1.35, -1.37, -1.39, -1.41, -1.43, -1.45, -1.47, -1.49, -1.51, -1.53, -1.55, -1.57, -1.59, -1.61, -1.63, -1.65, -1.67, -1.69, -1.71, -1.73, -1.75, -1.77, -1.79, -1.81, -1.83, -1.85, -1.87, -1.89, -1.91, -1.93, -1.95, -1.97, -1.99, -2.01, -2.03, -2.05, -2.07, -2.09, -2.11, -2.13, -2.15, -2.17, -2.19, -2.21, -2.23, -2.25, -2.27, -2.29, -2.31, -2.33, -2.35, -2.37, -2.39, -2.41, -2.43, -2.45, -2.47, -2.49, -2.51, -2.53, -2.55, -2.57, -2.59, -2.61, -2.63, -2.65, -2.67, -2.69, -2.71, -2.73, -2.75, -2.77, -2.79, -2.81, -2.83, -2.85, -2.87, -2.89, -2.91, -2.93, -2.95, -2.97, -2.99, -3.01, -3.03, -3.05, -3.07, -3.09, -3.11, -3.13, -3.15, -3.17, -3.19, -3.21, -3.23, -3.25, -3.27, -3.29, -3.31, -3.33, -3.35, -3.37, -3.39, -3.41, -3.43, -3.45, -3.47, -3.49, -3.51, -3.53, -3.55, -3.57, -3.59, -3.61, -3.63, -3.65, -3.67, -3.69, -3.71, -3.73, -3.75, -3.77, -3.79, -3.81, -3.83, -3.85, -3.87, -3.89, -3.91, -3.93, -3.95, -3.97, -3.99, -4.01, -4.03, -4.05, -4.07, -4.09, -4.11, -4.13, -4.15, -4.17, -4.19, -4.21, -4.23, -4.25, -4.27, -4.29, -4.31, -4.33, -4.3

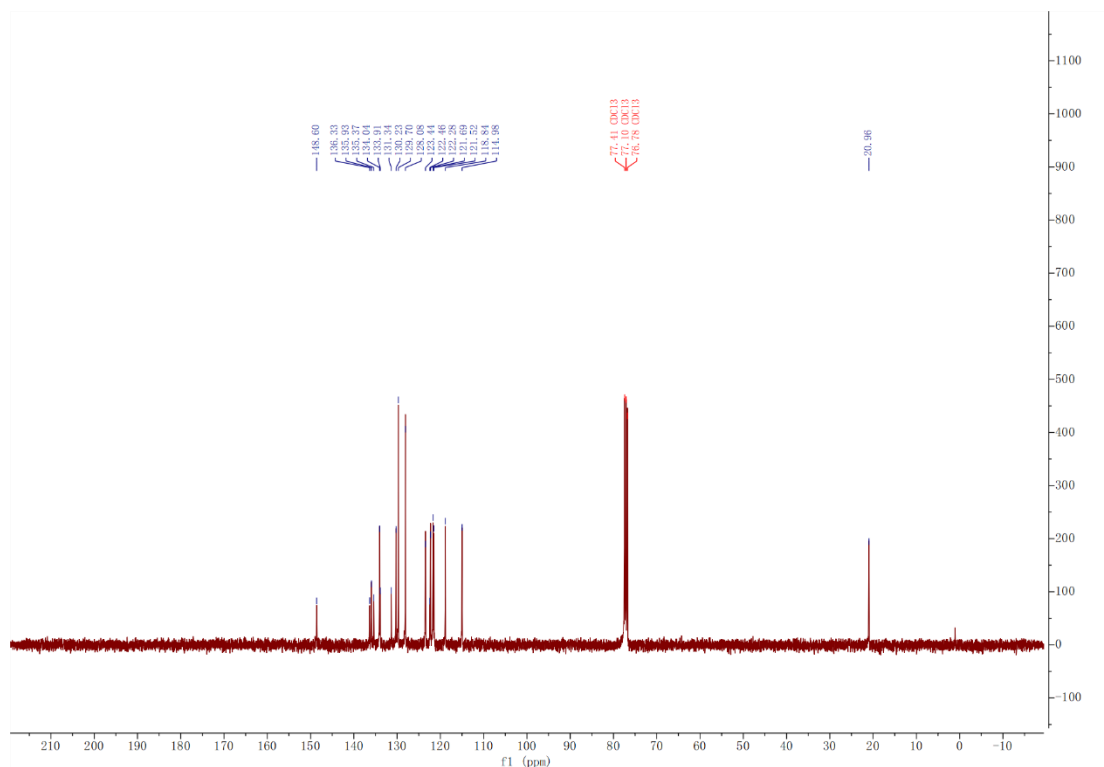
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121.69
120.52
118.53
115.12
77.45 CDCl₃
77.13 CDCl₃
76.81 CDCl₃

42

3-(3-nitrophenyl)-1-(p-tolylthio)imidazo[1,5-a]pyridine(4y)

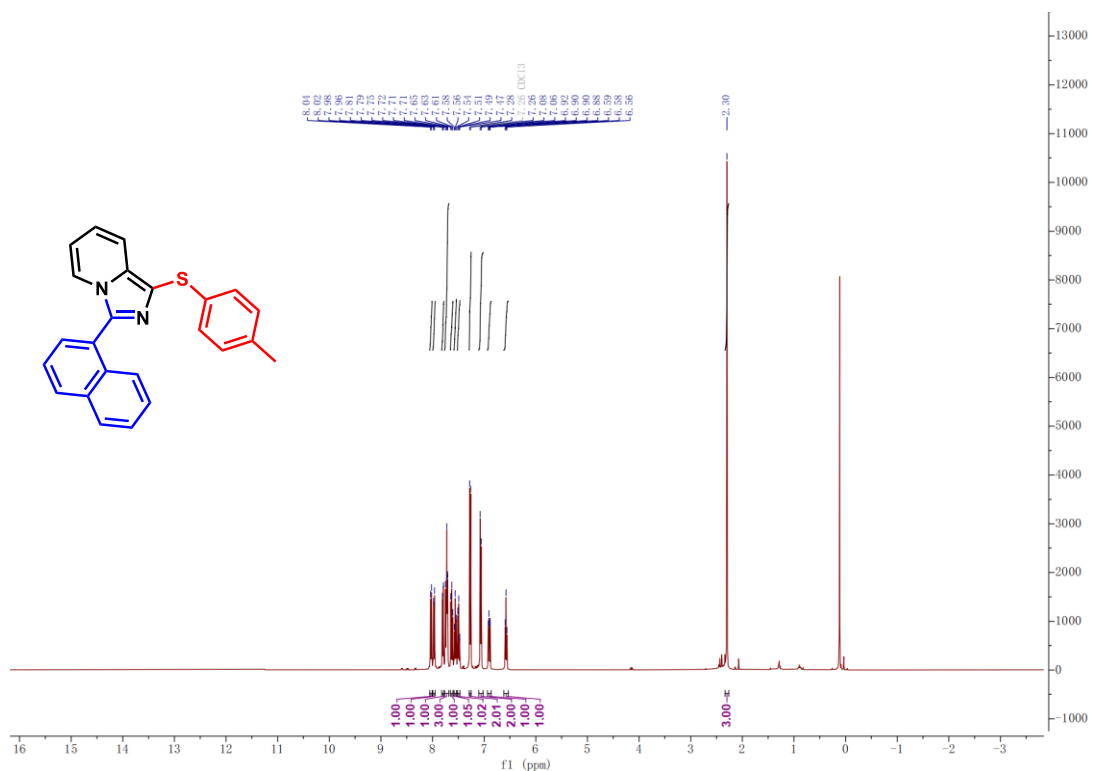


¹H NMR spectrum of 4y

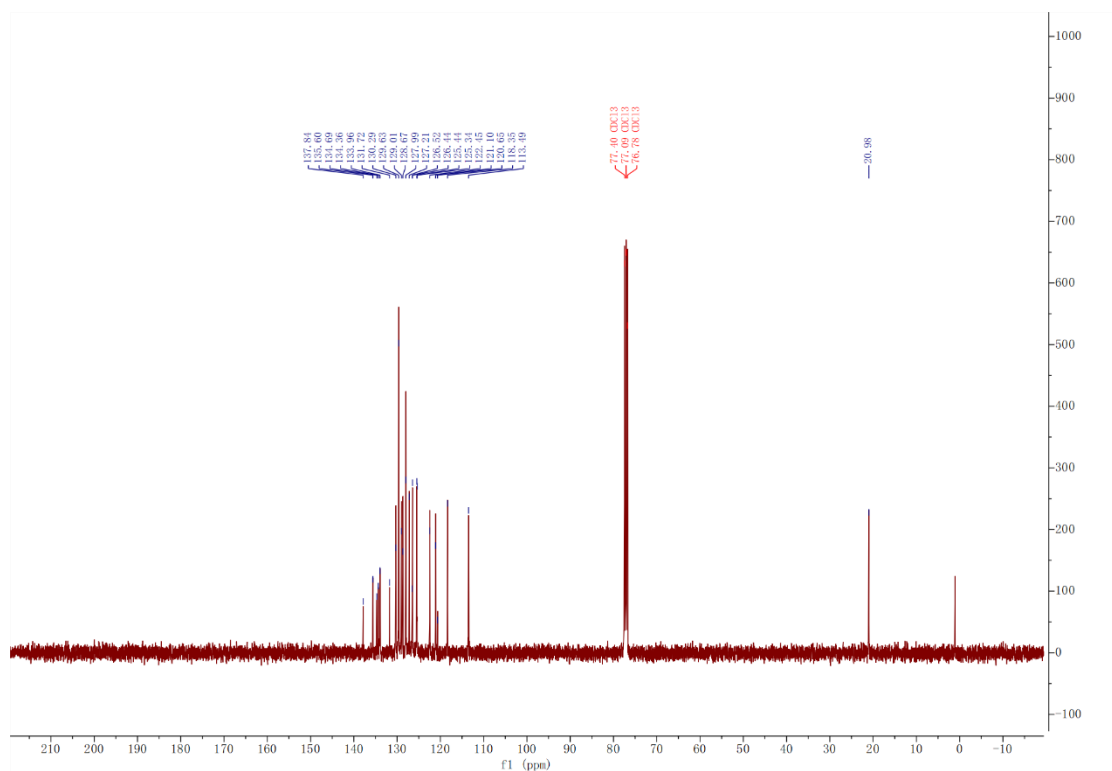


^{13}C NMR spectrum of 4y

3-(naphthalen-1-yl)-1-(p-tolylthio)imidazo[1,5-a]pyridine(4z)

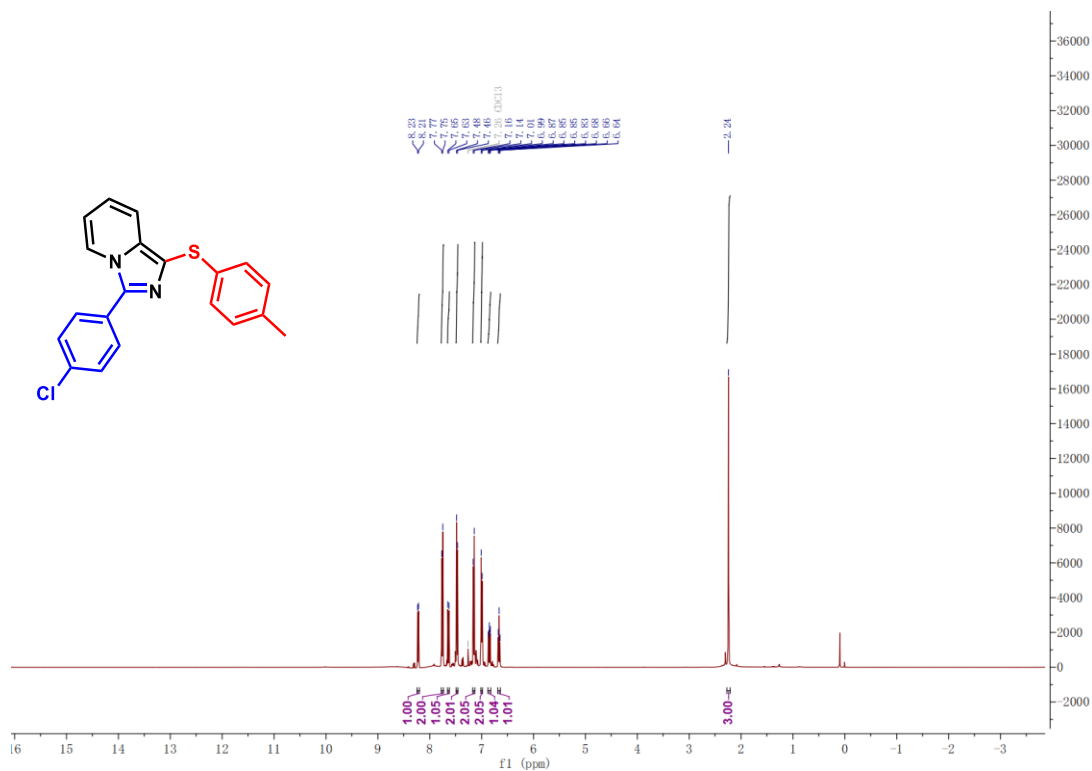


¹H NMR spectrum of 4z

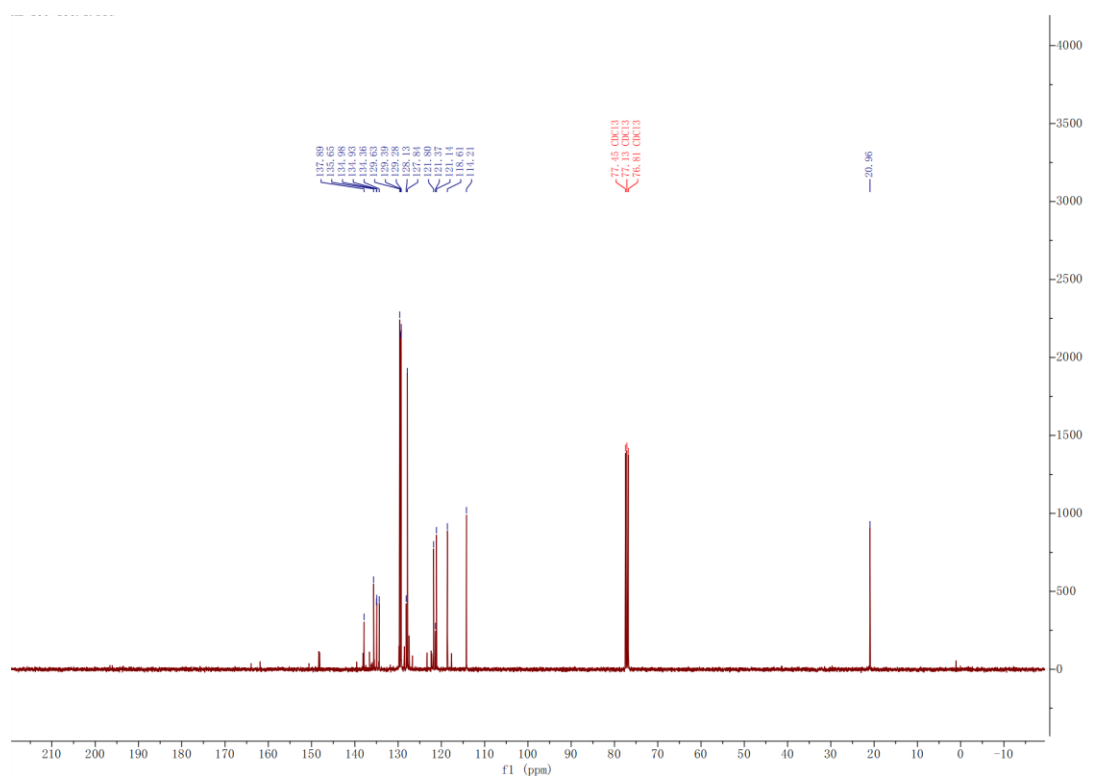


¹³C NMR spectrum of 4z

3-(4-chlorophenyl)-1-(p-tolylthio)imidazo[1,5-a]pyridine (4za)



¹H NMR spectrum of 4za



^{13}C NMR spectrum of 4za