Ce(III)-catalyzed highly efficient synthesis of pyridyl benzamides from aminopyridines and nitroolefins without external oxidants

Zhengwang Chen,*[a,b] Xiaowei Wen,[a] Yiping Qian,[a] Pei Liang,[a] Botao Liu[a] and Min Ye*[a]

[a] Key Laboratory of Organo-Pharmaceutical Chemistry of Jiangxi Province, Gannan Normal University, Ganzhou 341000, PR China
[b] Key Laboratory of Functional Molecular Engineering of Guangdong Province, South China University of Technology, Guangzhou, 510640, China.
E-mail: chenzwang@126.com

Supporting Information

List of Contents

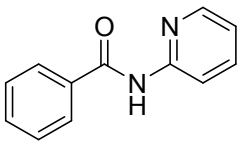
A. General method

^{1}H and ^{13}C NMR spectra were obtained on a 400 MHz NMR spectrometer. The chemical shifts are referenced to signals at 7.26 and 77.0 ppm, respectively, chloroform is solvent with TMS as the internal standard unless otherwise noted. Mass spectra were recorded on a GC-MS spectrometer at an ionization voltage of 70 eV equipped with a DB-WAX capillary column (internal diameter: 0.25 mm, length: 30 m). Elemental analyses were performed with a Vario EL elemental analyzer. High-resolution mass spectra (HRMS) were obtained from a JEOL JMS-700 instrument (EI). Silica gel (300-400 mesh) was used for flash column chromatograph, eluting (unless otherwise stated) with ethyl acetate/petroleum ether (PE) (60-90 ^{o}C) mixture.

B. General procedure for the synthesis of *N*-(pyridin-2-yl)benzamides or oxazolo[4,5-b]pyridines

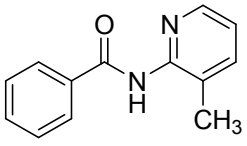
A mixture of aminopyridine (0.2 mmol), nitroolefins (0.2 mmol), $Ce(NO_3)_3 \cdot 6H_2O$ (10 mol%), water (0.5 mL) and dioxane (0.5 mL) was placed in a test tube (10 mL) equipped with a magnetic stirring bar. The mixture was stirred at 100 °C for 16 h. After the reaction was finished, water (5 mL) was added and the solution was extracted with ethyl acetate (3×5 mL), the combined extract was dried with anhydrous $MgSO_4$. Solvent was removed, and the residue was separated by column chromatography to give the pure sample.

C. Analytical data



_N_-(pyridin-2-yl)benzamide (3a)[1]

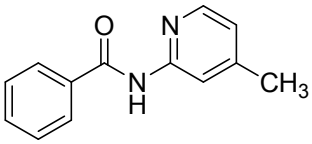
Yield 85%; R_f = 0.3 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.86 (s, 1H), 8.41 (d, J = 8.4 Hz, 1H), 8.26-8.24 (m, 1H), 7.95-7.92 (m, 2H), 7.77-7.74 (m, 1H), 7.59-7.55 (m, 1H), 7.51-7.47 (m, 2H), 7.08-7.05 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.7, 151.5, 147.7, 138.5, 134.2, 132.2, 128.8, 127.2, 119.9, 114.2. MS (EI) m/z: 198, 169, 105, 77, 65, 51, 39, 29.



N-**(3-methylpyridin-2-yl)benzamide (3b)[1]**

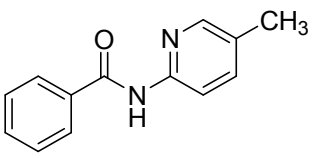
Yield 62%; R_f = 0.33 (hexane/EtOAc, 1:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.41 (s, 1H), 8.19 (s, 1H), 7.88 (d, J = 7.2 Hz, 2H), 7.56 (d, J = 7.2 Hz, 1H), 7.49 (t, J = 7.2 Hz, 1H), 7.41 (t, J = 7.2 Hz, 2H), 7.09-7.06 (m, 1H), 2.27 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 166.1, 149.9, 149.2, 140.0, 134.0, 131.9, 129.4, 128.5, 127.6, 121.7, 18.3. MS (EI) m/z: 212,

183, 105, 77, 51, 39, 29.



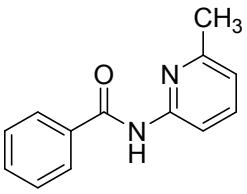
***N*-(4-methylpyridin-2-yl)benzamide (3c)[1]**

Yield 80%; R_f = 0.3 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.67 (s, 1H), 8.24 (s, 1H), 8.12 (d, J = 4.8 Hz, 1H), 7.93-7.91 (m, 2H), 7.58-7.54 (m, 1H), 7.49 (t, J = 7.6 Hz, 2H), 6.90 (d, J = 5.2 Hz, 1H), 2.40 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.6, 151.6, 150.0, 147.4, 134.4, 132.1, 128.8, 127.1, 121.1, 114.6, 21.4. MS (EI) m/z: 212, 183, 105, 77, 51, 39, 29.



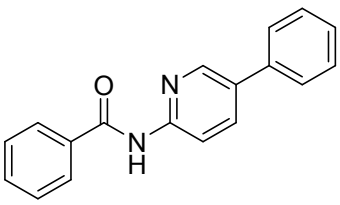
***N*-(5-methylpyridin-2-yl)benzamide (3d)[2]**

Yield 88%; R_f = 0.45 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.82 (s, 1H), 8.29 (d, J = 8.4 Hz, 1H), 8.03 (s, 1H), 7.92-7.90 (m, 2H), 7.57-7.53 (m, 2H), 7.49-7.45 (m, 2H), 2.29 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.6, 149.4, 147.7, 138.9, 134.4, 132.0, 129.2, 128.7, 127.1, 113.7, 17.7. MS (EI) m/z: 212, 183, 105, 77, 65, 51, 39.



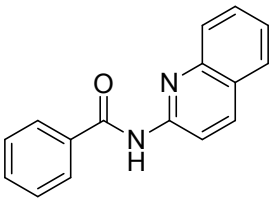
***N*-(6-methylpyridin-2-yl)benzamide (3e)[1]**

Yield 91%; R_f = 0.32 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.96 (s, 1H), 8.18 (d, J = 8.0 Hz, 1H), 7.89-7.87 (m, 2H), 7.59 (t, J = 8.0 Hz, 1H), 7.50-7.47 (m, 1H), 7.42-7.38 (m, 2H), 6.86 (d, J = 7.6 Hz, 1H), 2.35 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.6, 156.7, 150.8, 138.5, 134.2, 131.9, 128.5, 127.1, 119.2, 110.9, 23.6. MS (EI) m/z: 212, 183, 105, 77, 51, 39, 29.



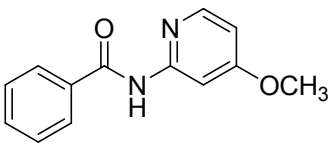
***N*-(5-phenylpyridin-2-yl)benzamide (3f)[3]**

Yield 70%; R_f = 0.38 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.89 (s, 1H), 8.41 (d, J = 8.4 Hz, 1H), 8.37 (d, J = 2.4 Hz, 1H), 7.90-7.86 (m, 3H), 7.51-7.46 (m, 3H), 7.44-7.36 (m, 4H), 7.32-7.28 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.7, 150.7, 146.0, 137.3, 136.8, 134.3, 133.0, 132.2, 129.0, 128.8, 127.8, 127.2, 126.7, 113.9. MS (EI) m/z: 274, 245, 105, 77, 51.



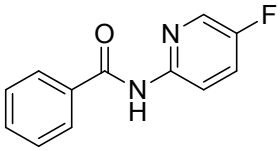
***N*-(quinolin-2-yl)benzamide (3g)[3]**

Yield 51%; R_f = 0.40 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.89 (s, 1H), 8.59 (d, J = 9.2 Hz, 1H), 8.23 (d, J = 9.2 Hz, 1H), 8.01-7.98 (m, 2H), 7.85-7.80 (m, 2H), 7.70-7.66 (m, 1H), 7.61-7.57 (m, 1H), 7.54-7.50 (m, 2H), 7.49-7.45 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 166.0, 151.1, 146.6, 138.6, 134.2, 132.4, 130.0, 128.8, 127.6, 127.3, 126.4, 125.2, 114.4. MS (EI) m/z: 248, 219, 105, 77, 51, 39, 27.



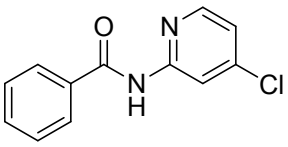
***N*-(4-methoxypyridin-2-yl)benzamide (3h)[4]**

Yield 60%; R_f = 0.2 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.79 (s, 1H), 8.05-8.04 (m, 2H), 7.93-7.91 (m, 2H), 7.59-7.55 (m, 1H), 7.52-7.47 (m, 2H), 6.63-6.61 (m, 1H), 3.91 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.6, 165.8, 153.2, 148.4, 134.2, 132.2, 128.8, 127.1, 107.9, 98.7, 55.4. MS (EI) m/z: 228, 199, 105, 77, 51, 39, 27.



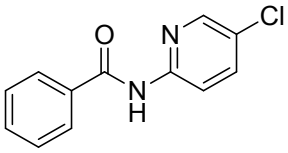
***N*-(5-fluoropyridin-2-yl)benzamide (3i)[1]**

Yield 72%; R_f = 0.37 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.72 (s, 1H), 8.43-8.40 (m, 1H), 8.10 (d, J = 4.2 Hz, 1H), 7.92-7.90 (m, 2H), 7.59-7.55 (m, 1H), 7.51-7.46 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.4, 157.6 (d, J = 250.0 Hz), 147.8, 135.4 (d, J = 25.0 Hz), 134.0, 132.3, 128.8, 127.1, 125.3 (d, J =19.0 Hz), 114.9 (d, J = 4.0 Hz). MS (EI) m/z: 216, 187, 105, 77, 51, 39, 27.



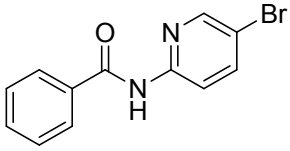
***N*-(4-chloropyridin-2-yl)benzamide (3j)[2]**

Yield 74%; R_f = 0.28 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.80 (s, 1H), 8.50 (d, J = 1.6 Hz, 1H), 8.13 (d, J = 5.6 Hz, 1H), 7.92-7.90 (m, 2H), 7.60-7.56 (m, 1H), 7.52-7.48 (m, 2H), 7.07-7.06 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.7, 152.4, 148.4, 146.0, 133.8, 132.4, 128.9, 127.2, 120.3, 114.3. MS (EI) m/z: 232, 203, 105, 77, 51, 39, 27.



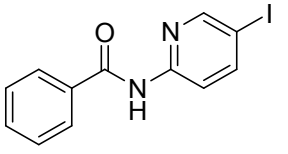
***N*-(5-chloropyridin-2-yl)benzamide (3k)[5]**

Yield 83%; R_f = 0.38 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.64 (s, 1H), 8.40-8.37 (m, 1H), 8.22 (d, J = 4.2 Hz, 1H), 7.92-7.90 (m, 2H), 7.73-7.71 (m, 1H), 7.61-7.56 (m, 1H), 7.52-7.48 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.7, 149.9, 146.4, 138.0, 133.9, 132.3, 128.8, 127.2, 126.8, 114.8. MS (EI) m/z: 232, 203, 105, 77, 51, 39, 27.



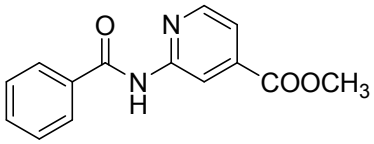
***N*-(5-bromopyridin-2-yl)benzamide (3l)[1]**

Yield 62%; R_f = 0.40 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.59 (s, 1H), 8.29-8.24 (m, 2H), 7.84 (d, J = 7.2 Hz, 2H), 7.80-7.77 (m, 1H), 7.52 (t, J = 7.2 Hz, 1H), 7.43 (t, J = 7.2 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.6, 150.2, 148.7, 140.8, 133.9, 132.4, 128.8, 127.1, 115.3, 114.7. MS (EI) m/z: 278, 249, 105, 77, 51, 39, 28.



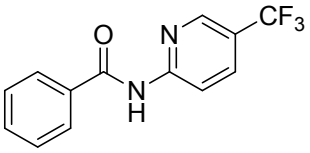
***N*-(5-iodopyridin-2-yl)benzamide (3m)[6]**

Yield 57%; R_f = 0.61 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.67 (s, 1H), 8.44-8.43 (m, 1H), 8.26-8.23 (m, 1H), 8.02-7.99 (m, 1H), 7.92-7.89 (m, 2H), 7.60-7.56 (m, 1H), 7.52-7.48 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.6, 153.8, 150.7, 146.3, 133.9, 132.4, 128.9, 127.2, 115.9, 85.8. MS (EI) m/z: 324, 295, 105, 77, 51, 38.



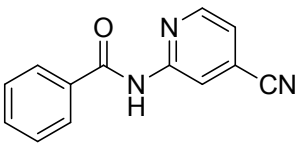
methyl 2-benzamidoisonicotinate (3n)

Yield 50%; R_f = 0.23 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.93-8.92 (m, 1H), 8.73 (s, 1H),8.44-8.43 (m, 1H), 7.96-7.93 (m, 2H), 7.65-7.64 (m, 1H), 7.61-7.57 (m, 1H), 7.54-7.50 (m, 2H), 3.97 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.6, 165.4, 152.4, 148.6, 139.9, 133.9, 132.4, 128.9, 127.2, 119.3, 113.7, 52.7. MS (EI) m/z: 256, 227, 105, 77, 51, 38, 28. Anal. Calcd for $C_{14}H_{12}N_2O_3$: C, 65.62; H, 4.72; N, 10.93; Found: C, 65.41; H, 4.80; N, 10.82.



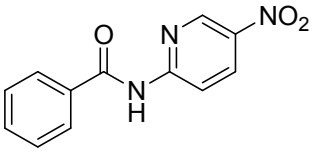
N-**(5-(trifluoromethyl)pyridin-2-yl)benzamide (3o)**[7]

Yield 66%; R_f = 0.62 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.89 (s, 1H), 8.54-8.50 (m, 2H), 7.99-7.96 (m, 1H), 7.94-7.92 (m, 2H), 7.62-7.58 (m, 1H), 7.54-7.50 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.8, 154.1, 145.4 (q, J = 4.0 Hz), 135.8 (d, J = 3.0 Hz), 133.7, 132.7, 128.9, 127.3, 124.8, 120.8 (d, J = 270.0 Hz), 113.4. MS (EI) m/z: 266, 237, 105, 77, 51, 39, 28.



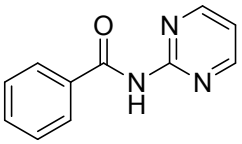
N-**(4-cyanopyridin-2-yl)benzamide (3p)**[8]

Yield 50%; R_f = 0.22 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.04 (s, 1H), 8.72 (s, 1H), 8.36 (d, J = 5.2 Hz, 1H), 7.92 (d, J = 7.2 Hz, 2H), 7.60 (t, J = 7.2 Hz, 1H), 7.51 (t, J = 7.6 Hz, 2H), 7.27 (d, J = 5.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.8, 152.3, 149.0, 133.3, 132.7, 128.9, 127.2, 122.4, 121.1, 116.4, 116.1. MS (EI) m/z: 223, 194, 105, 77, 51, 39, 28.



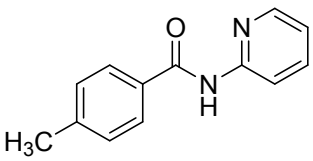
N-**(5-nitropyridin-2-yl)benzamide (3q)**[9]

Yield 44%; R_f = 0.40 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.11 (s, 1H), 9.03 (s, 1H), 8.91 (s, 1H), 8.60-8.53 (m, 2H), 7.94 (d, J = 7.6 Hz, 2H), 7.63 (t, J = 7.2 Hz, 1H), 7.54 (t, J = 7.2 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.6, 155.5, 144.7, 140.7, 134.1, 133.2, 133.0, 129.1, 127.3, 113.1. MS (EI) m/z: 243, 214, 105, 77, 51, 39, 28.



N-**(pyrimidin-2-yl)benzamide (3r)**[5]

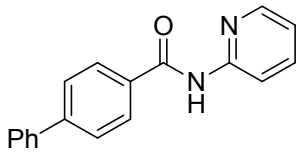
Yield 43%; R_f = 0.22 (hexane/EtOAc, 1:4); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.81 (s, 1H), 8.65 (d, J = 4.8 Hz, 2H), 7.95-7.93 (m, 2H), 7.60-7.55 (m, 1H), 7.51-7.47 (m, 2H), 7.06 (t, J = 4.8 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 164.8, 158.4, 157.8, 134.3, 132.4, 128.8, 127.4, 116.8, 111.5. MS (EI) m/z: 199, 171, 105, 77, 51, 39, 28.



4-methyl-*N*-(pyridin-2-yl)benzamide (4a)[2]

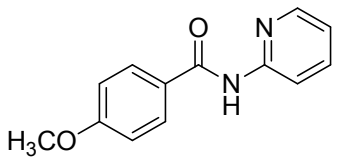
Yield 71%; R_f = 0.44 (hexane/EtOAc, 2:1); ^{1}H NMR (400

MHz, $CDCl_3$): δ = 8.62 (s, 1H), 8.40-8.38 (m, 1H), 8.30-8.29 (m, 1H), 7.84-7.82 (m, 2H), 7.78-7.73 (m, 1H), 7.30 (d, J = 8.0 Hz, 2H), 7.08-7.05 (m, 1H), 2.43 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.5, 151.6, 147.8, 142.9, 138.4, 131.4, 129.5, 127.2, 119.8, 114.1, 21.5. MS (EI) m/z: 212, 183, 19, 91, 65, 51, 39, 27.



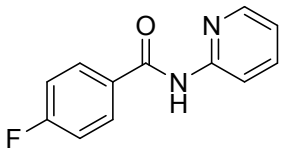
***N*-(pyridin-2-yl)-[1,1'-biphenyl]-4-carboxamide (4b)[10]**

Yield 70%; R_f = 0.40 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.74 (s, 1H), 8.42 (d, J = 8.4 Hz, 1H), 8.31 (d, J = 4.0 Hz, 1H), 8.01 (d, J = 8.4 Hz, 2H), 7.79-7.71 (m, 3H), 7.64 (d, J = 7.2 Hz, 1H), 7.48 (t, J = 7.2 Hz, 2H), 7.40 (t, J = 7.2 Hz, 1H), 7.10-7.07 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.3, 151.6, 147.8, 145.1, 139.8, 138.5, 132.8, 128.9, 128.1, 127.7, 127.4, 127.2, 119.9, 114.2. MS (EI) m/z: 274, 234, 205, 91, 77, 65, 51, 39, 28.



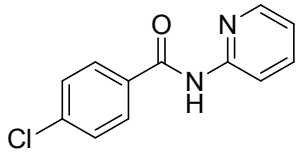
4-methoxy-*N*-(pyridin-2-yl)benzamide (4c)[1]

Yield 80%; R_f = 0.36 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.79 (s, 1H), 8.37 (d, J = 8.4 Hz, 1H), 8.24-8.23 (m, 1H), 7.91-7.88 (m, 2H), 7.75-7.71 (m, 1H), 7.05-7.01 (m, 1H), 6.98-6.94 (m, 2H), 3.86 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.2, 162.8, 151.8, 147.7, 138.3, 129.1, 126.4, 119.6, 114.1, 114.0, 55.4. MS (EI) m/z: 228, 199, 135, 107, 92, 77, 64, 51, 39, 28.



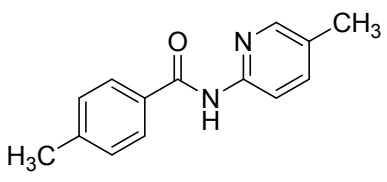
4-fluoro-*N*-(pyridin-2-yl)benzamide (4d)[1]

Yield 86%; R_f = 0.50 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.98 (s, 1H), 8.36 (d, J = 8.4 Hz, 1H), 8.20 (d, J = 4.4 Hz, 1H), 7.97-7.92 (m, 2H), 7.77-7.72 (m, 1H), 7.17-7.12 (m, 2H), 7.06-7.03 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.1 (d, J = 252.0 Hz), 164.7, 151.5, 147.8, 138.5, 130.5 (d, J = 3.0 Hz), 129.7 (d, J = 10.0 Hz), 119.9, 115.8 (d, J = 22.0 Hz), 114.3. MS (EI) m/z: 216, 187, 123, 95, 75, 65, 51, 39, 28.



4-chloro-*N*-(pyridin-2-yl)benzamide (4e)[2]

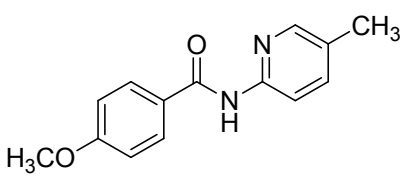
Yield 80%; R_f = 0.50 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.89 (s, 1H), 8.36 (d, J = 8.4 Hz, 1H), 8.23 (d, J = 4.0 Hz, 1H), 7.88-7.85 (m, 2H), 7.78-7.73 (m, 1H), 7.47-7.43 (m, 2H), 7.08-7.05 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 164.6, 151.4, 147.8, 138.6, 138.5, 132.6, 129.0, 128.6, 120.0, 114.3. MS (EI) m/z: 232, 203, 139, 111, 75, 51, 39, 28.



4-methyl-*N*-(5-methylpyridin-2-yl)benzamide (4f)[11]

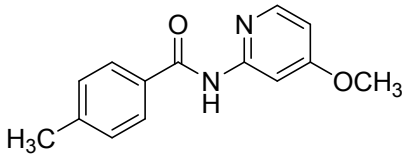
Yield 70%; R_f = 0.49 (hexane/EtOAc, 2:1); ^{1}H NMR

(400 MHz, $CDCl_3$): δ = 8.56 (s, 1H), 8.28 (d, J = 8.4 Hz, 1H), 8.10-8.10 (m, 1H), 7.83-7.80 (m, 2H), 7.58-7.55 (m, 1H), 7.29 (d, J = 8.0 Hz, 2H), 2.42 (s, 3H), 2.31 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.4, 149.5, 147.7, 142.6, 138.9, 131.5, 129.4, 129.1, 127.1, 113.6, 21.4, 17.7. MS (EI) m/z: 226, 197, 119, 107, 91, 77, 65, 51, 39, 28.



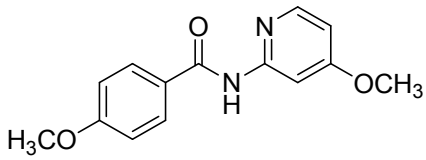
4-methoxy-*N*-(5-methylpyridin-2-yl)benzamide (4g)[12]

Yield 75%; R_f = 0.26 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.67 (s, 1H), 8.26 (d, J = 8.8 Hz, 1H), 8.06-8.06 (m, 1H), 7.90-7.87 (m, 2H), 7.56-7.53 (m, 1H), 6.98-6.94 (m, 2H), 3.86 (s, 3H), 2.29 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.0, 162.7, 149.6, 147.6, 138.9, 129.0, 126.5, 114.0, 113.6, 55.4, 17.7. MS (EI) m/z: 242, 213, 135, 107, 92, 77, 64, 39, 28.



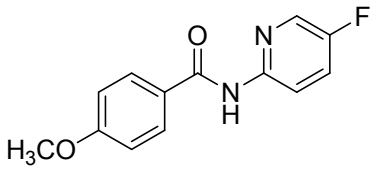
***N*-(4-methoxypyridin-2-yl)-4-methylbenzamide (4h)**

Yield 81%; R_f = 0.26 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.13 (s, 1H), 8.04 (d, J = 2.4 Hz, 1H), 7.94 (d, J = 5.6 Hz, 1H), 7.82-7.80 (m, 2H), 7.25 (d, J = 8.0 Hz, 2H), 6.57-6.55 (m, 1H), 3.88 (s, 3H), 2.39 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.5, 165.9, 153.4, 148.3, 142.7, 131.4, 129.3, 127.2, 107.7, 98.7, 55.3, 21.4. MS (EI) m/z: 242, 213, 119, 91, 77, 65, 39, 28. Anal. Calcd for $C_{14}H_{14}N_2O_2$: C, 69.41; H, 5.82; N, 11.56; Found: C, 69.19; H, 5.92; N, 11.43.



4-methoxy-*N*-(4-methoxypyridin-2-yl)benzamide (4i)

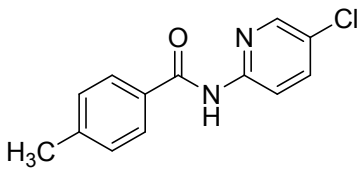
Yield 74%; R_f = 0.50 (hexane/EtOAc, 1:2); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.00 (s, 1H), 8.03 (d, J = 2.4 Hz, 1H), 7.97 (d, J = 6.0 Hz, 1H), 7.90-7.87 (m, 2H), 6.96-6.92 (m, 2H), 6.57-6.55 (m, 1H), 3.88 (s, 3H), 3.85 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.5, 165.4, 162.7, 153.5, 148.3, 129.1, 126.4, 113.9, 107.7, 98.6, 55.4, 55.3. MS (EI) m/z: 258, 229, 215, 135, 107, 92, 77, 64, 51, 28. Anal. Calcd for $C_{14}H_{14}N_2O_3$: C, 65.11; H, 5.46; N, 10.85; Found: C, 64.90; H, 5.54; N, 10.71.



***N*-(5-fluoropyridin-2-yl)-4-methoxybenzamide (4j)**

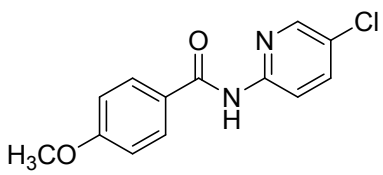
Yield 64%; R_f = 0.43 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.69 (s, 1H), 8.42-8.39 (m, 1H), 8.11 (d, J = 2.8 Hz, 1H), 7.90-7.87 (m, 2H), 7.50-7.45 (m, 1H), 6.99-6.96 (m, 2H), 3.87 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 164.9, 162.8, 156.3 (d, J = 249.0 Hz), 148.0 (d, J = 3.0 Hz), 135.2 (d, J = 26.0 Hz), 129.1, 126.1, 125.2 (d, J = 19.0 Hz), 114.9 (d, J = 4.0 Hz), 114.0, 55.4. MS (EI) m/z: 246, 201, 135, 105, 77, 63, 51, 38. Anal. Calcd for

$C_{13}H_{11}FN_2O_2$: C, 63.41; H, 4.50; N, 11.38; Found: C, 63.15; H, 4.59; N, 11.18.



***N*-(5-chloropyridin-2-yl)-4-methylbenzamide (4k)[7]**

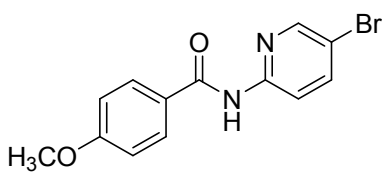
Yield 68%; R_f = 0.70 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.75 (s, 1H), 8.37 (d, J = 9.2 Hz, 1H), 8.16-7.15 (m, 1H), 7.79 (d, J = 8.0 Hz, 2H), 7.70-7.68 (m, 1H), 7.28 (d, J = 8.0 Hz, 2H), 2.41 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.5, 150.0, 146.4, 143.0, 138.0, 131.1, 129.5, 127.2, 126.7, 114.8, 21.4. MS (EI) m/z: 246, 217, 119, 91, 65, 51, 39, 28.



***N*-(5-chloropyridin-2-yl)-4-methoxybenzamide (4l)[13]**

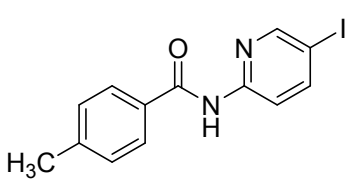
Yield 65%; R_f = 0.48 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.67 (s, 1H), 8.36 (d, J = 8.8 Hz, 1H), 8.19 (d, J = 2.4 Hz, 1H), 7.89-7.85 (m, 2H), 7.70-7.67 (m, 1H), 6.98-6.94 (m, 2H), 3.86 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.0, 162.9, 150.0, 146.4, 137.9, 129.1, 126.6, 126.0, 114.7, 114.1, 55.4. MS (EI) m/z: 262, 135, 90, 77, 63, 51, 39.

.



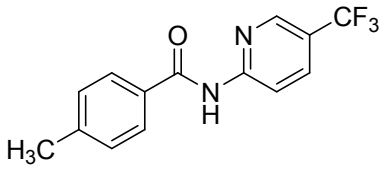
***N*-(5-bromopyridin-2-yl)-4-methoxybenzamide (4m)[13]**

Yield 64%; R_f = 0.50 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.66 (s, 1H), 8.32-8.28 (m, 2H), 7.89-7.88 (m, 1H), 7.86-7.85 (m, 1H), 7.83-7.81 (m, 1H), 6.98-6.95 (m, 2H), 3.86 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.1, 162.9, 150.4, 148.6, 140.7, 129.1, 126.0, 115.3, 114.4, 114.0, 55.4. MS (EI) m/z: 307, 135, 107, 92, 77, 64, 51, 38, 26.



***N*-(5-iodopyridin-2-yl)-4-methylbenzamide (4n)**

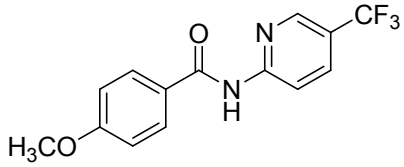
Yield 62%; R_f = 0.66 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.68 (s, 1H), 8.40 (d, J = 1.6 Hz, 1H), 8.25-8.22 (m, 1H), 8.00-7.97 (m, 1H), 7.79 (d, J = 8.4 Hz, 2H), 7.29 (d, J = 8.0 Hz, 2H), 2.42 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.6, 153.7, 150.8, 146.2, 143.1, 131.1, 129.5, 127.2, 115.9, 85.5, 21.5. MS (EI) m/z: 338, 309, 279, 119, 91, 77, 65, 51, 39, 28. Anal. Calcd for $C_{13}H_{11}IN_2O$: C, 46.18; H, 3.28; N, 8.28; Found: C, 45.96; H, 3.37; N, 8.40.



4-methyl-*N*-(5-(trifluoromethyl)pyridin-2-yl)benzamide (4o)[7]

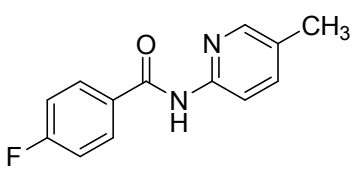
Yield 77%; R_f = 0.62 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.34 (s, 1H), 8.53 (d, J = 8.8 Hz, 1H), 8.26 (s, 1H), 7.94-7.91 (m, 1H), 7.80 (d, J = 8.0 Hz, 2H), 7.27 (d, J = 8.0 Hz, 2H), 2.41 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ =

166.2, 154.4, 145.2 (q, J = 4.0 Hz), 143.3, 135.7 (d, J = 3.0 Hz), 131.0, 129.4, 127.4, 124.8, 122.3 (q, J = 33 Hz), 113.4, 21.4. MS (EI) m/z: 280, 256, 119, 91, 65, 51, 39, 27.



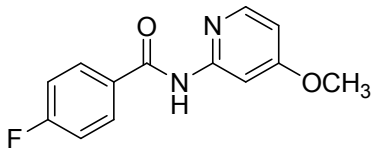
4-methoxy-*N*-(5-(trifluoromethyl)pyridin-2-yl)benzamide (4p)

Yield 77%; R_f = 0.52 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.97 (s, 1H), 8.52-8.43 (m, 2H), 7.95-7.92 (m, 1H), 7.91-7.87 (m, 2H), 6.99-6.95 (m, 2H), 3.86 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.3, 163.2, 154.4, 145.2 (d, J = 4.0 Hz), 135.7 (q, J = 4.0 Hz), 131.9, 129.3, 125.8, 120.8 (d, J = 271.0 Hz), 114.1, 113.3, 55.4. MS (EI) m/z: 296, 135, 107, 92, 77, 64, 51. Anal. Calcd for $C_{14}H_{11}F_3N_2O_2$: C, 56.76; H, 3.74; N, 9.46; Found: C, 56.49; H, 3.85; N, 9.63.



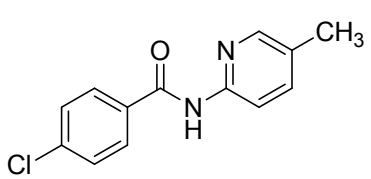
4-fluoro-*N*-(5-methylpyridin-2-yl)benzamide (4q)

Yield 79%; R_f = 0.50 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.81 (s, 1H), 8.25 (d, J = 8.4 Hz, 1H), 8.04 (d, J = 1.6 Hz, 1H), 7.96-7.91 (m, 2H), 7.57-7.55 (m, 1H), 7.17-7.12 (m, 2H), 2.29 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.0 (d, J = 251.0 Hz), 164.5, 149.3, 147.6, 139.0, 130.5 (d, J = 3.0 Hz), 129.6 (d, J = 9.0 Hz), 129.4, 115.8 (d, J = 22.0 Hz), 113.7, 17.7. MS (EI) m/z: 230, 201, 123, 107, 95, 75, 63, 51, 39, 27. Anal. Calcd for $C_{13}H_{11}FN_2O$: C, 67.82; H, 4.82; N, 12.17; Found: C, 67.55; H, 4.91; N, 12.34.



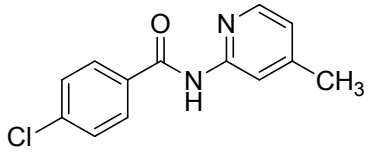
4-fluoro-*N*-(4-methoxypyridin-2-yl)benzamide (4r)

Yield 72%; R_f = 0.24 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.09 (s, 1H), 8.01 (d, J = 2.4 Hz, 1H), 7.96-7.91 (m, 3H), 7.17-7.12 (m, 2H), 6.60-6.58 (m, 1H), 3.90 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.6, 150.1 (d, J = 251.0 Hz), 164.8, 153.2, 148.4, 130.5 (d, J = 3.0 Hz), 129.7 (d, J = 9.0 Hz), 115.8 (d, J = 22.0 Hz), 107.9, 98.9, 55.3. MS (EI) m/z: 246, 217, 123, 108, 95, 79, 67, 52, 39, 26. Anal. Calcd for $C_{13}H_{11}FN_2O_2$: C, 63.41; H, 4.50; N, 11.38; Found: C, 63.19; H, 4.58; N, 11.24.



4-chloro-*N*-(5-methylpyridin-2-yl)benzamide (4s)

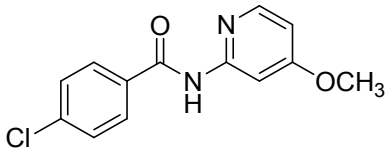
Yield 70%; R_f = 0.50 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.69 (s, 1H), 8.25 (d, J = 8.8 Hz, 1H), 8.07-8.06 (m, 1H), 7.87-7.84 (m, 2H), 7.58-7.55 (m, 1H), 7.47-7.44 (m, 2H), 2.30 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 164.4, 149.2, 147.7, 139.0, 138.4, 132.8, 129.5, 128.6, 113.7, 17.8. MS (EI) m/z: 247, 217, 139, 111, 75, 65, 51, 39, 28. Anal. Calcd for $C_{13}H_{11}ClN_2O$: C, 63.29; H, 4.49; N, 11.36; Found: C, 63.02; H, 4.58; N, 11.49.



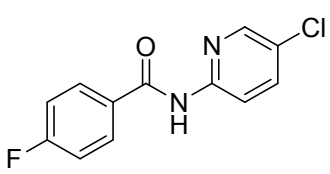
4-chloro-*N*-(4-methylpyridin-2-yl)benzamide (4t)[2]

Yield 76%; R_f = 0.48 (hexane/EtOAc, 2:1); ^{1}H NMR

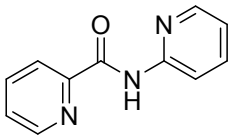
(400 MHz, $CDCl_3$): δ = 8.94 (s, 1H), 8.21 (s, 1H), 8.04 (d, J = 5.2 Hz, 1H), 7.87-7.84 (m, 2H), 7.45-7.42 (m, 2H), 6.89-6.87 (m, 1H), 2.39 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 164.6, 151.4, 150.1, 147.3, 138.5, 132.7, 129.0, 128.6, 121.2, 114.8, 21.3. MS (EI) m/z: 247, 217, 139, 111, 92, 75, 63, 51, 39, 28.



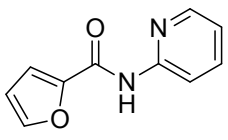
4-chloro-*N*-(4-methoxypyridin-2-yl)benzamide (4u)
Yield 83%; R_f = 0.33 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.24 (s, 1H), 8.01 (d, J = 2.4 Hz, 1H), 7.92 (d, J = 5.6 Hz, 1H), 7.87-7.84 (m, 2H), 7.45-7.41 (m, 2H), 6.59-6.57 (m, 1H), 3.89 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 1676, 164.9, 153.2, 148.3, 138.5, 132.6, 129.0, 128.7, 107.9, 99.0, 55.3. MS (EI) m/z: 263, 233, 206, 139, 111, 97, 83, 69, 45. Anal. Calcd for $C_{13}H_{11}ClN_2O_2$: C, 59.44; H, 4.22; N, 10.66; Found: C, 59.15; H, 4.31; N, 10.75.



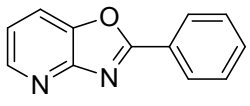
***N*-(5-chloropyridin-2-yl)-4-fluorobenzamide (4v)**
Yield 78%; R_f = 0.66 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.85 (s, 1H), 8.34 (d, J = 9.2 Hz, 1H), 8.13 (d, J = 2.0 Hz, 1H), 7.93-7.89 (m, 2H), 7.70-7.68 (m, 1H), 7.17-7.13 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.2 (d, J = 253.0 Hz), 164.5, 149.8, 146.4, 138.0, 130.1 (d, J = 3.0 Hz), 129.6 (d, J = 9.0 Hz), 126.9, 115.9 (d, J = 22.0 Hz), 114.8. MS (EI) m/z: 251, 221, 123, 95, 75, 64, 50, 44, 39, 28. Anal. Calcd for $C_{12}H_8ClFN_2O$: C, 57.50; H, 3.22; N, 11.18; Found: C, 57.26; H, 3.31; N, 11.29.



***N*-(pyridin-2-yl)picolinamide (4w)**[9]
Yield 48%; R_f = 0.40 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 10.52 (s, 1H), 8.61-8.60 (m, 1H), 8.40 (d, J = 8.0 Hz, 1H), 8.35-8.33 (m, 1H), 8.27-8.25 (m, 1H), 7.90-7.86 (m, 1H), 7.73 (t, J = 8.0 Hz, 1H), 7.48-7.44 (m, 1H), 7.06-7.03 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): 162.5, 151.1, 149.2, 148.1, 148.1, 138.1, 137.4, 126.6, 122.3, 119.7, 113.8. MS (EI) m/z: 199, 170, 121, 78, 51, 39, 28.

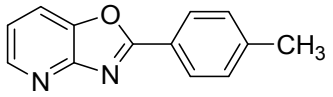


***N*-(pyridin-2-yl)furan-2-carboxamide (4x)**[14]
Yield 41%; R_f = 0.26 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.75 (s, 1H), 8.25 (d, J = 8.4 Hz, 2H), 7.67 (t, J = 8.0 Hz, 1H), 7.46 (s, 1H), 7.20 (d, J = 3.2 Hz, 1H), 7.00 (t, J = 5.6 Hz, 1H), 6.50 (t, J = 5.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): 156.1, 150.9, 148.0, 147.3, 144.6, 138.3, 119.9, 115.8, 114.1, 112.6. MS (EI) m/z: 188, 160, 134, 95, 79, 67, 51,39, 28.

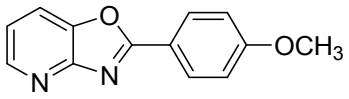


2-phenyloxazolo[4,5-b]pyridine (5a)[15]
Yield 77%; R_f = 0.36 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.58 (d, J = 3.6 Hz, 1H), 8.34-8.31 (m, 2H), 7.88-7.86 (m, 1H), 7.61-7.53 (m, 3H), 7.31-7.28 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ

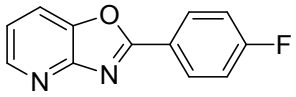
= 165.7, 156.4, 146.7, 143.1, 132.4, 129.0, 128.1, 126.5, 120.0, 118.0. MS (EI) m/z: 196, 167, 105, 93, 77, 65, 51, 39, 28.



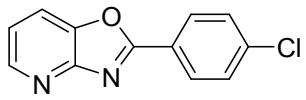
2-(*p*-tolyl)oxazolo[4,5-b]pyridine (5b)[15]
Yield 65%; R_f = 0.37 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.56 (d, J = 4.8 Hz, 1H), 8.21 (d, J = 8.0 Hz, 2H), 7.84 (d, J = 8.0 Hz, 1H), 7.35 (d, J = 8.0 Hz, 2H), 7.29-7.27 (m, 1H), 2.45 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.9, 156.5, 146.5, 143.1, 143.0, 129.7, 128.1, 123.7, 119.7, 117.9, 21.7. MS (EI) m/z: 210, 192, 164, 93, 77, 65, 51, 39, 28.



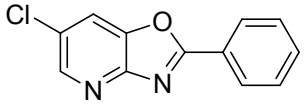
2-(4-methoxyphenyl)oxazolo[4,5-b]pyridine (5c)[15]
Yield 79%; R_f = 0.23 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.52-8.50 (m, 1H), 8.25-8.21 (m, 2H), 7.80-7.78 (m, 1H), 7.24-7.20 (m, 1H), 7.02-7.00 (m, 2H), 3.87 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.7, 163.0, 156.6, 146.3, 142.9, 129.9, 119.4, 118.8, 117.6, 114.4, 55.4. MS (EI) m/z: 226, 211, 183, 133, 93, 77, 65, 51, 38, 28.



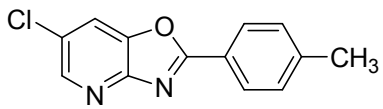
2-(4-fluorophenyl)oxazolo[4,5-b]pyridine (5d)[16]
Yield 58%; R_f = 0.32 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.51 (d, J = 4.4 Hz, 1H), 8.28-8.23 (m, 2H), 7.80-7.78 (m, 1H), 7.24-7.21 (m, 1H), 7.20-7.14 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.4 (d, J = 253.0 Hz), 164.8, 158.0, 146.8, 143.1, 130.4 (d, J = 9.0 Hz), 122.8 (d, J = 3.0 Hz), 120.0, 118.0, 116.4 (d, J = 22.0 Hz). MS (EI) m/z: 214, 172, 107, 93, 65, 38, 28.



2-(4-chlorophenyl)oxazolo[4,5-b]pyridine (5e)[15]
Yield 54%; R_f = 0.26 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.57 (d, J = 4.0 Hz, 1H), 8.24 (d, J = 8.4 Hz, 2H), 7.86 (d, J = 8.0 Hz, 1H), 7.52 (d, J = 8.4 Hz, 2H), 7.32-7.28 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 164.6, 156.2, 146.9, 143.1, 138.8, 129.4, 129.3, 124.9, 120.2, 118.1. MS (EI) m/z: 231, 93, 77, 65, 51, 38, 28.

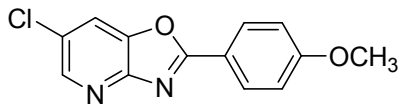


6-chloro-2-phenyloxazolo[4,5-b]pyridine (5f)
Yield 56%; R_f = 0.60 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.55 (d, J = 2.0 Hz, 1H), 8.32-8.29 (m, 2H), 7.89 (d, J = 2.0 Hz, 1H), 7.63-7.53 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 166.4, 154.9, 145.8, 142.9, 132.7, 129.1, 128.2, 128.0, 126.0, 118.4. MS (EI) m/z: 231, 127, 92, 77, 64, 51, 38, 28. Anal. Calcd for $C_{12}H_7ClN_2O$: C, 62.49; H, 3.06; N, 12.15; Found: C, 62.12; H, 3.14; N, 12.36.



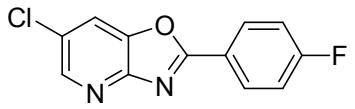
6-chloro-2-(*p*-tolyl)oxazolo[4,5-b]pyridine (5g)
Yield 75%; R_f = 0.62 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.52 (d, J = 2.0 Hz, 1H), 8.18-8.16 (m, 2H), 7.84 (d, J = 2.0 Hz, 1H), 7.34 (d, J = 8.0 Hz, 2H), 2.45 (s, 3H). ^{13}C

NMR (100 MHz, $CDCl_3$): δ = 166.7, 155.0, 145.6, 143.6, 142.8, 129.8, 128.1, 127.7, 123.3, 118.2, 21.7. MS (EI) m/z: 245, 217, 127, 92, 77, 64, 51, 39, 28. Anal. Calcd for $C_{13}H_9ClN_2O$: C, 63.81; H, 3.71; N, 11.45; Found: C, 63.57; H, 3.82; N, 11.58.



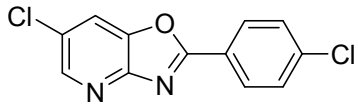
6-chloro-2-(4-methoxyphenyl)oxazolo[4,5-b]pyridine (5h)

Yield 78%; R_f = 0.44 (hexane/EtOAc, 2:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.49 (d, J = 2.0 Hz, 1H), 8.24-8.20 (m, 2H), 7.82 (d, J = 2.4 Hz, 1H), 7.05-7.01 (m, 2H), 3.90 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 166.6, 163.3, 155.2, 145.4, 142.8, 130.1, 127.3, 118.4, 118.0, 1145, 55.5. MS (EI) m/z: 261, 245, 217, 133, 92, 64, 51, 39, 28. Anal. Calcd for $C_{13}H_9ClN_2O_2$: C, 59.90; H, 3.48; N, 10.75; Found: C, 59.68; H, 3.56; N, 10.63.



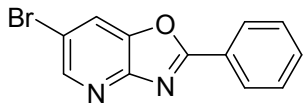
6-chloro-2-(4-fluorophenyl)oxazolo[4,5-b]pyridine (5i)

Yield 62%; R_f = 0.60 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.53 (d, J = 2.0 Hz, 1H), 8.32-8.27 (m, 2H), 7.87 (d, J = 2.0 Hz, 1H), 7.27-7.21 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.8 (d, J = 253.0 Hz), 165.5, 154.8, 145.8, 142.9, 130.5 (d, J = 9.0 Hz), 128.0, 122.4 (d, J = 3.0 Hz), 118.3, 116.5 (d, J = 23.0 Hz). MS (EI) m/z: 249, 205, 127, 92, 77, 64, 51. Anal. Calcd for $C_{12}H_6ClFN_2O$: C, 57.97; H, 2.43; N, 11.27; Found: C, 57.73; H, 2.52; N, 11.10.



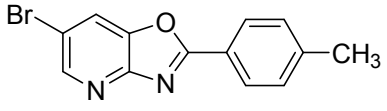
6-chloro-2-(4-chlorophenyl)oxazolo[4,5-b]pyridine (5j)

Yield 58%; R_f = 0.64 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.54 (d, J = 2.0 Hz, 1H), 8.23-8.20 (m, 2H), 7.88 (d, J = 2.0 Hz, 1H), 7.54-7.51 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.4, 154.7, 146.0, 142.9, 139.2, 129.5, 129.4, 128.2, 124.5, 118.4. MS (EI) m/z: 265, 189, 127, 92, 77, 64, 51, 39, 28. Anal. Calcd for $C_{12}H_6Cl_2N_2O$: C, 54.37; H, 2.28; N, 10.57; Found: C, 54.12; H, 2.41; N, 10.42.



6-bromo-2-phenyloxazolo[4,5-b]pyridine (5k)[17]

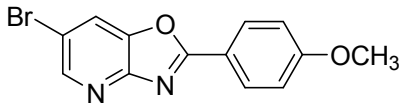
Yield 60%; R_f = 0.59 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.63 (d, J = 2.0 Hz, 1H), 8.30-8.28 (m, 2H), 8.02 (d, J = 2.0 Hz, 1H), 7.62-7.52 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 166.2, 155.2, 147.8, 143.3, 132.7, 129.1, 128.2, 126.0, 121.0, 115.7. MS (EI) m/z: 275, 171, 138, 92, 77, 64, 51, 38, 26.



6-bromo-2-(*p*-tolyl)oxazolo[4,5-b]pyridine (5l)

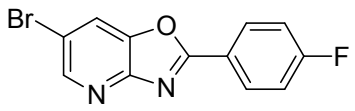
Yield 53%; R_f = 0.61 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.61 (d, J = 2.0 Hz, 1H), 8.18 (d, J = 8.4 Hz, 2H), 8.00 (d, J = 2.0 Hz, 1H), 7.35 (d, J = 8.0 Hz, 2H), 2.45 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 166.5, 155.3, 147.6, 143.6, 143.2, 129.8, 128.2, 123.2, 120.9, 115.4, 21.7. MS (EI) m/z: 89, 173, 168, 105, 92, 77, 64, 51. Anal. Calcd

for $C_{13}H_9BrN_2O$: C, 54.00; H, 3.14; N, 9.69; Found: C, 53.79; H, 3.25; N, 9.83.



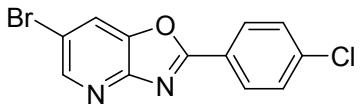
6-bromo-2-(4-methoxyphenyl)oxazolo[4,5-b]pyridine (5m)

Yield 62%; R_f = 0.38 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.59 (d, J = 2.0 Hz, 1H), 8.23 (d, J = 8.8 Hz, 2H), 7.97 (d, J = 2.0 Hz, 1H), 7.04 (d, J = 8.8 Hz, 2H), 3.90 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 166.4, 163.4, 155.5, 147.4, 143.2, 130.1, 120.7, 118.4, 115.0, 114.6, 55.5. MS (EI) m/z: 305, 289, 276, 241, 133, 92, 77, 64, 51, 38, 28. Anal. Calcd for $C_{13}H_9BrN_2O_2$: C, 51.17; H, 2.97; N, 9.18; Found: C, 51.01; H, 3.08; N, 9.34.



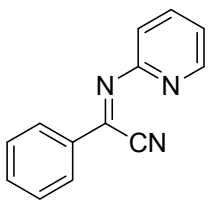
6-bromo-2-(4-fluorophenyl)oxazolo[4,5-b]pyridine (5n)

Yield 56%; R_f = 0.70 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.63 (d, J = 2.0 Hz, 1H), 8.33-8.28 (m, 2H), 8.02 (d, J = 2.0 Hz, 1H), 7.27-7.21 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.6 9 (d, J =254.0 Hz), 165.3, 155.1, 147.9, 143.3, 130.6 (d, J = 9.0 Hz), 122.4 (d, J = 3.0 Hz), 121.0, 116.5 (d, J = 23.0 Hz), 115.7. MS (EI) m/z: 293, 236, 207, 169, 92, 77, 64, 43, 28. Anal. Calcd for $C_{12}H_6BrFN_2O$: C, 49.18; H, 2.06; N, 9.56; Found: C, 49.37; H, 2.12; N, 9.32.



6-bromo-2-(4-chlorophenyl)oxazolo[4,5-b]pyridine (5o)

Yield 48%; R_f = 0.71 (hexane/EtOAc, 4:1); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.64 (d, J = 2.0 Hz, 1H), 8.24-8.22 (m, 2H), 8.03 (d, J = 2.0 Hz, 1H), 7.56-7.52 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 165.2, 155.0, 148.0, 143.3, 139.2, 129.5, 129.4, 124.4,121.2, 115.9. MS (EI) m/z: 310, 267, 171, 145, 92, 64, 50, 43, 38, 28. Anal. Calcd for $C_{12}H_6BrClN_2O$: C, 46.56; H, 1.95; N, 9.05; Found: C, 46.24; H, 2.04; N, 9.20.



(Z)-*N*-(pyridin-2-yl)benzimidoyl cyanide (F)[18]

^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.61-8.59 (m, 1H), 8.24-8.21 (m, 2H), 7.86-7.82 (m, 1H), 7.64-7.59 (m, 1H), 7.56-7.52 (m, 2H), 7.30-7.26 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ = 159.2, 148.9, 141.1, 138.2, 133.6, 133.3, 129.0, 128.7, 122.9, 118.3, 111.4. MS (EI) m/z: 206, 181, 154, 127, 104, 78, 63, 51, 28.

D. Reference

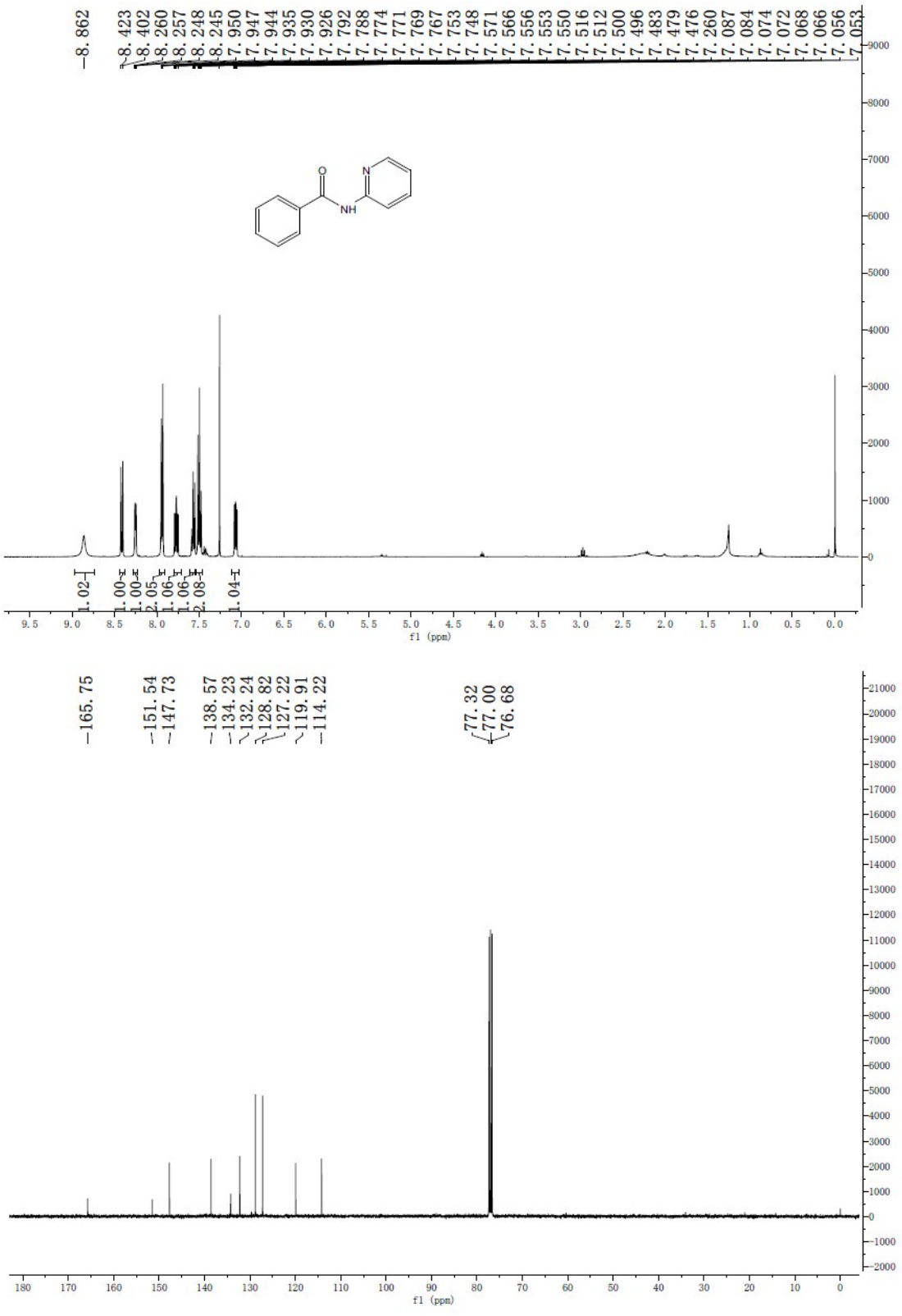
[1] A. Ragupathi, A. Sagadevan, C.-C. Lin, J.-R. Hwu and K. C. Hwang, *Chem. Commun*., 2016, **52**, 11756.

[2] O. P. S. Patel, D. Anand, R. K. Maurya and P. P. Yadav, *Green Chem*., 2015, **17**,

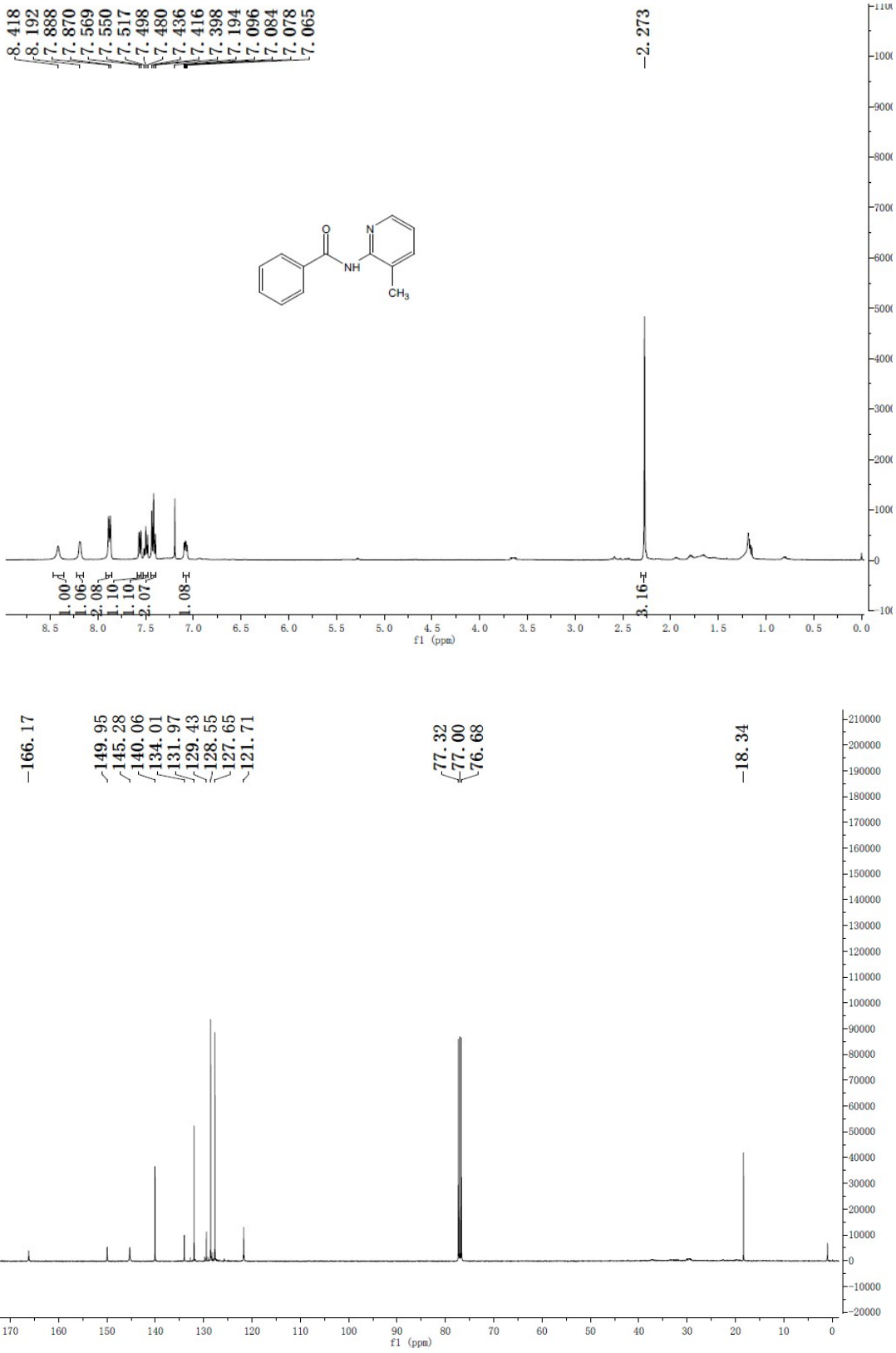
3728.
[3] L. H. Heitman, J. P. D. Veldhoven, A. M. Zwemer, K. Ye, J. Brussee and A. P. Ijzerman, *J. Med. Chem*., 2008, **51**, 4724.
[4] T. J. Broxton, L. W. Deady and Y.-T. Pang, *J. Am. Chem. Soc*., 1977, **99**, 2268.
[5] R. Fu, Y. Yang, W. Jin, H. Gu, X. Zeng, W. Chai, Y. Ma, Q. Wang, J. Yi and R. Yuan, *RSC Adv*., 2016, **6**, 107699
[6] H.-P. Hsieh and L. W. McLaughlin, *J. Org. Chem*., 1995, **60**, 5356.
[7] K. Yan, D. Yang, W. Wei, G. Li, M. Sun, Q. Zhang, L. Tian and H. Wang, *RSC Adv*., 2015, **5**, 100102.
[8] W. Dai, Y. Liu, T. Tong, X. Li and F. Luo, *Cuihua Xuebao*, 2014, **35**, 1012.
[9] E. S. Devi, A. Alanthadka, A. Tamilselvi, S. Nagarajan, V. Sridharan and C. U. Maheswari, *Org. Biomol. Chem*., 2016, **14**, 8228
[10] T. Yamamori, K. Nagata, N. Ishizuka and K. Sakai, Appl, 2004, US 20040235888.
[11] M. Malesevic, L. Zivanovic, A. Protic and Z. Jovic, *Chromatographia*, 2011, **74**, 197.
[12] A. Begouin and M.-J. R. P. Queiroz, *E. J. Org. Chem*., 2009, 2820.
[13]S. George and P. Shanmugapandiyan, *Int. J. ChemTech Res*., 2013, **5**, 2603.
[14] S. Kanama and C. David, *Org. Lett*., 2011, **13**, 2256.
[15] F. A. Zhuravlev, *Tetrahedron Lett*., 2006, **47**, 2929.
[16] D. Chen, Y. Wang, Y. Ma, B. Xiong, J. Ai, Y. Chen, M. Geng and J. Shen, *ChemmedChem*, 2012, **7**, 1057.
[17] V. Marie-Claude, J. Patricia, B. Marie-Laure, S. Laurence and G. Gerald. *Tetrahedron*, 1997, **53**, 5159.
[18] Kalbandhe, A. H.; Kavale, A. C.; Karade, N. N. *Eur. J. Org. Chem.* **2017**, 1318.

E. NMR Spectra

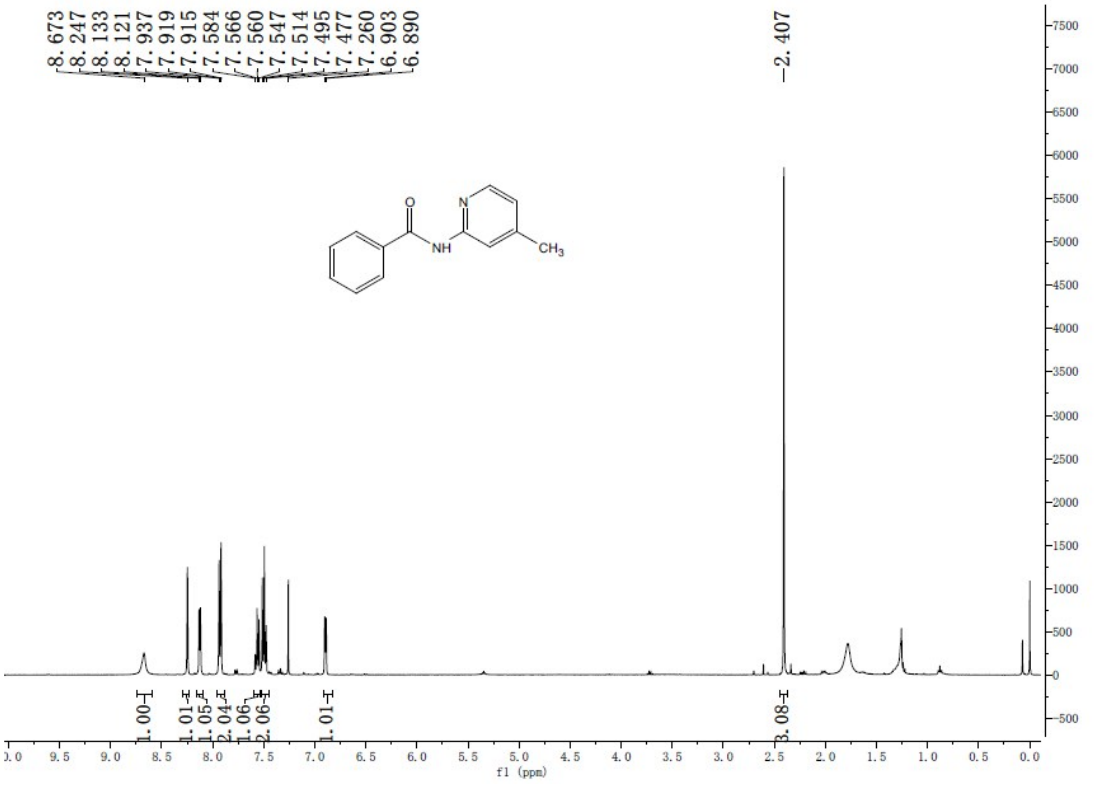
^{1}H NMR and ^{13}C NMR of *N*-(pyridin-2-yl)benzamide (3a)

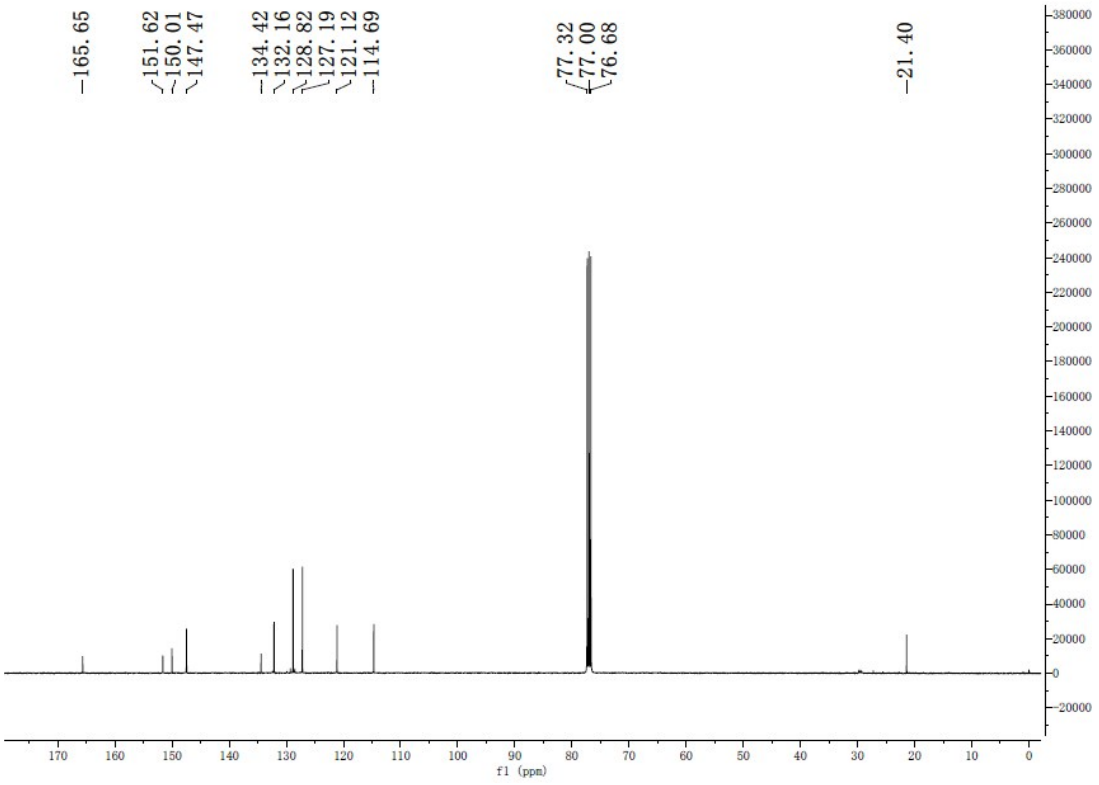


^{1}H NMR and ^{13}C NMR of *N*-(3-methylpyridin-2-yl)benzamide (3b)

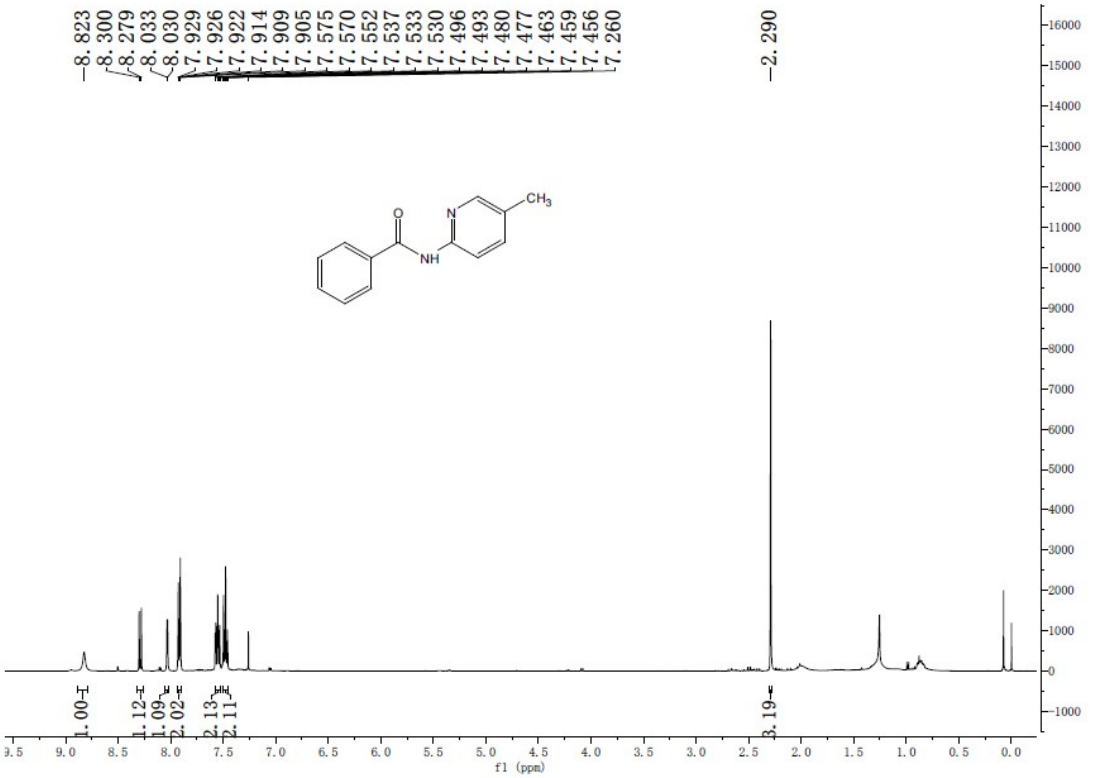


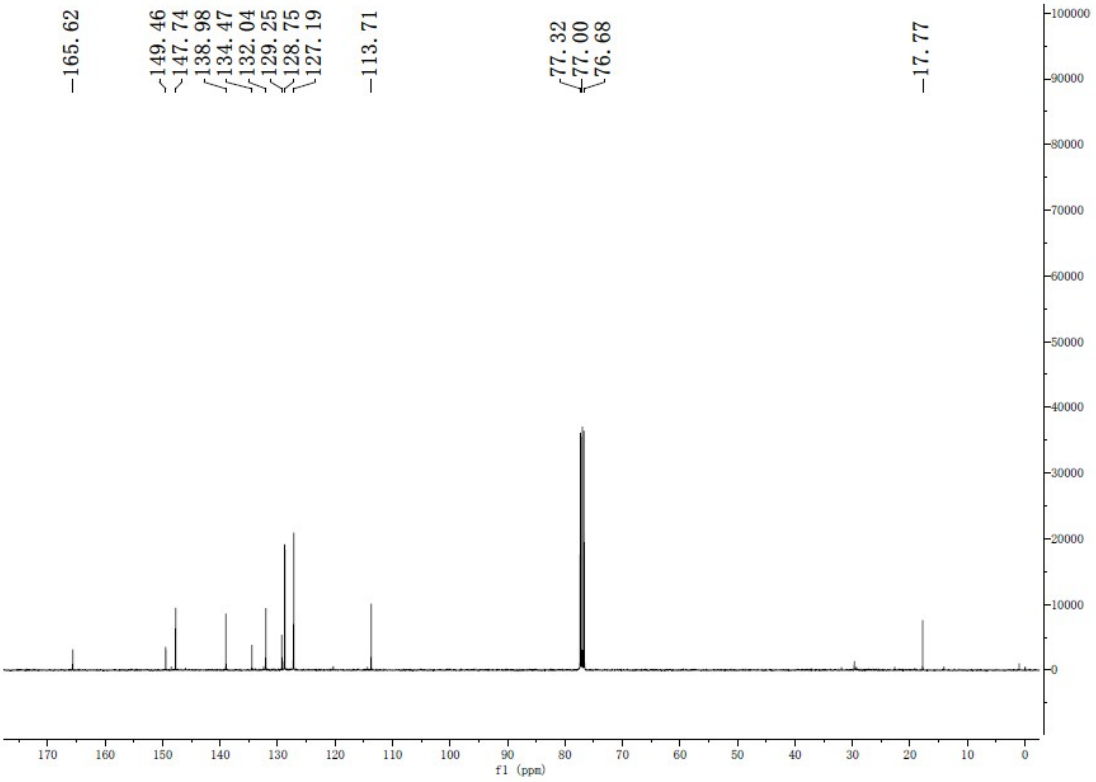
^{1}H NMR and ^{13}C NMR of *N*-(4-methylpyridin-2-yl)benzamide (3c)



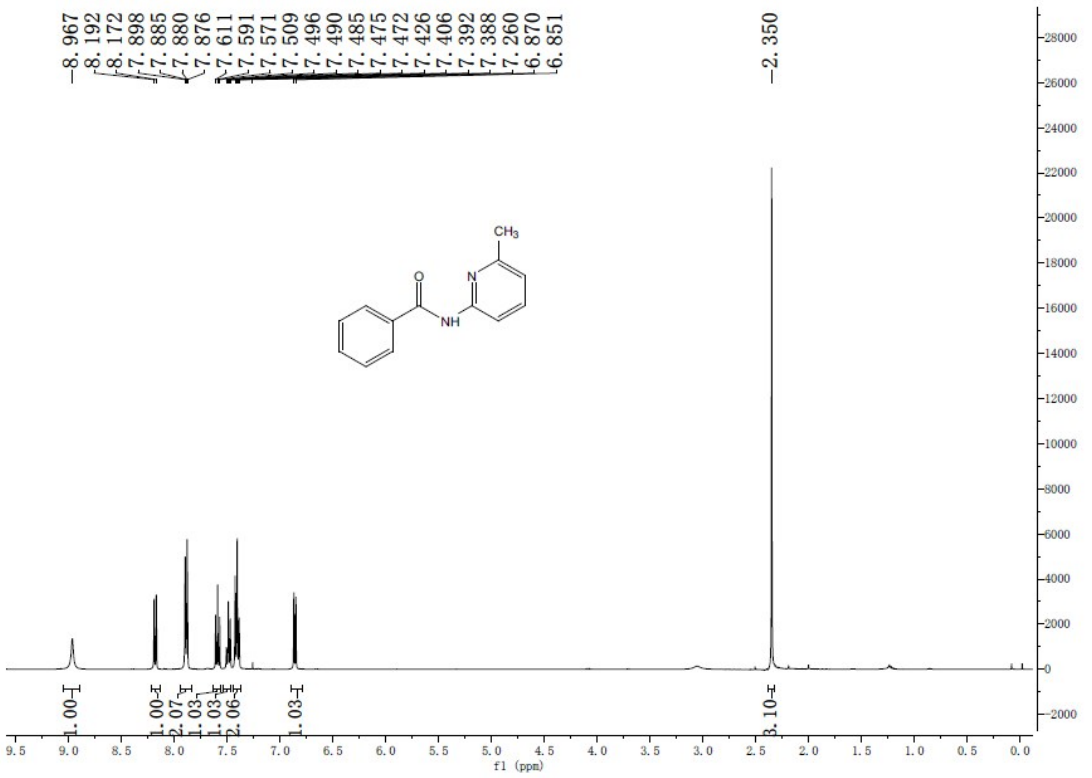


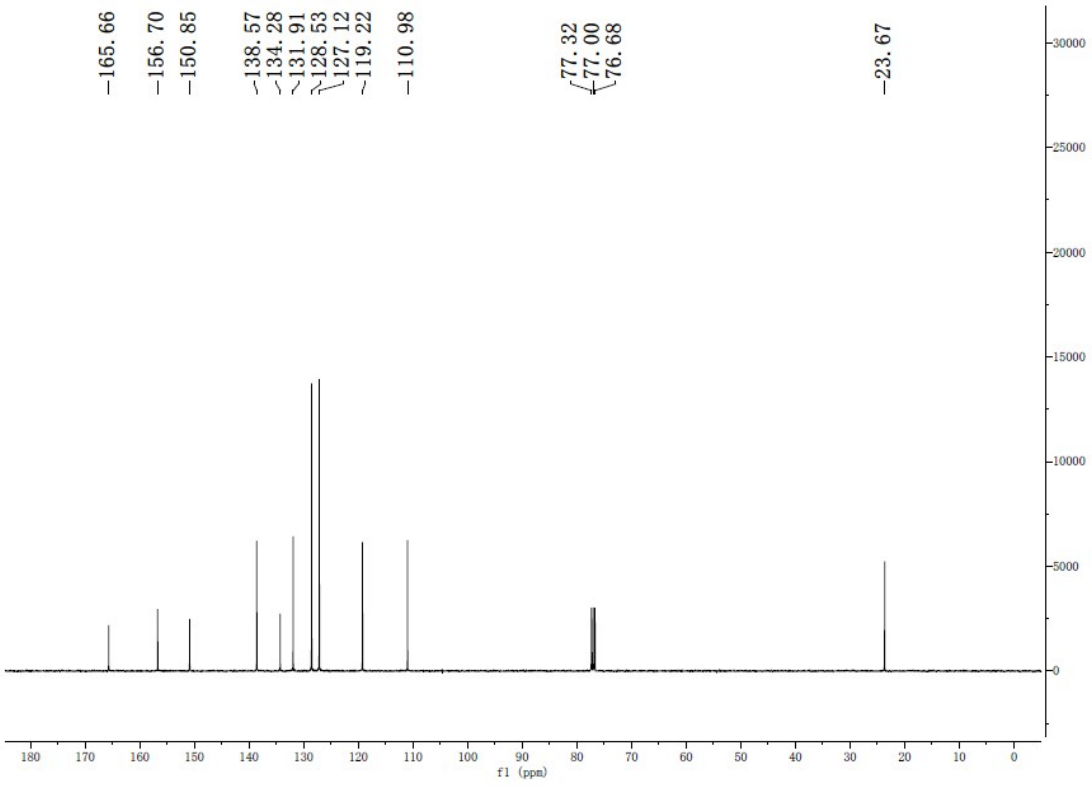
^{1}H NMR and ^{13}C NMR of *N*-(5-methylpyridin-2-yl)benzamide (3d)



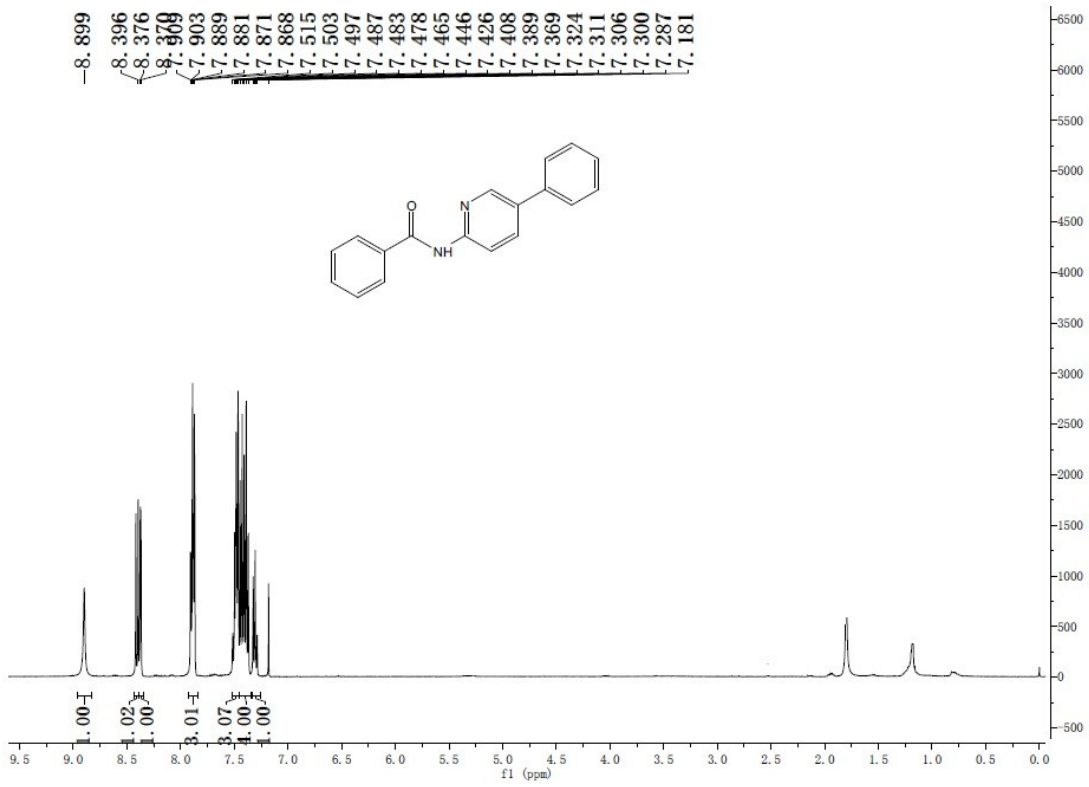


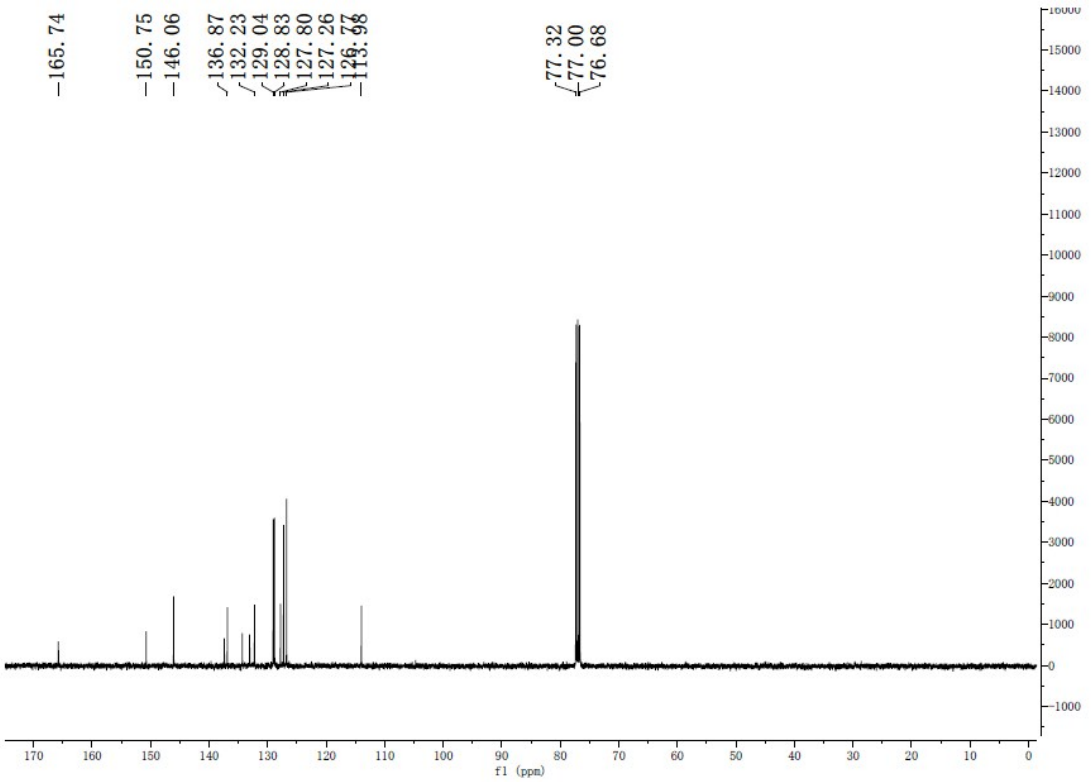
^{1}H NMR and ^{13}C NMR of *N*-(6-methylpyridin-2-yl)benzamide (3e)





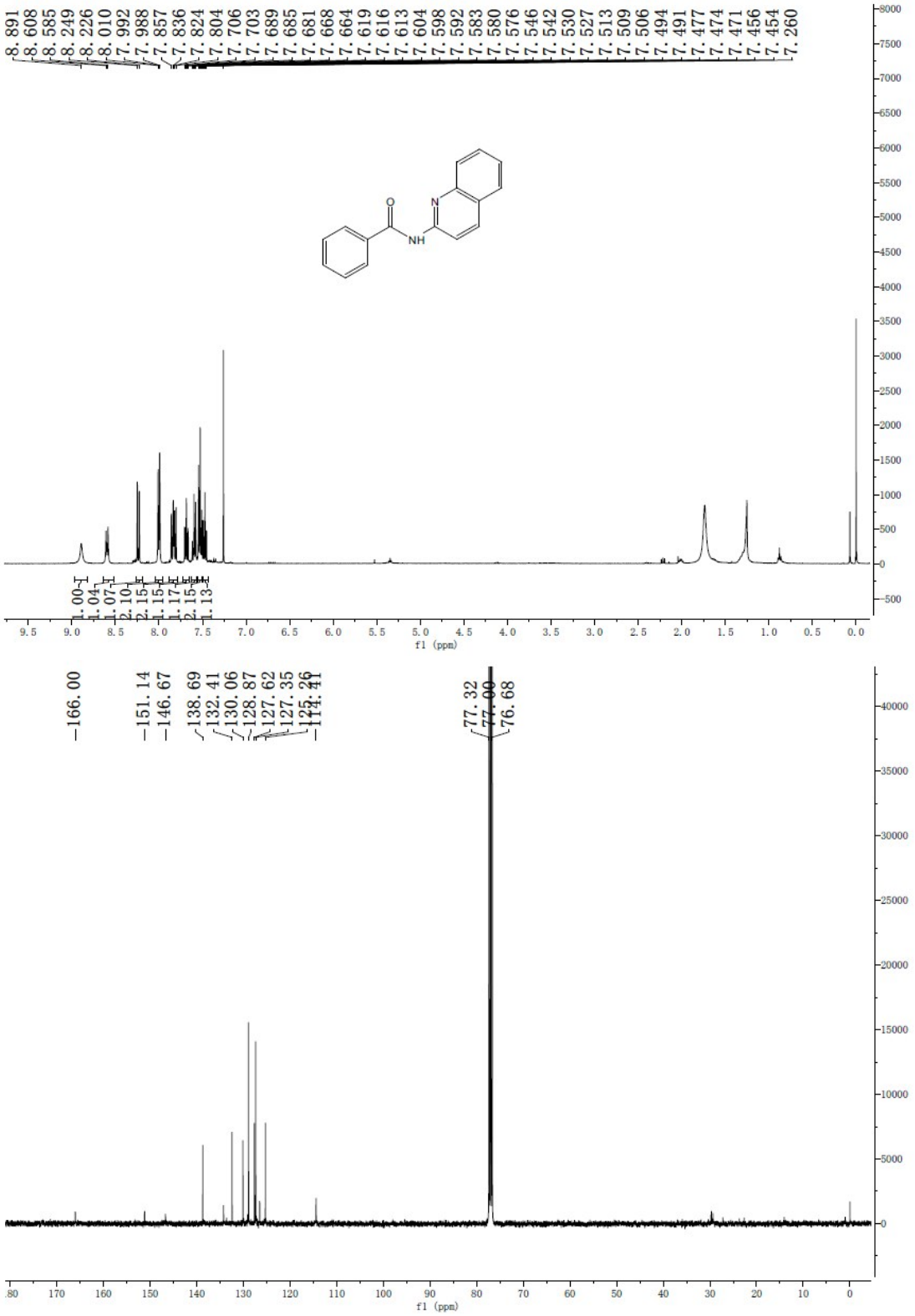
^{1}H NMR and ^{13}C NMR of *N*-(5-phenylpyridin-2-yl)benzamide (3f)



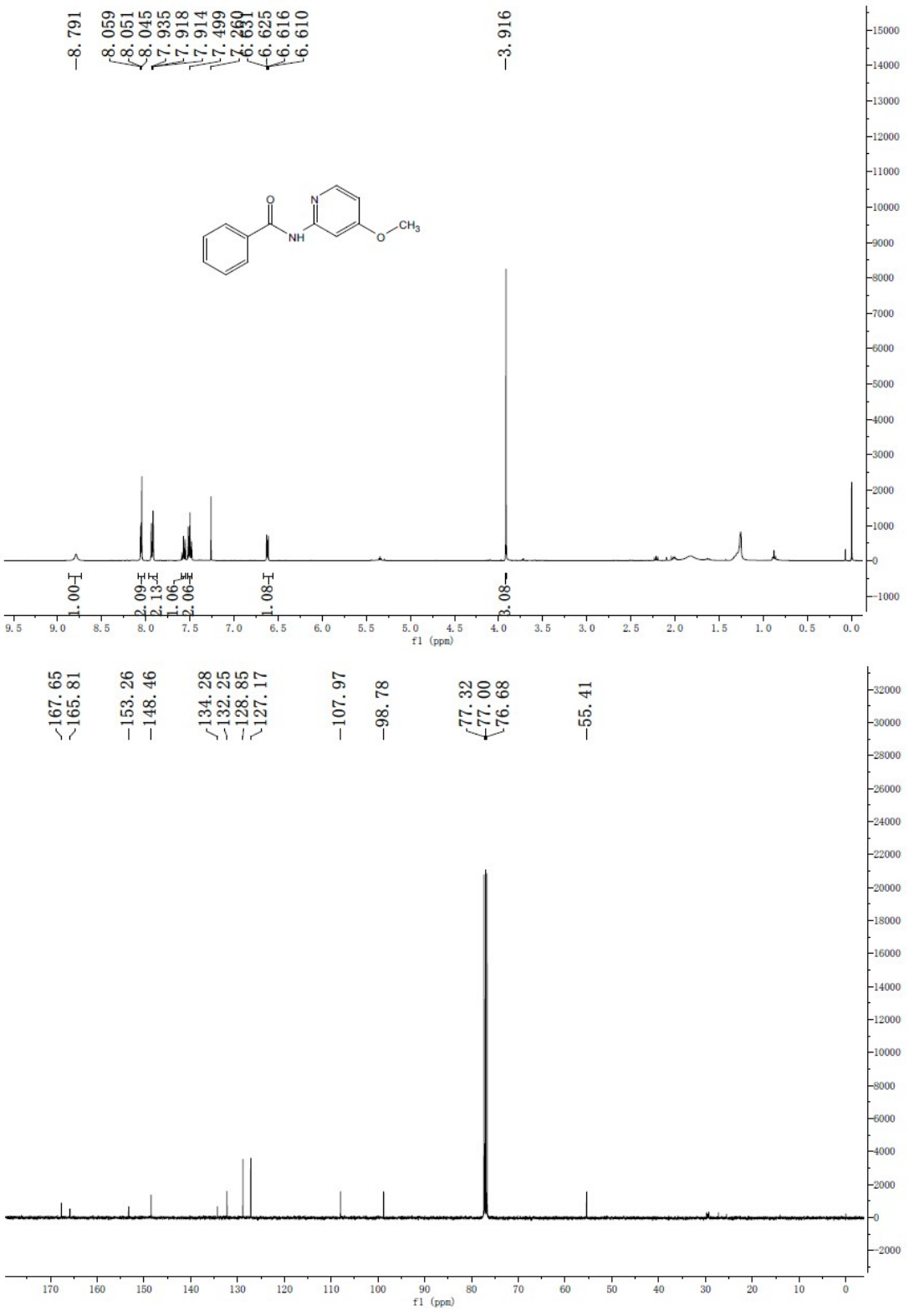


^{1}H NMR and ^{13}C NMR of

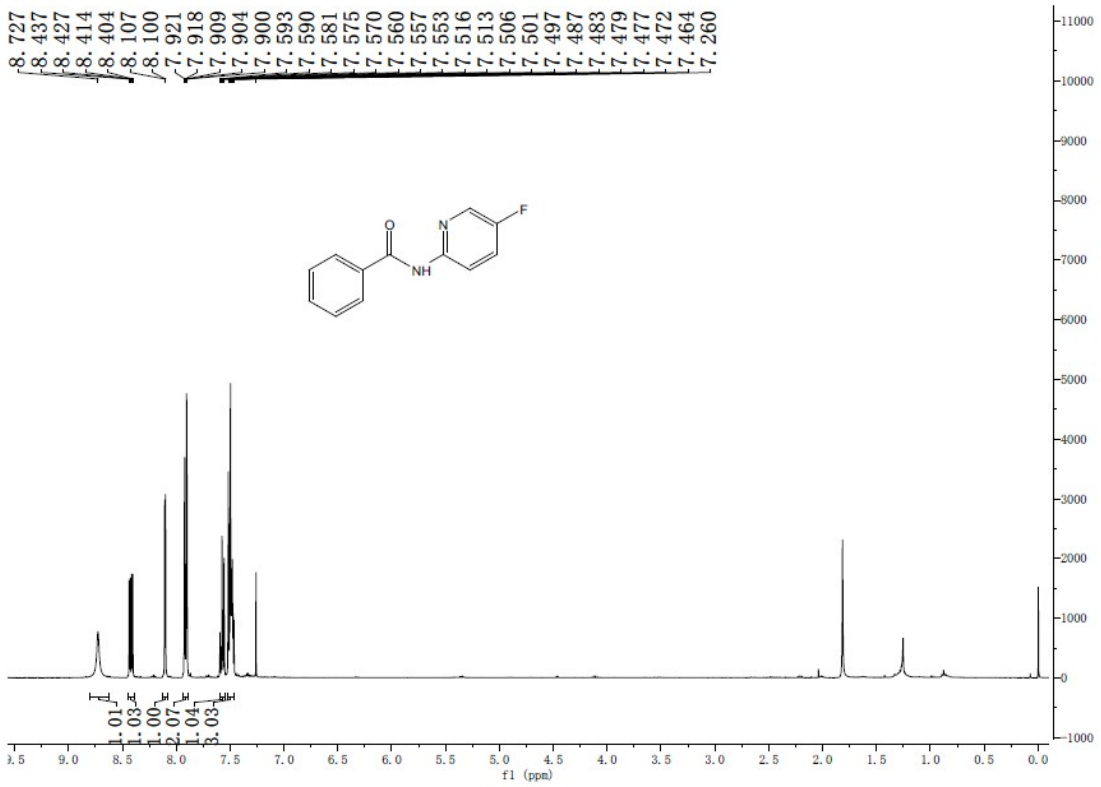
^{1}H NMR and ^{13}C NMR of *N*-(quinolin-2-yl)benzamide (3g)

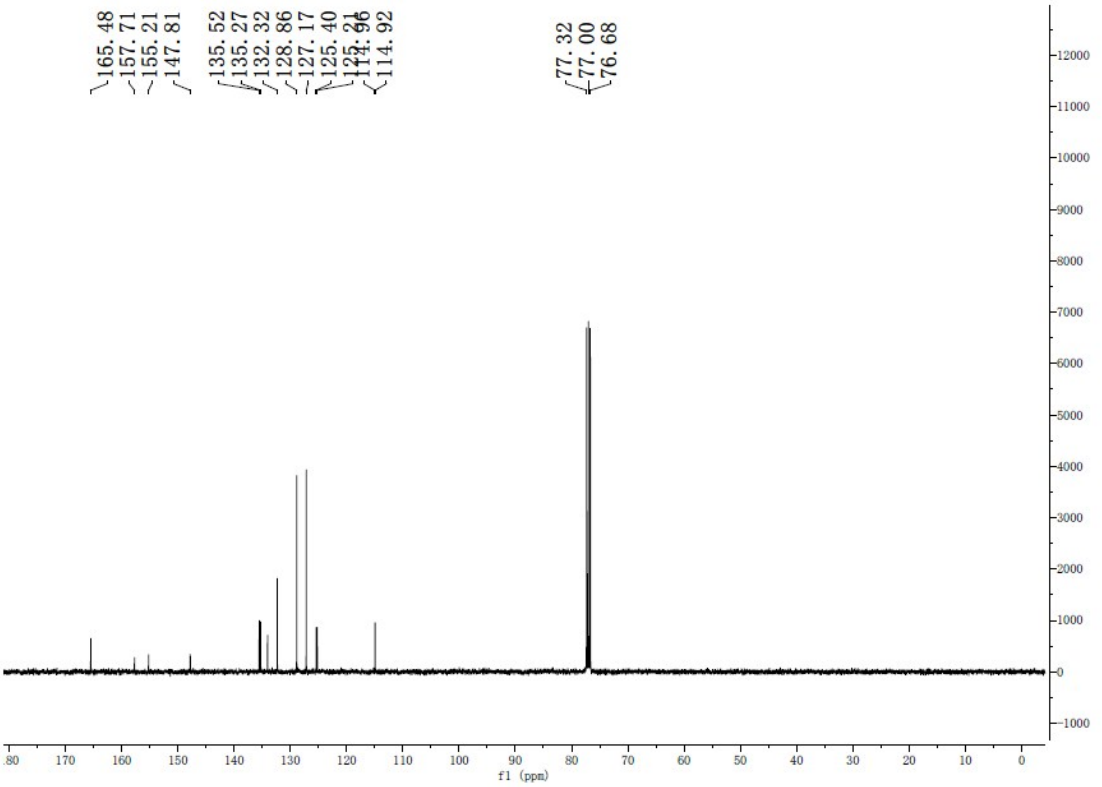


^{1}H NMR and ^{13}C NMR of *N*-(4-methoxypyridin-2-yl)benzamide (3h)

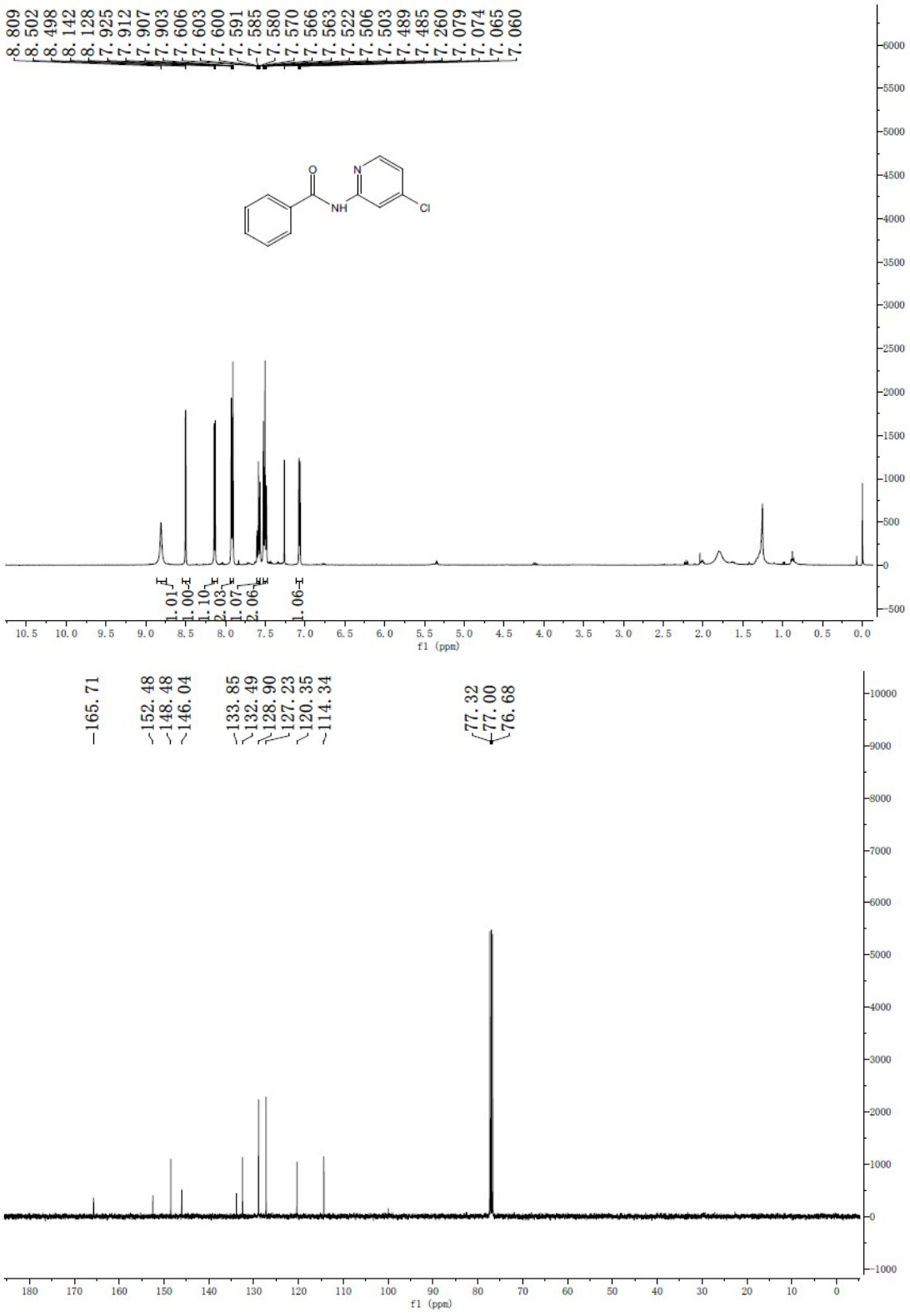


^{1}H NMR and ^{13}C NMR of *N*-(5-fluoropyridin-2-yl)benzamide (3i)

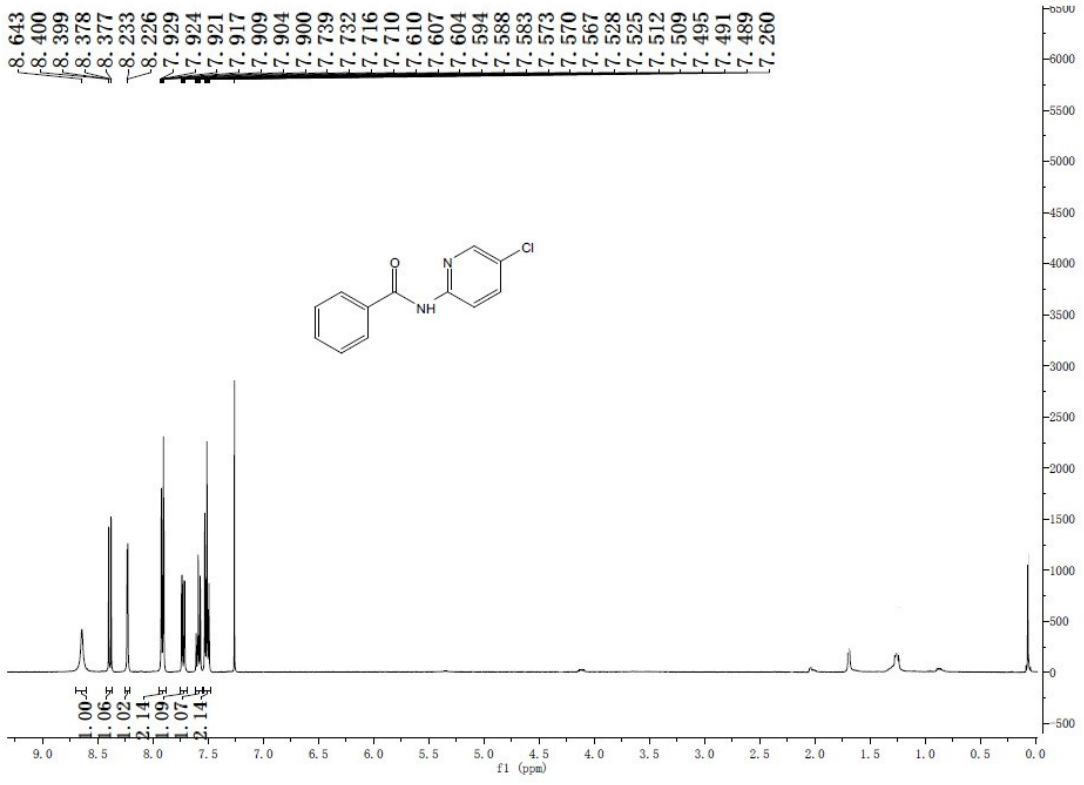


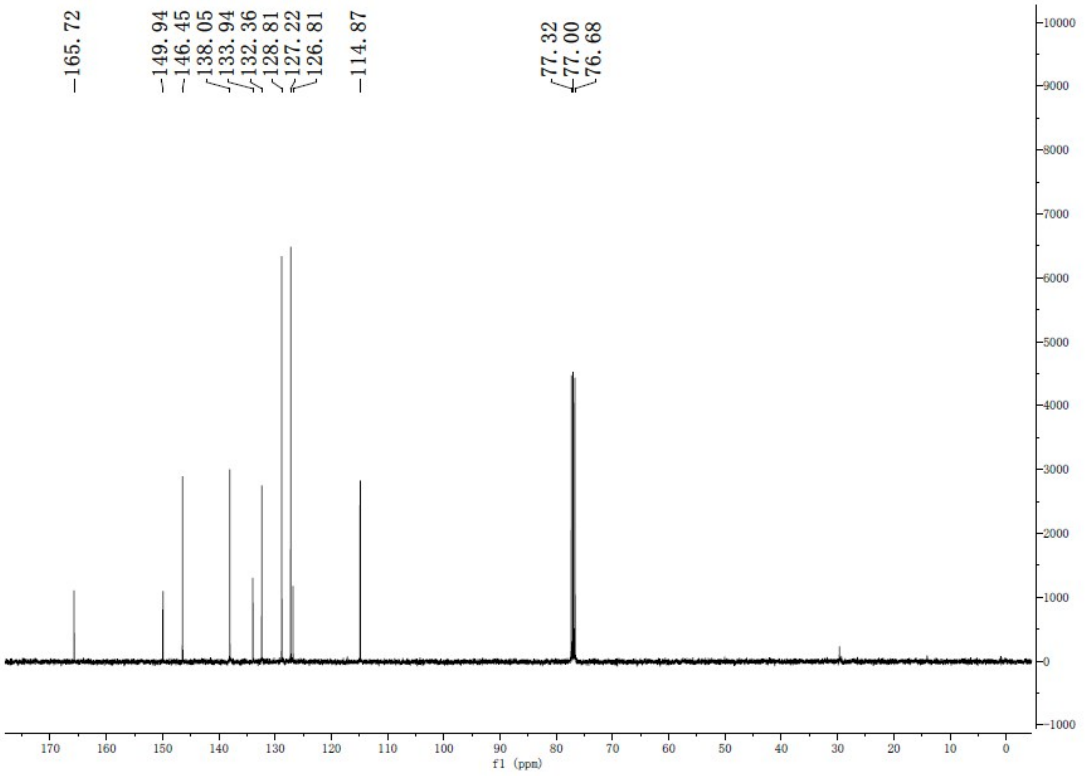


^{1}H NMR and ^{13}C NMR of *N*-(4-chloropyridin-2-yl)benzamide (3j)

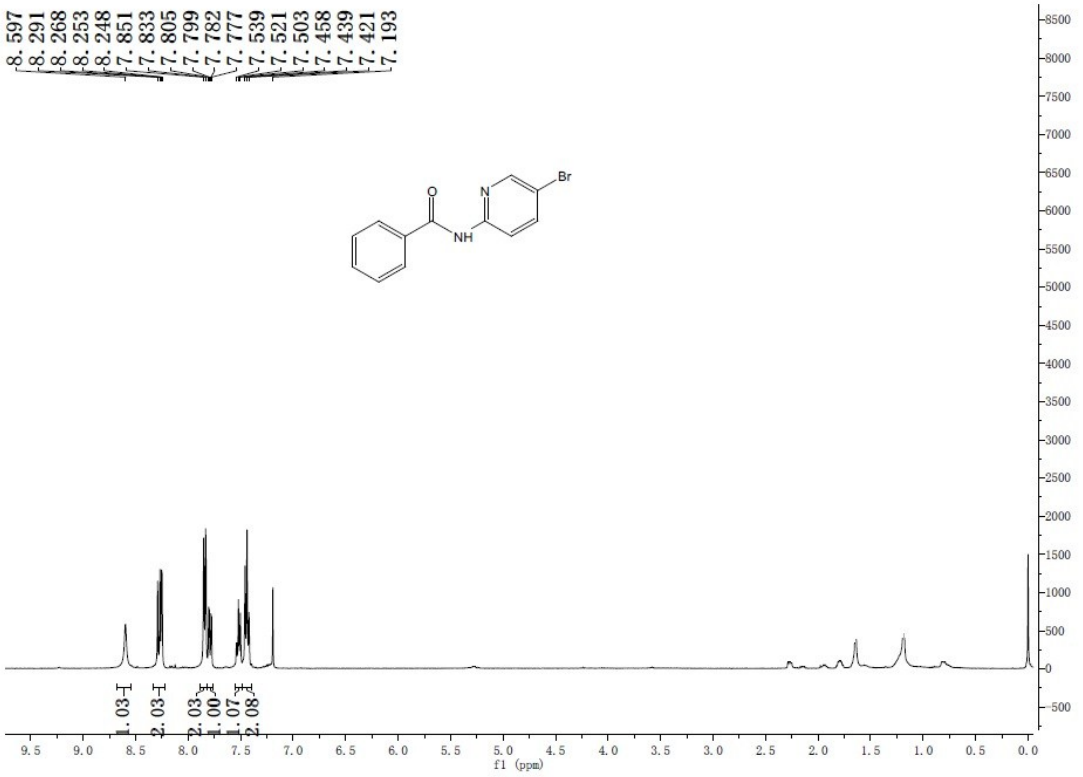


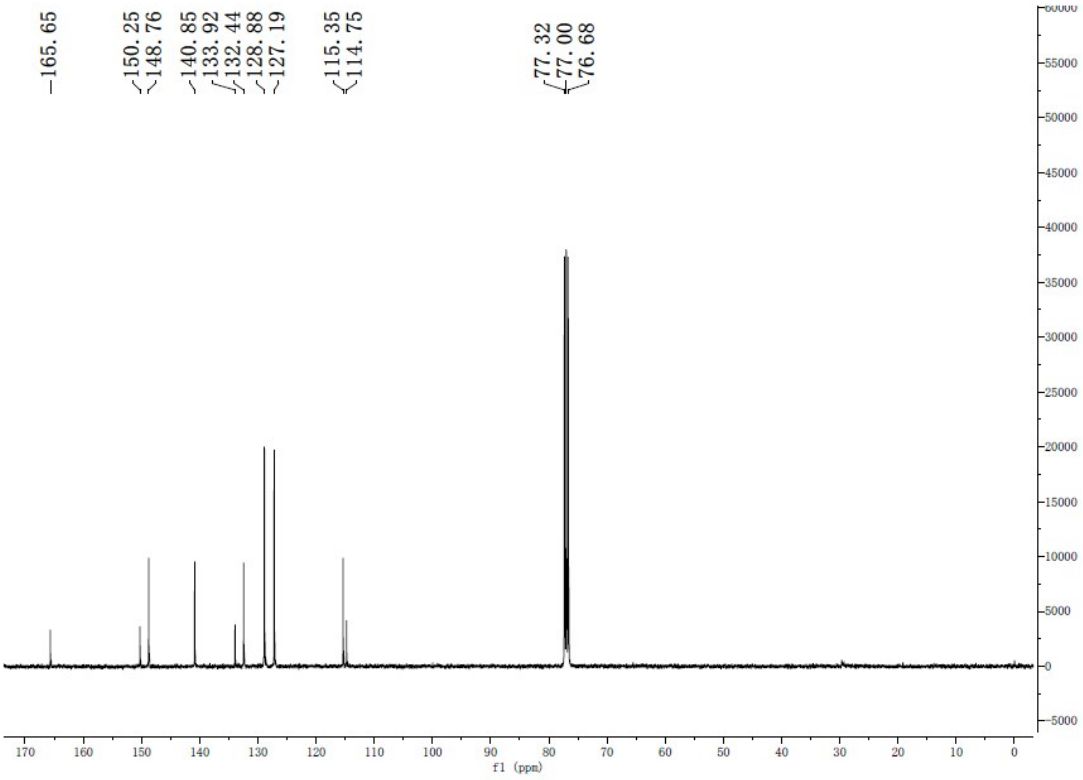
^{1}H NMR and ^{13}C NMR of *N*-(5-chloropyridin-2-yl)benzamide (3k)



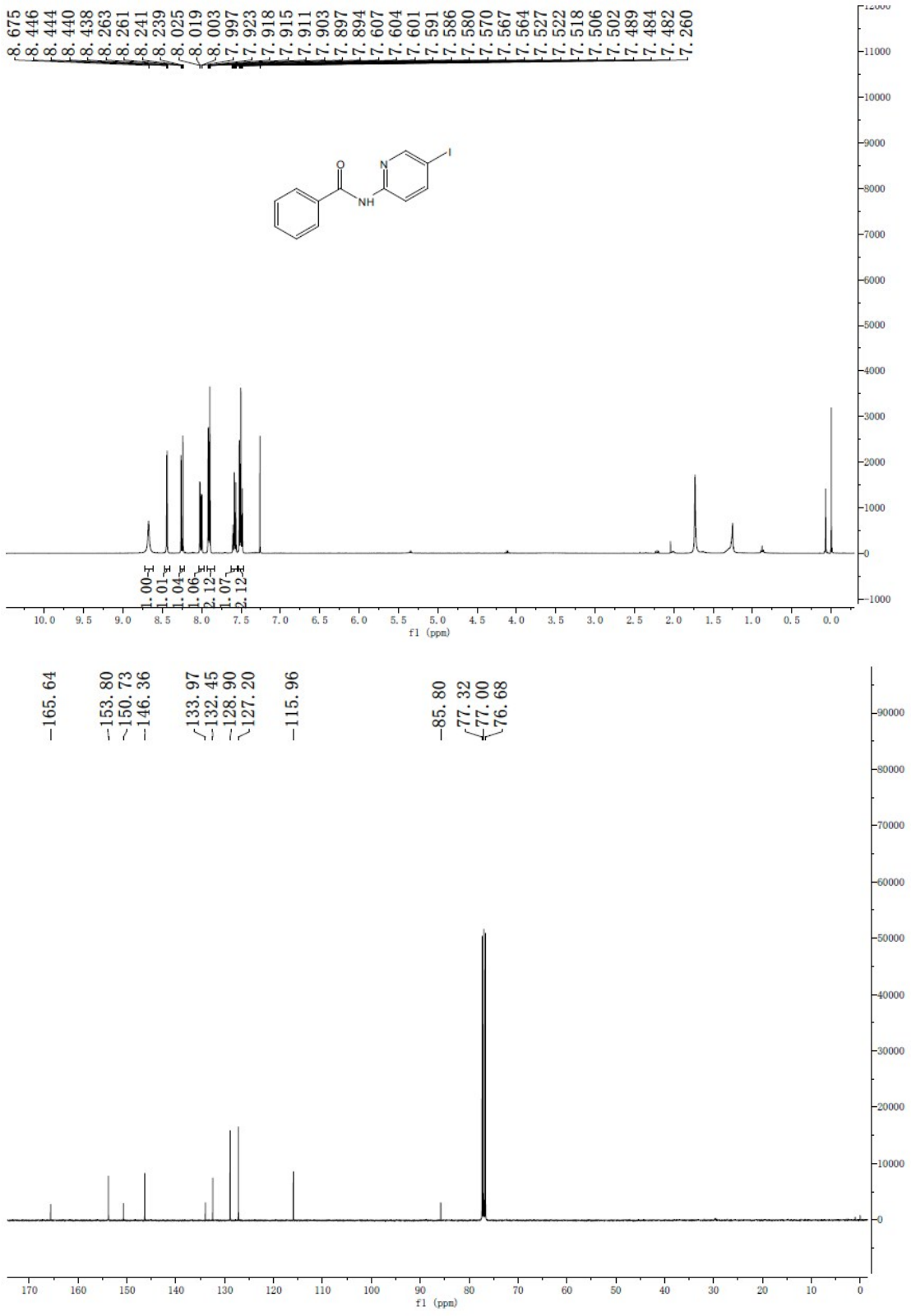


^{1}H NMR and ^{13}C NMR of *N*-(5-bromopyridin-2-yl)benzamide (3l)

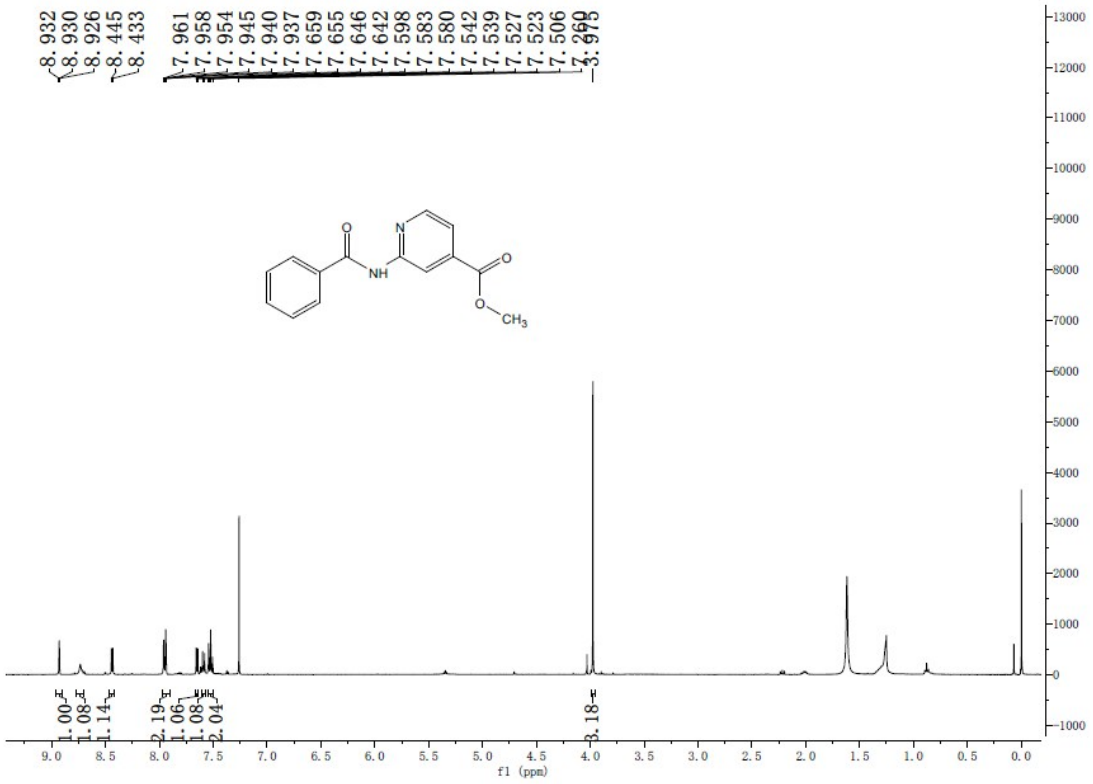


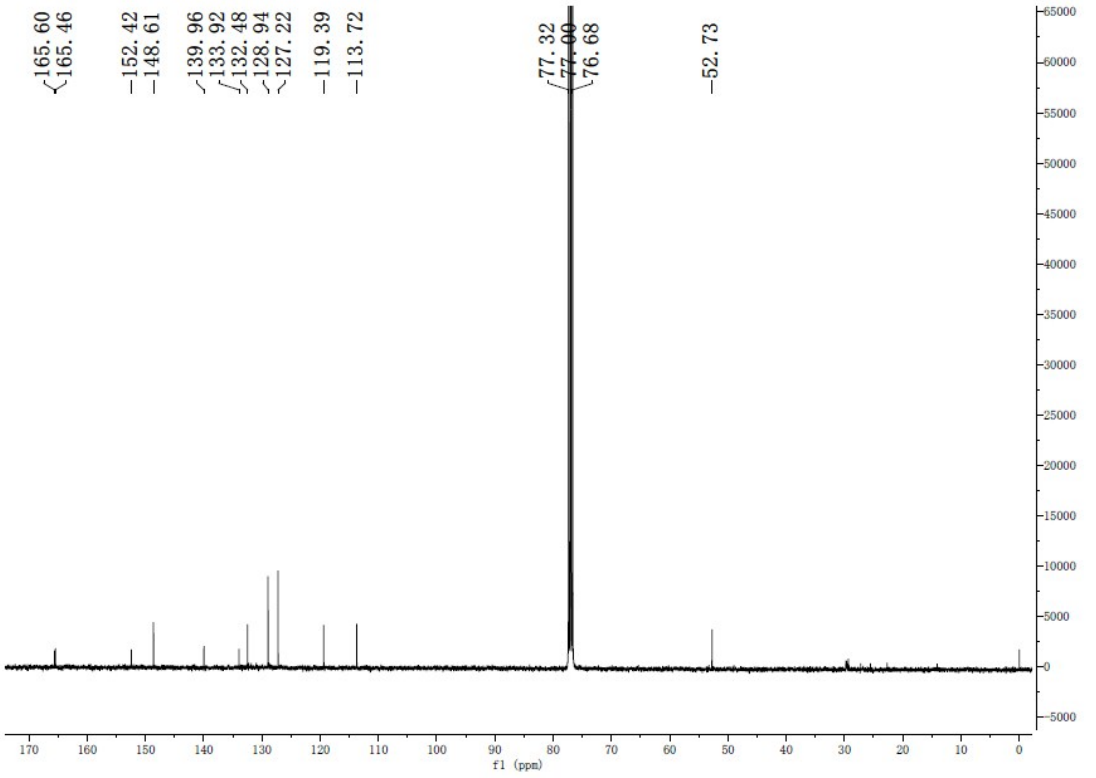


^{1}H NMR and ^{13}C NMR of *N*-(5-iodopyridin-2-yl)benzamide (3m)

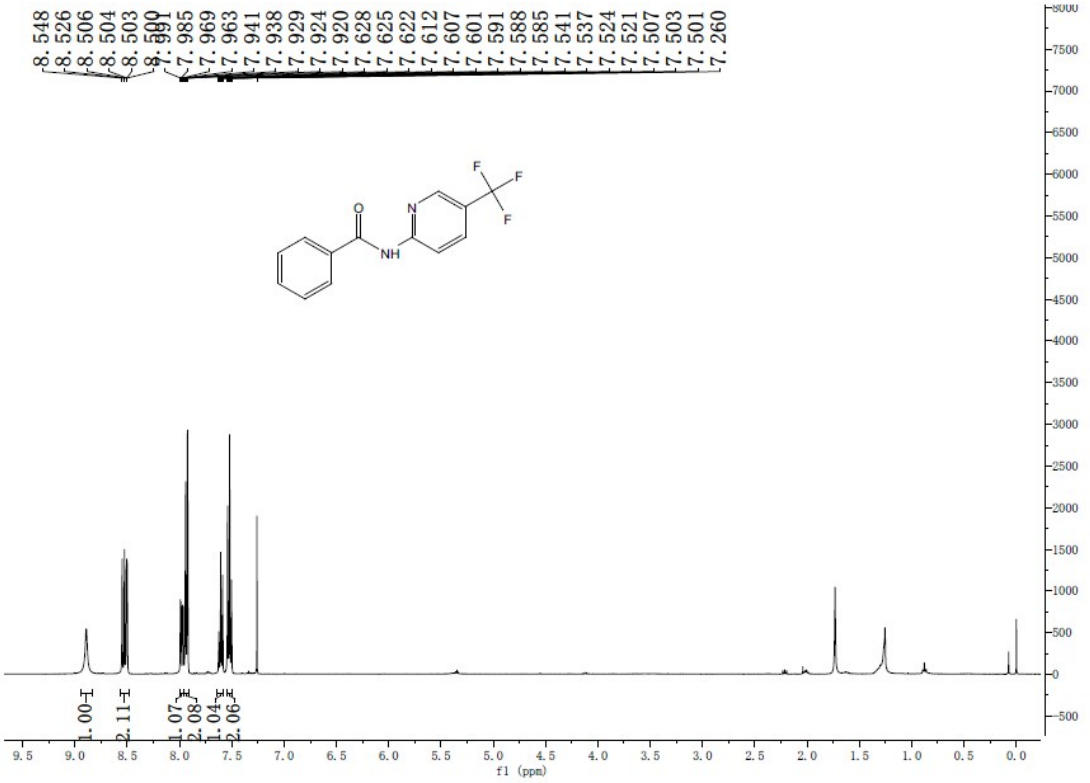


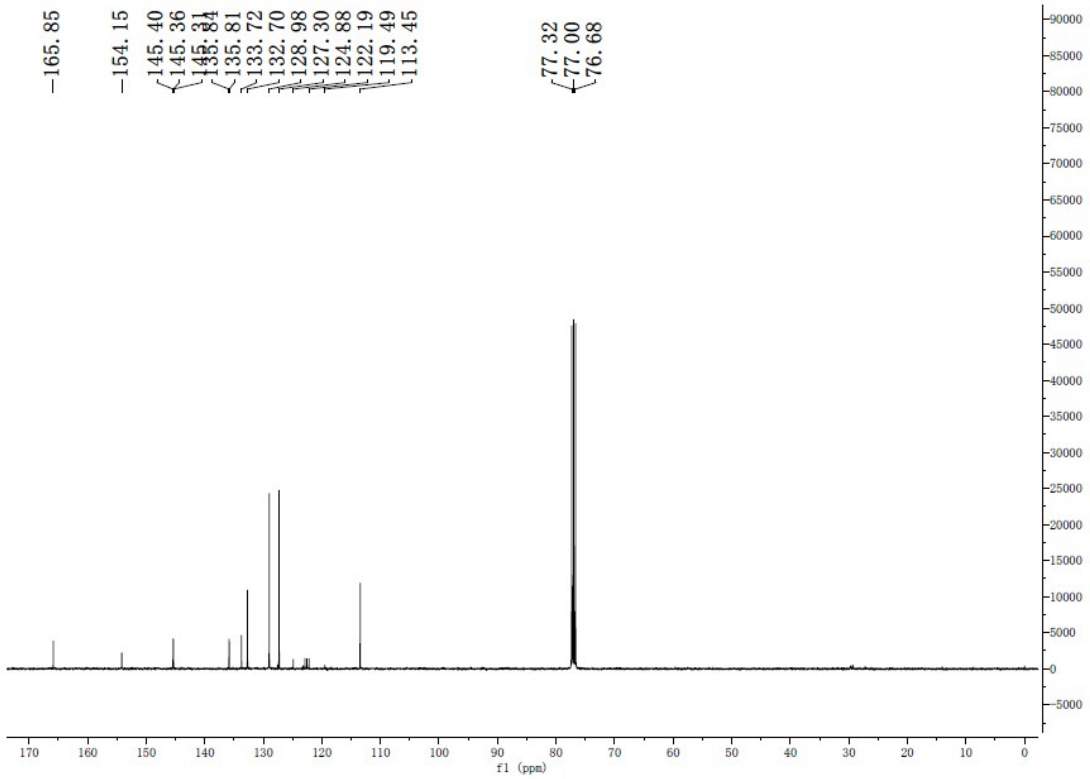
^{1}H NMR and ^{13}C NMR of methyl 2-benzamidoisonicotinate (3n)


8.932
8.930
8.926
8.445
8.433
7.961
7.958
7.954
7.945
7.940
7.937
7.659
7.655
7.646
7.642
7.598
7.583
7.580
7.542
7.539
7.527
7.523
7.506
3.975
O
N
NH
O
O
CH3
1.00
1.08
1.14
2.19
1.06
1.08
2.04
3.18
f1 (ppm)

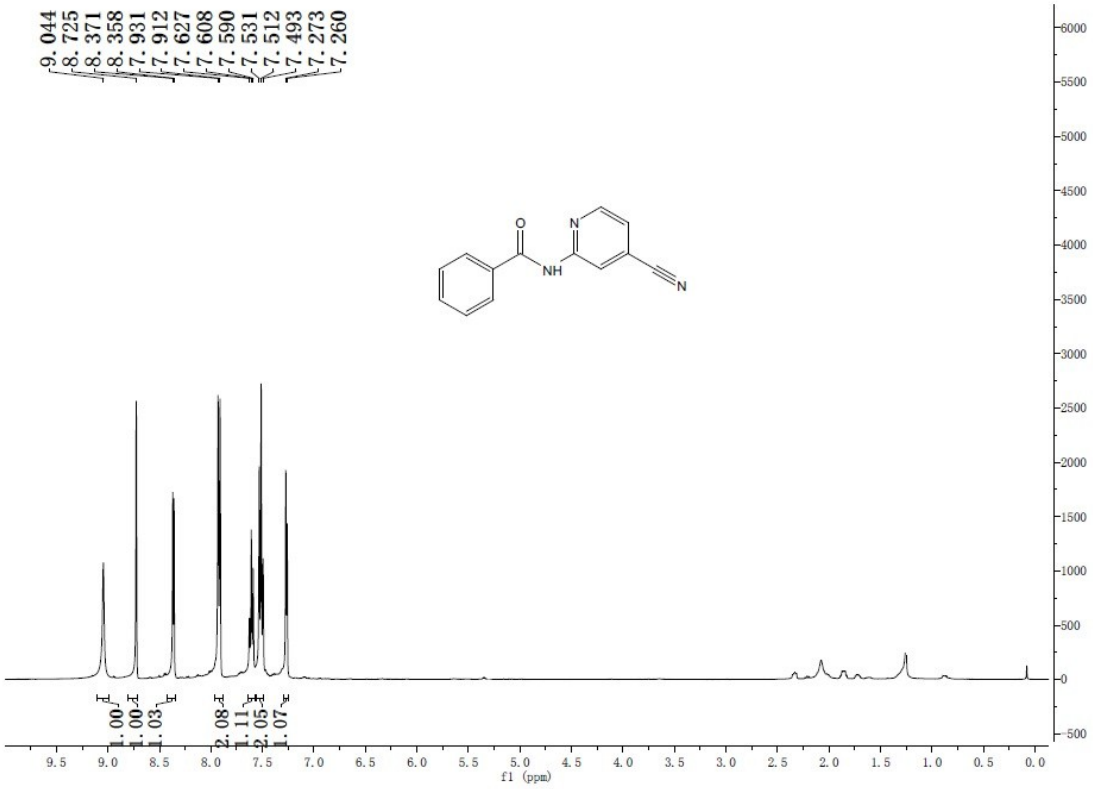

165.60
165.46
152.42
148.61
139.96
133.92
132.48
128.94
127.22
119.39
113.72
77.32
77.00
76.68
52.73
f1 (ppm)

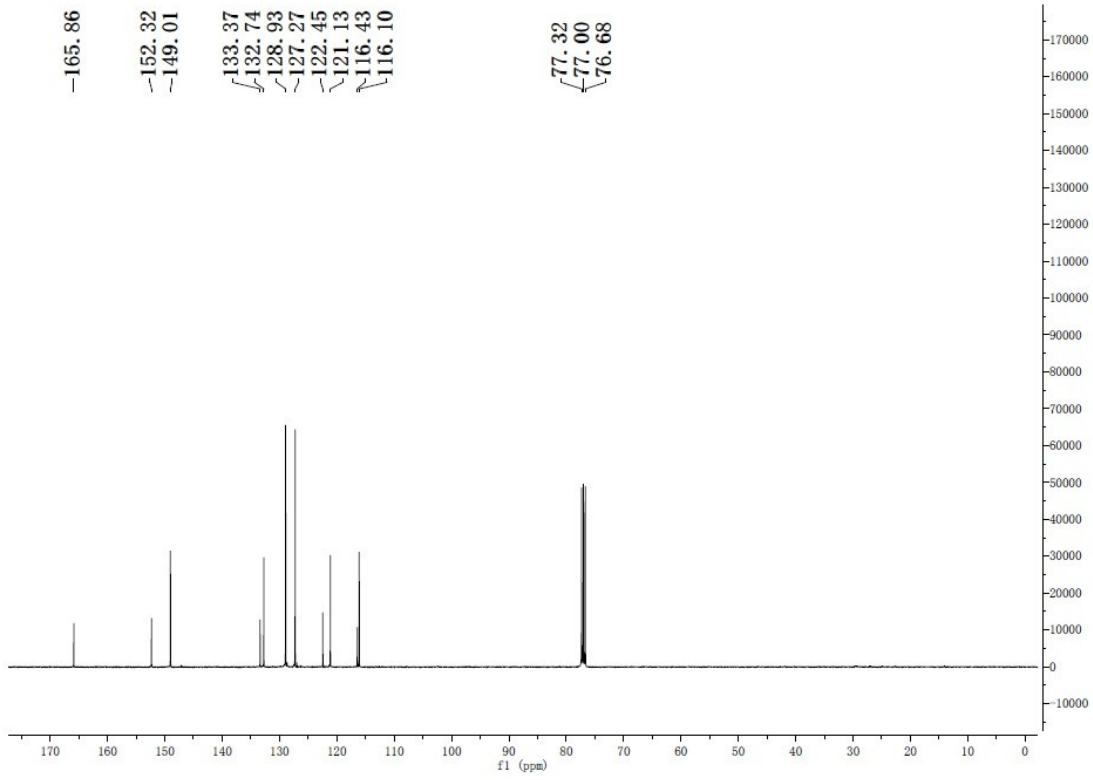
^{1}H NMR and ^{13}C NMR of *N*-(5-(trifluoromethyl)pyridin-2-yl)benzamide (3o)



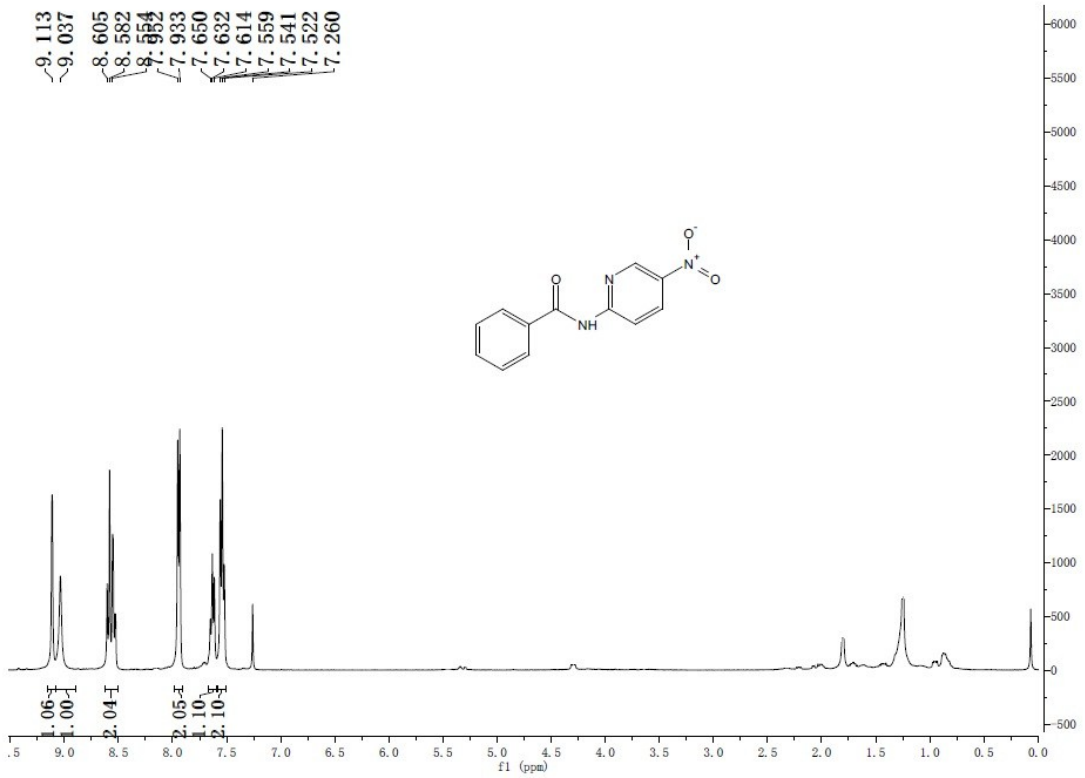


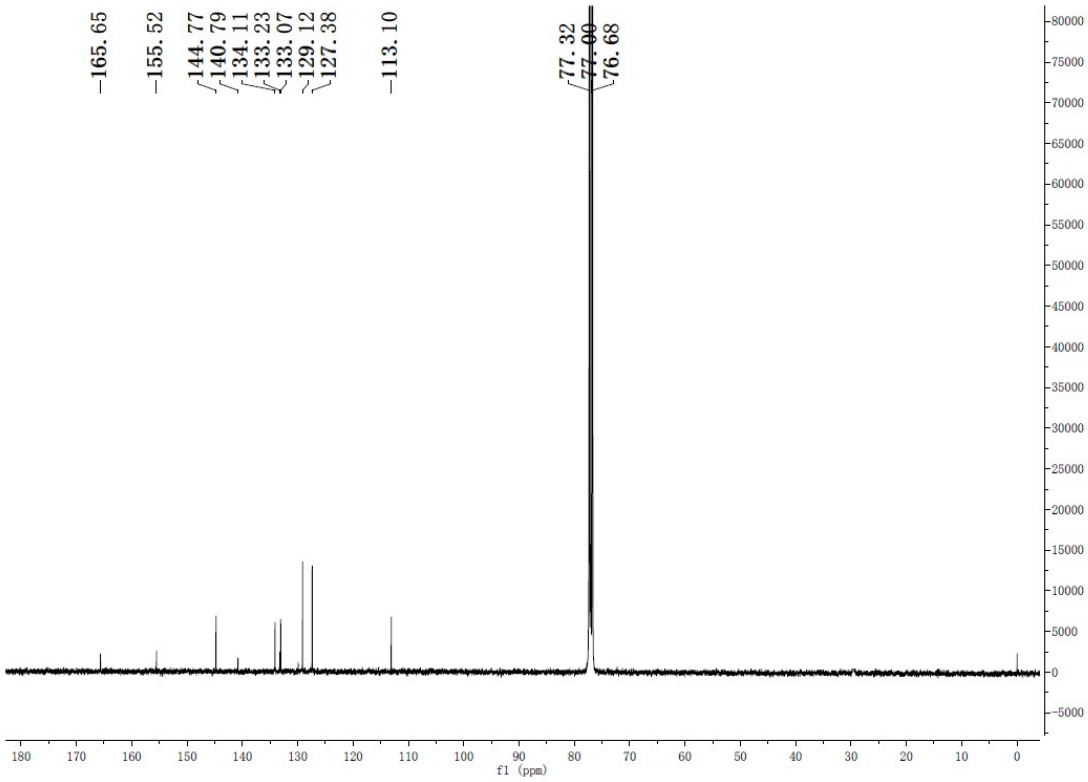
^{1}H NMR and ^{13}C NMR of *N*-(4-cyanopyridin-2-yl)benzamide (3p)



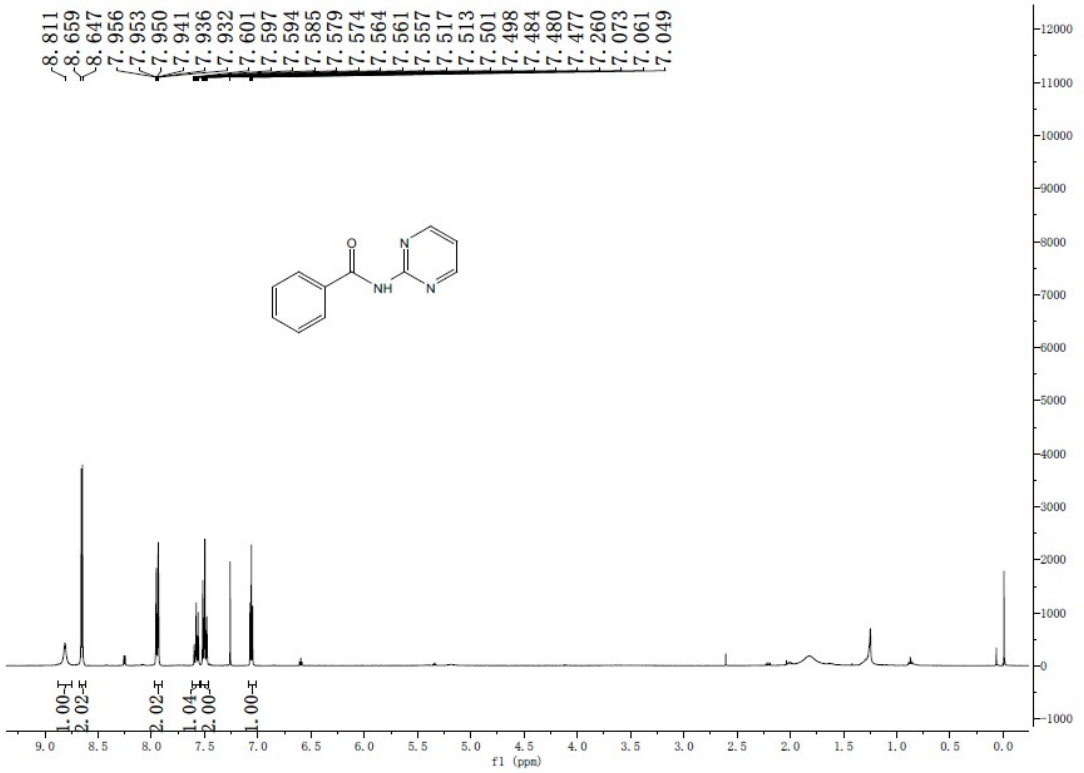


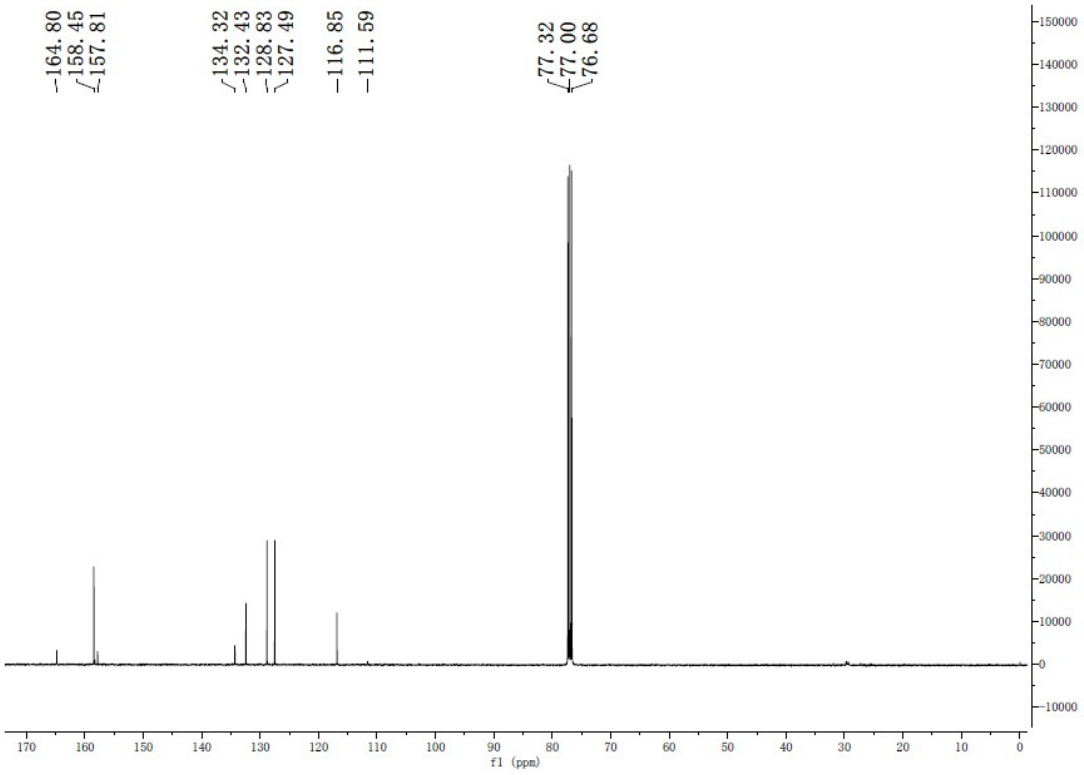
^{1}H NMR and ^{13}C NMR of *N*-(5-nitropyridin-2-yl)benzamide (3q)



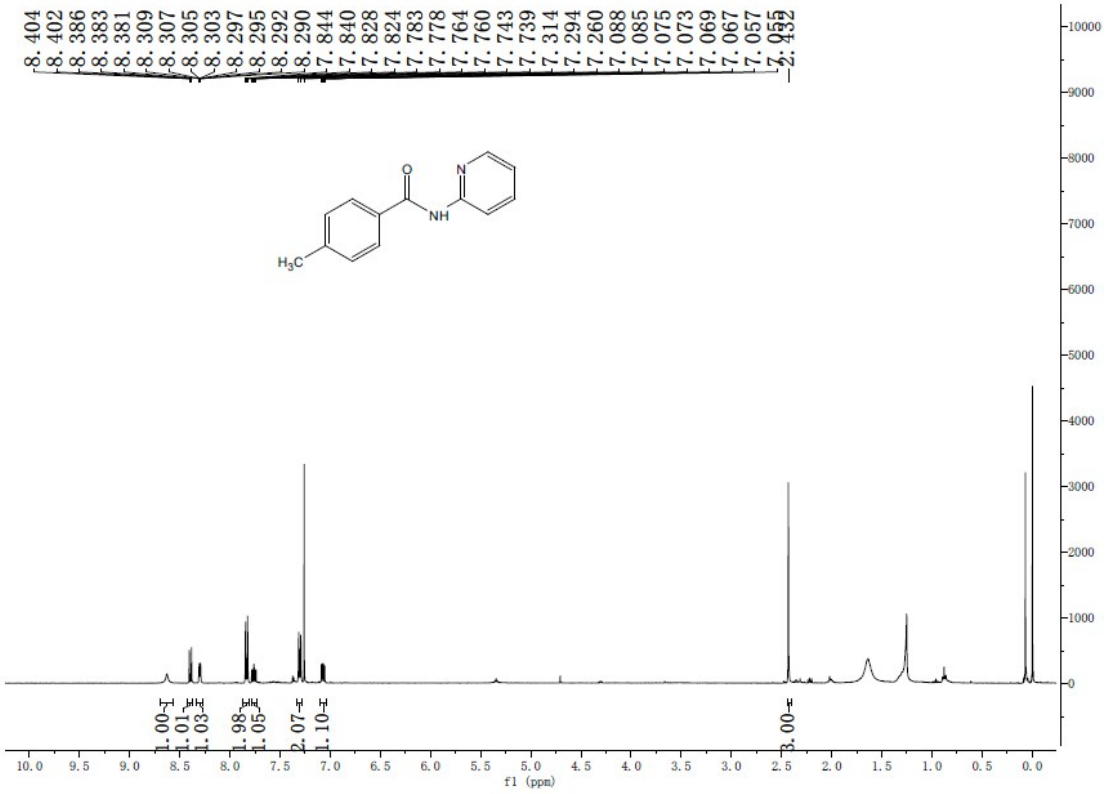


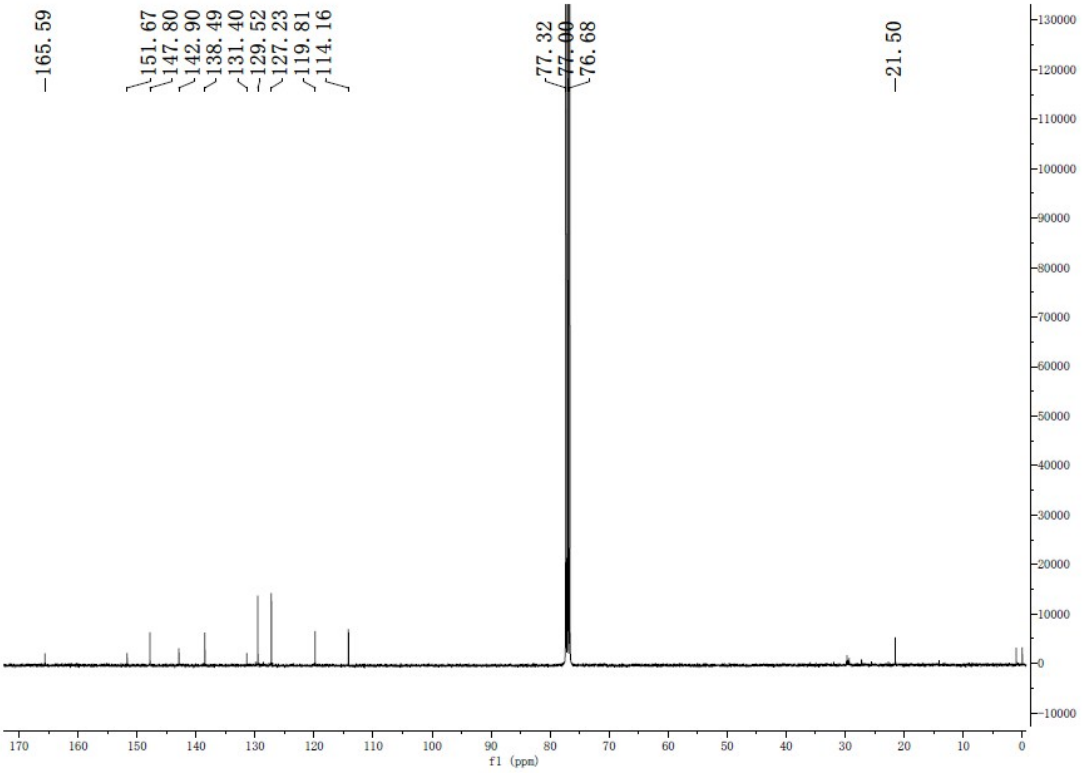
^{1}H NMR and ^{13}C NMR of *N*-(pyrimidin-2-yl)benzamide (3r)



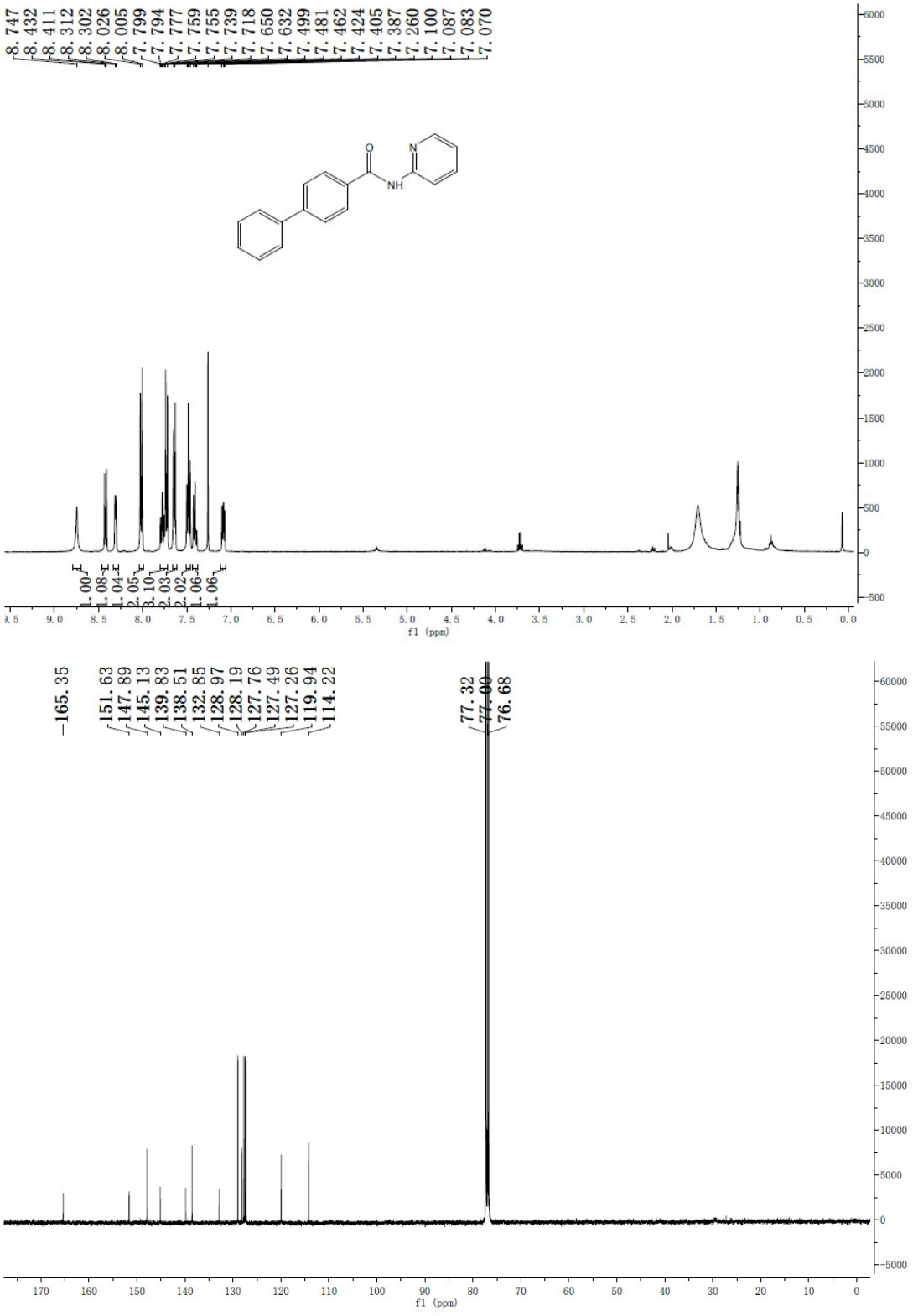


^{1}H NMR and ^{13}C NMR of 4-methyl-*N*-(pyridin-2-yl)benzamide (4a)

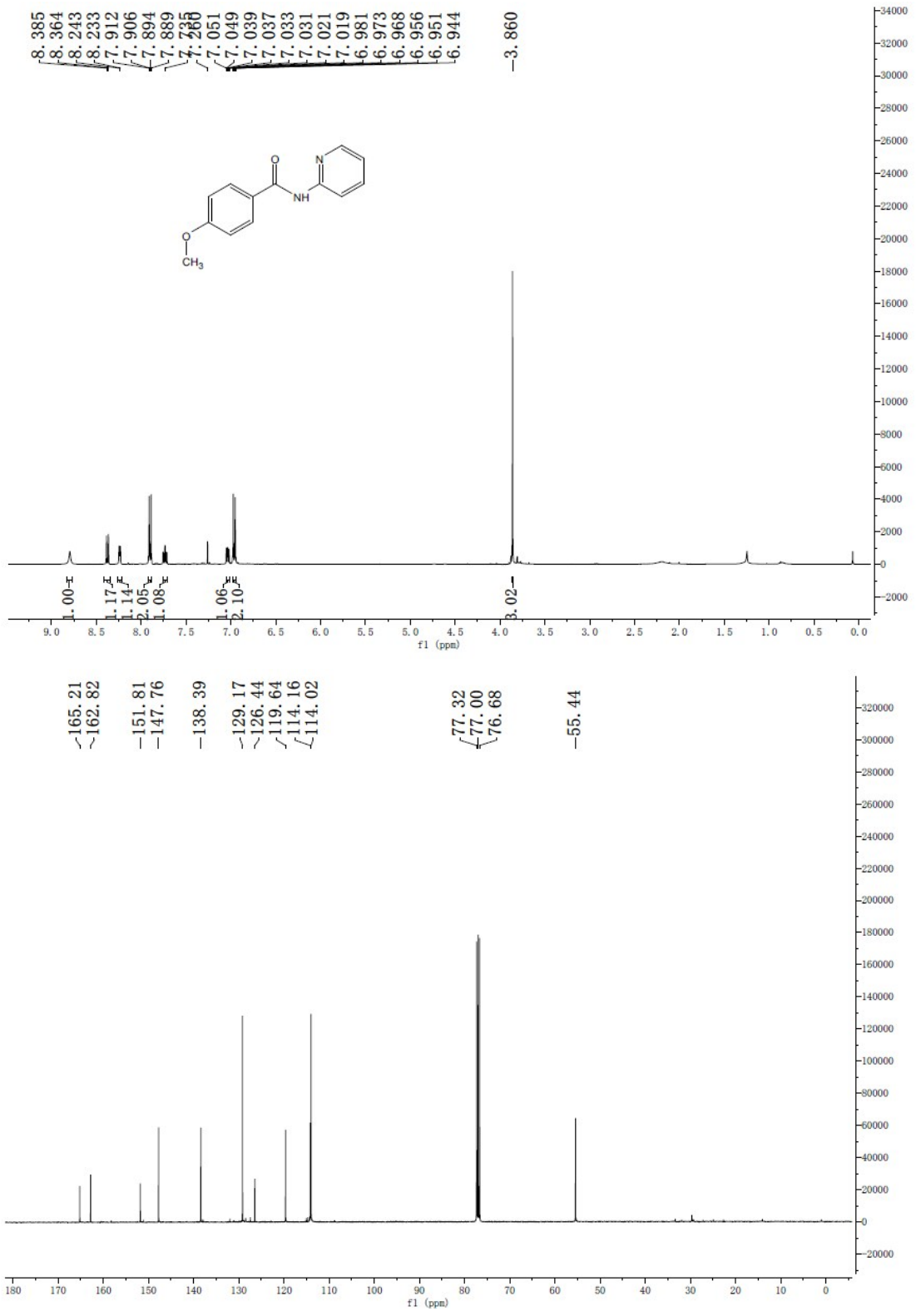




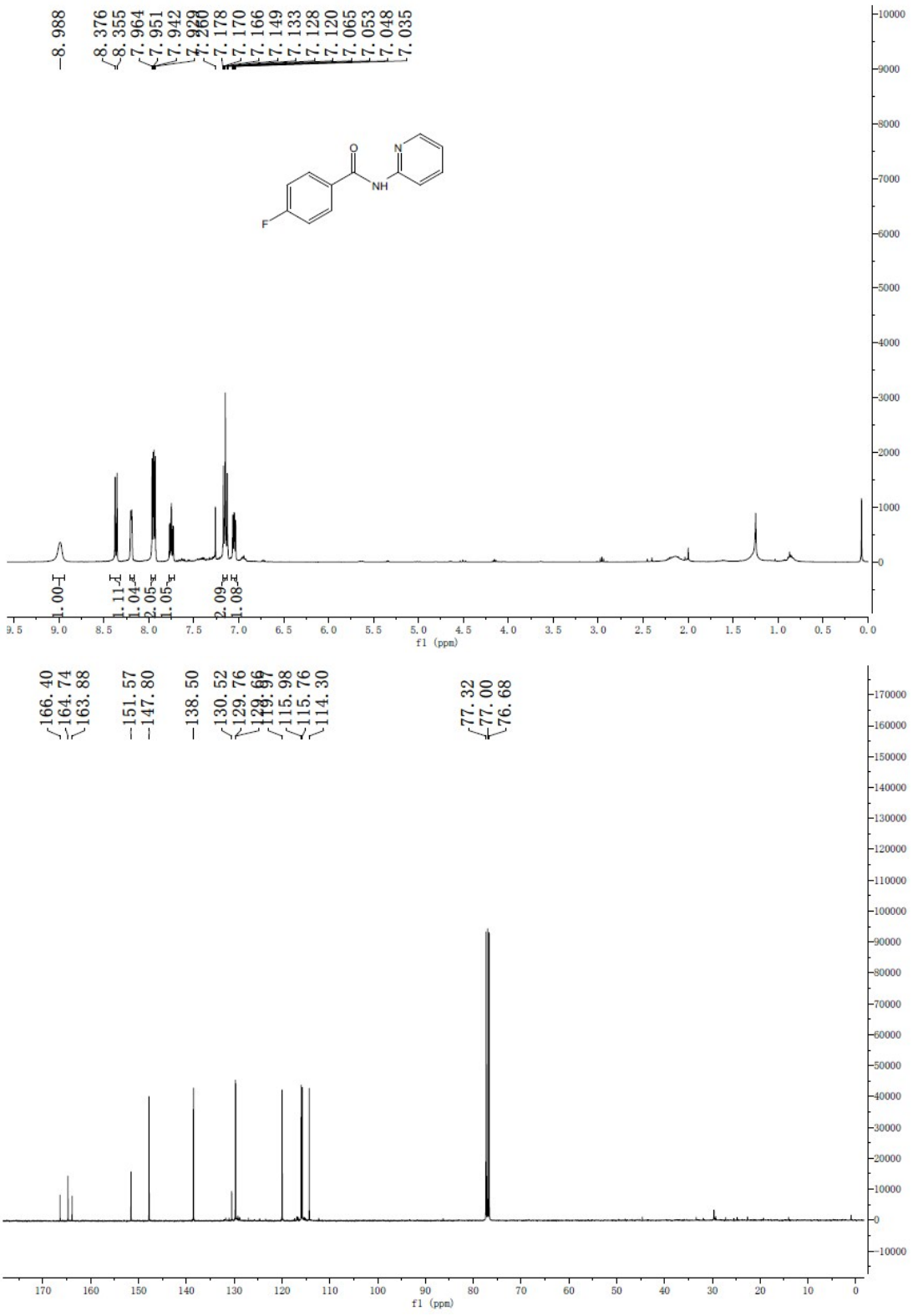
^{1}H NMR and ^{13}C NMR of *N*-(pyridin-2-yl)-[1,1'-biphenyl]-4-carboxamide (4b)



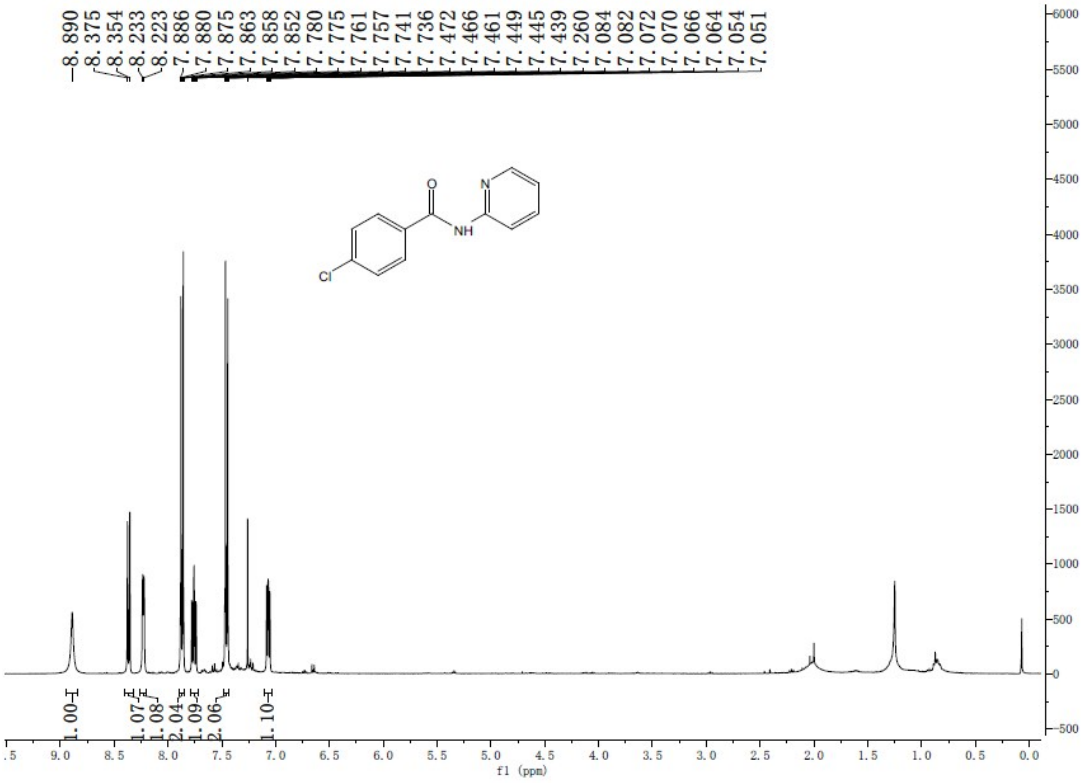
^{1}H NMR and ^{13}C NMR of 4-methoxy-*N*-(pyridin-2-yl)benzamide (4c)

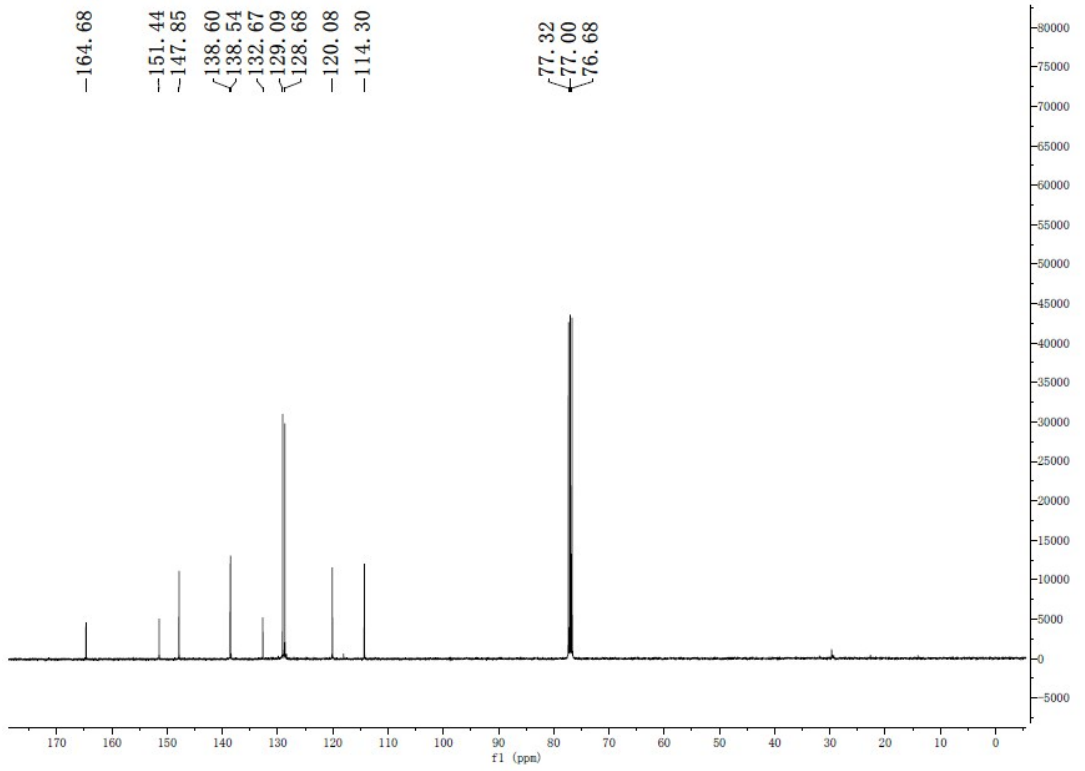


^{1}H NMR and ^{13}C NMR of 4-fluoro-*N*-(pyridin-2-yl)benzamide (4d)

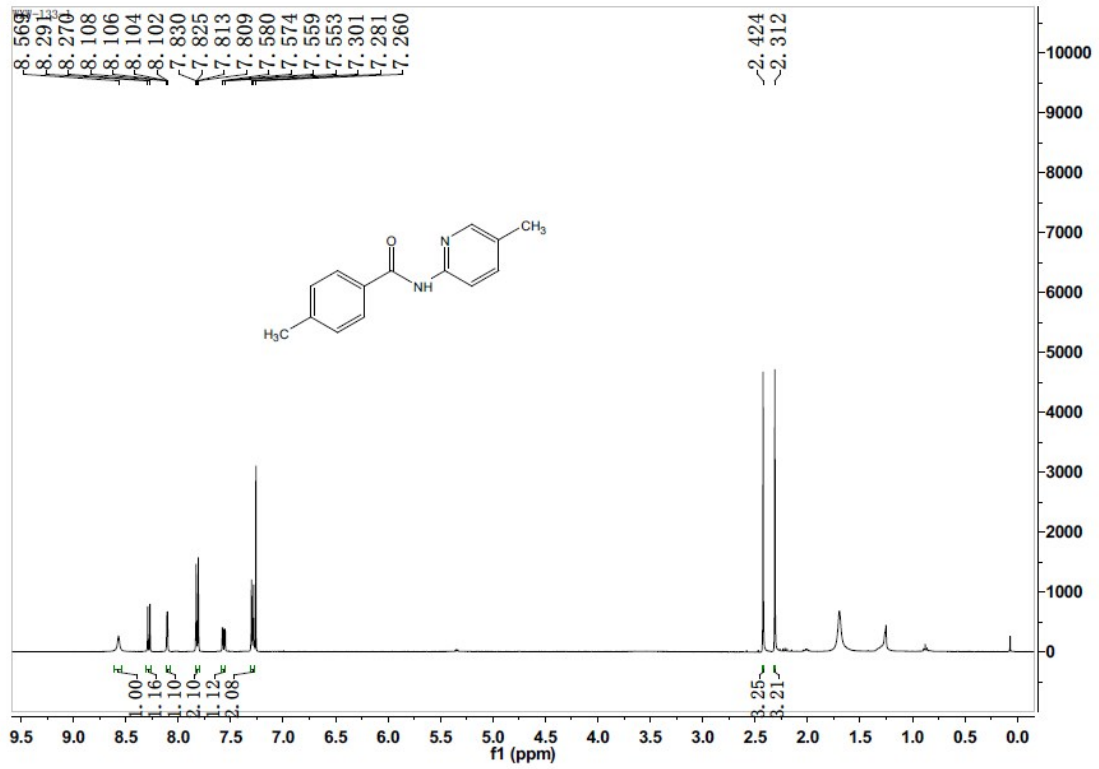


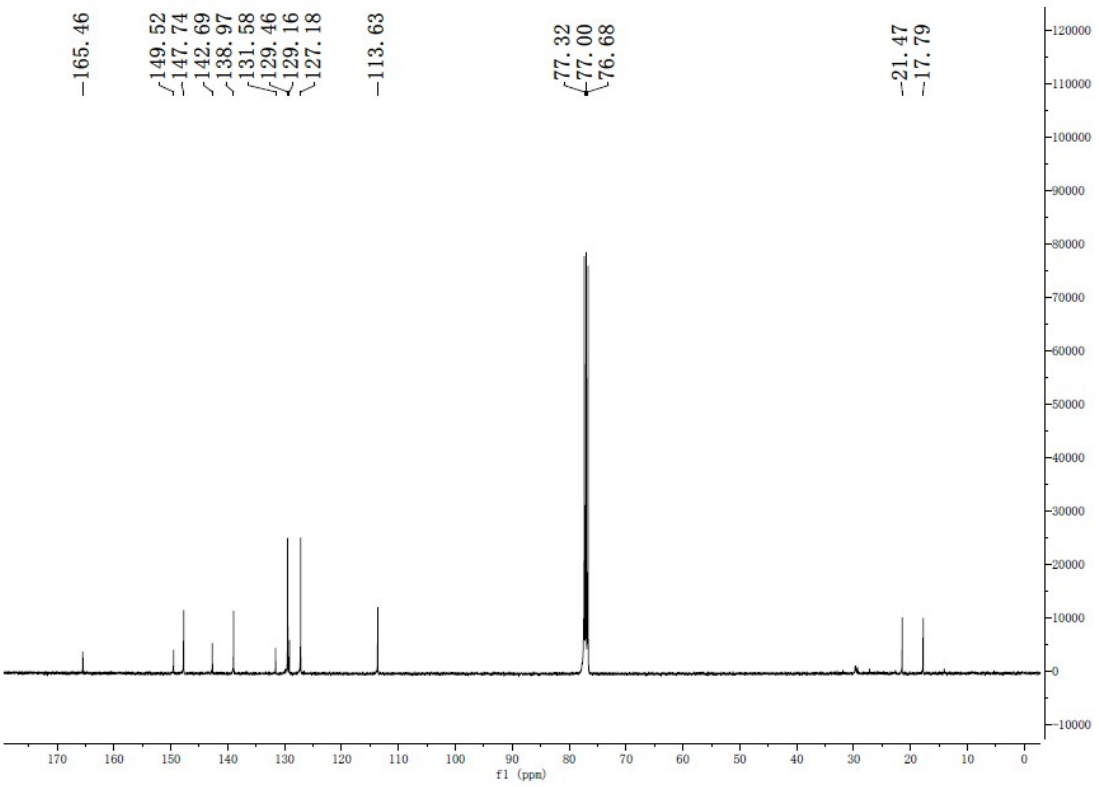
^{1}H NMR and ^{13}C NMR of 4-chloro-*N*-(pyridin-2-yl)benzamide (4e)



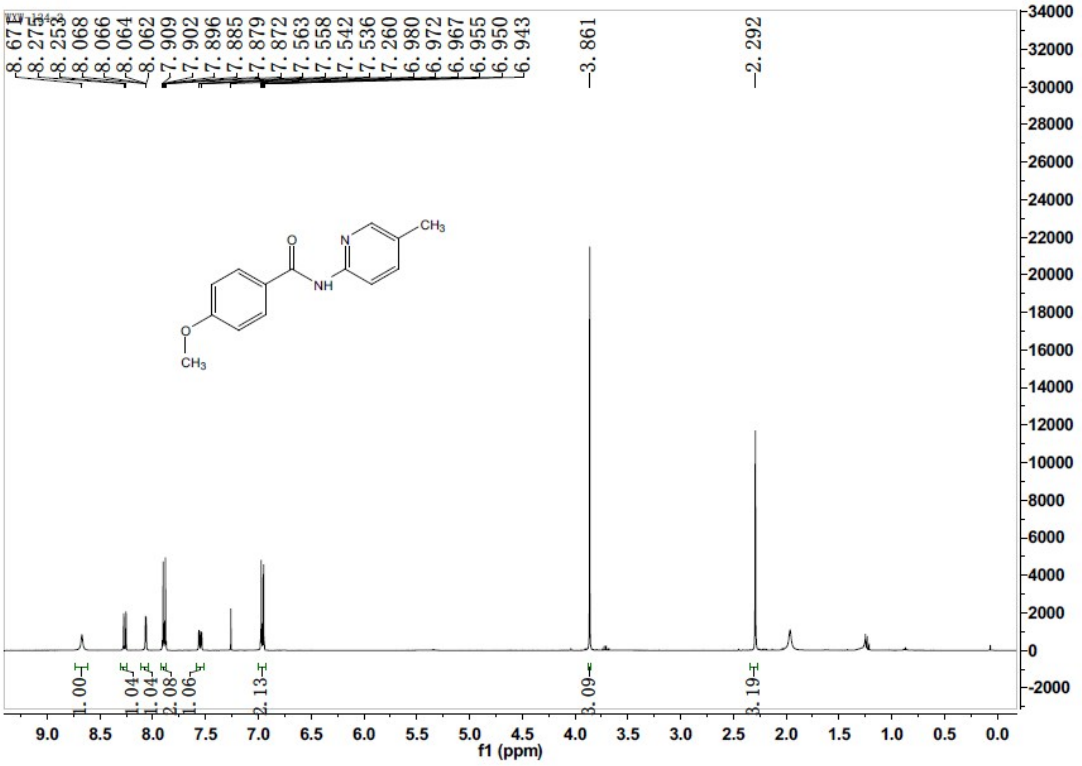


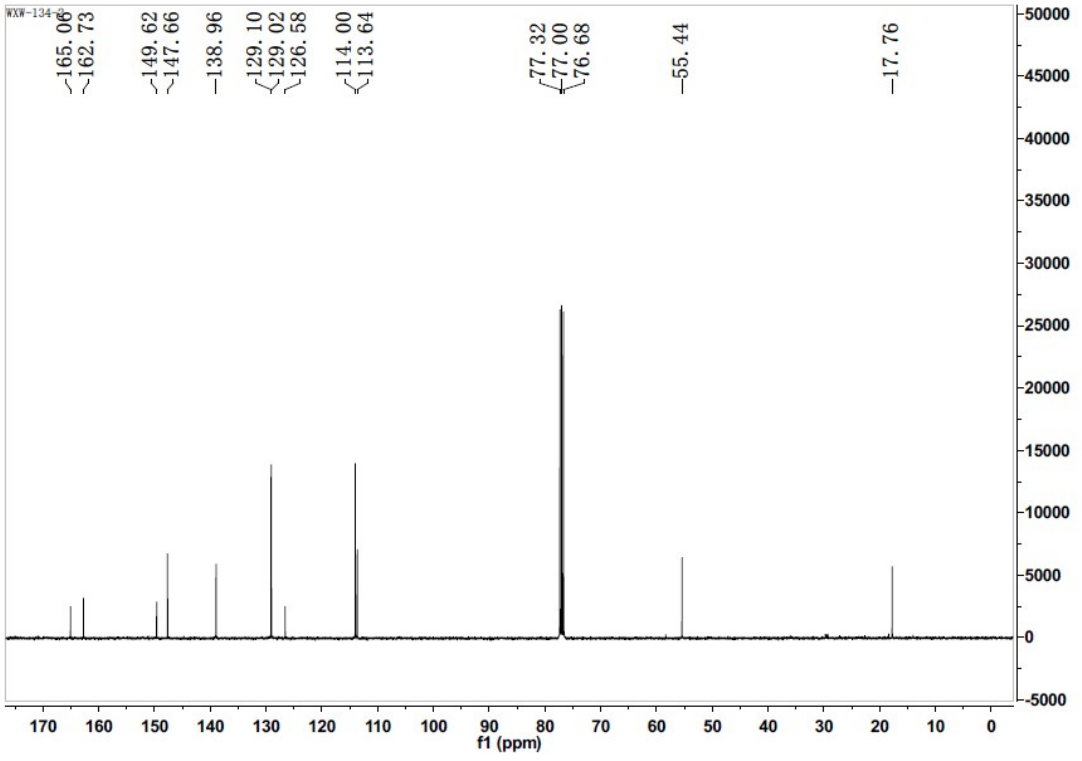
^{1}H NMR and ^{13}C NMR of 4-methyl-*N*-(5-methylpyridin-2-yl)benzamide (4f)



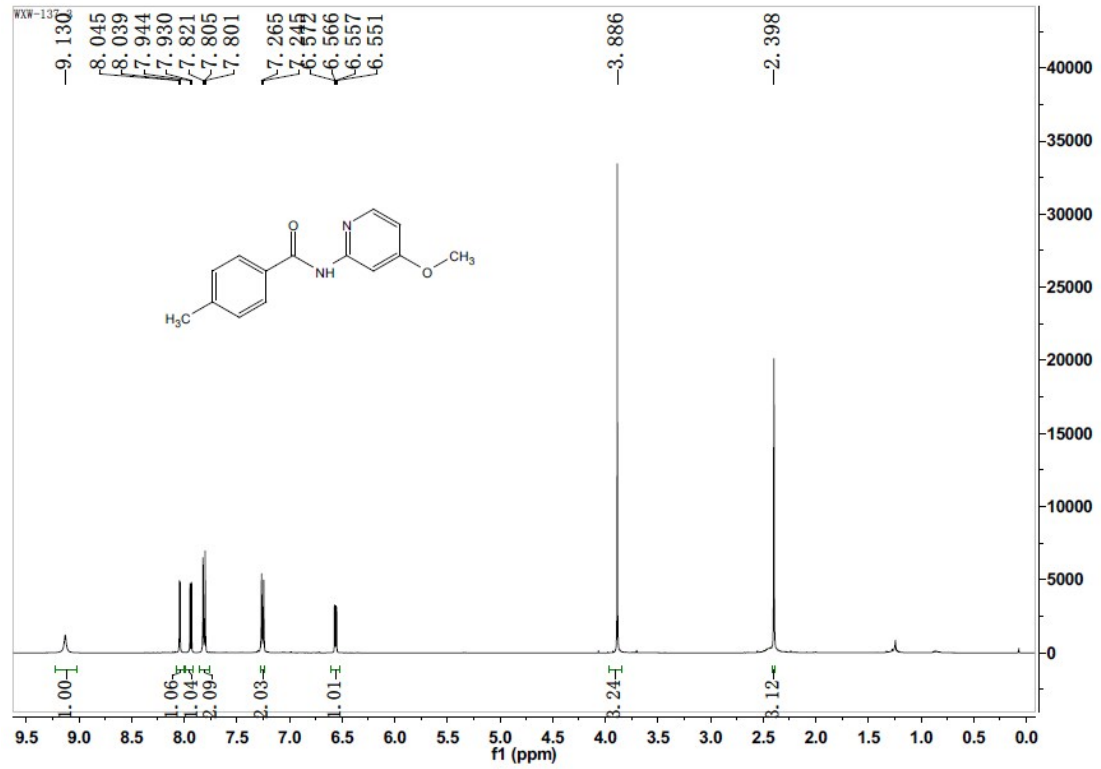


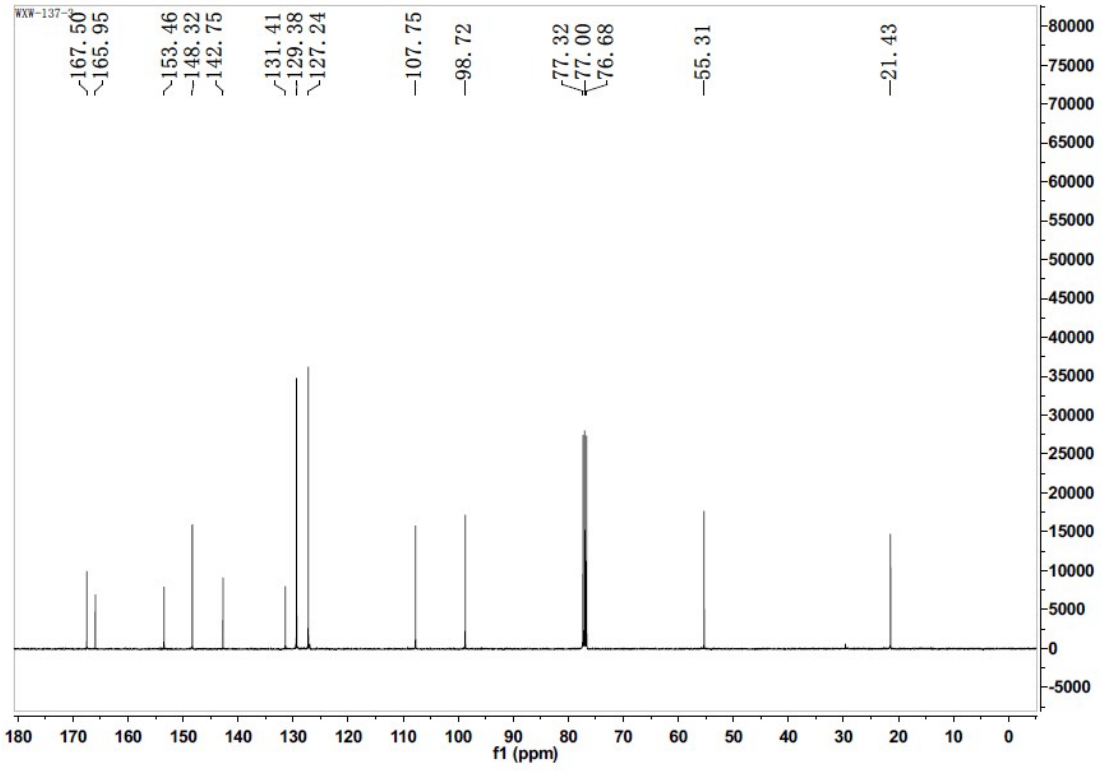
^{1}H NMR and ^{13}C NMR of 4-methoxy-*N*-(5-methylpyridin-2-yl)benzamide (4g)



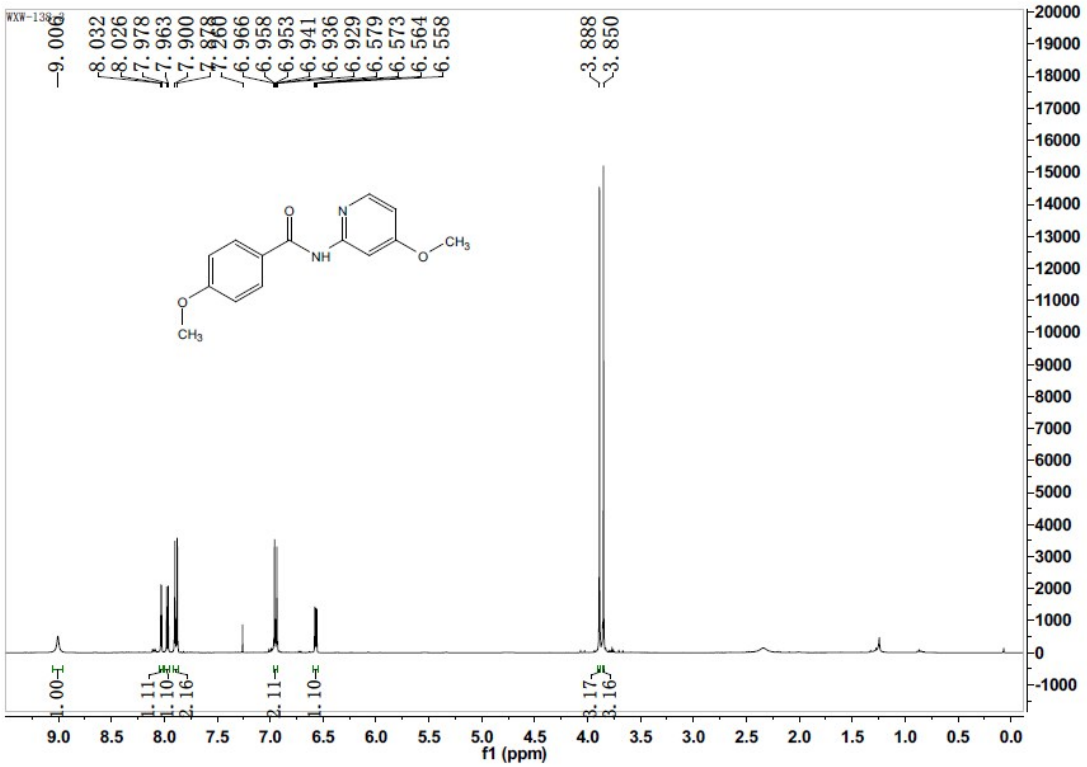


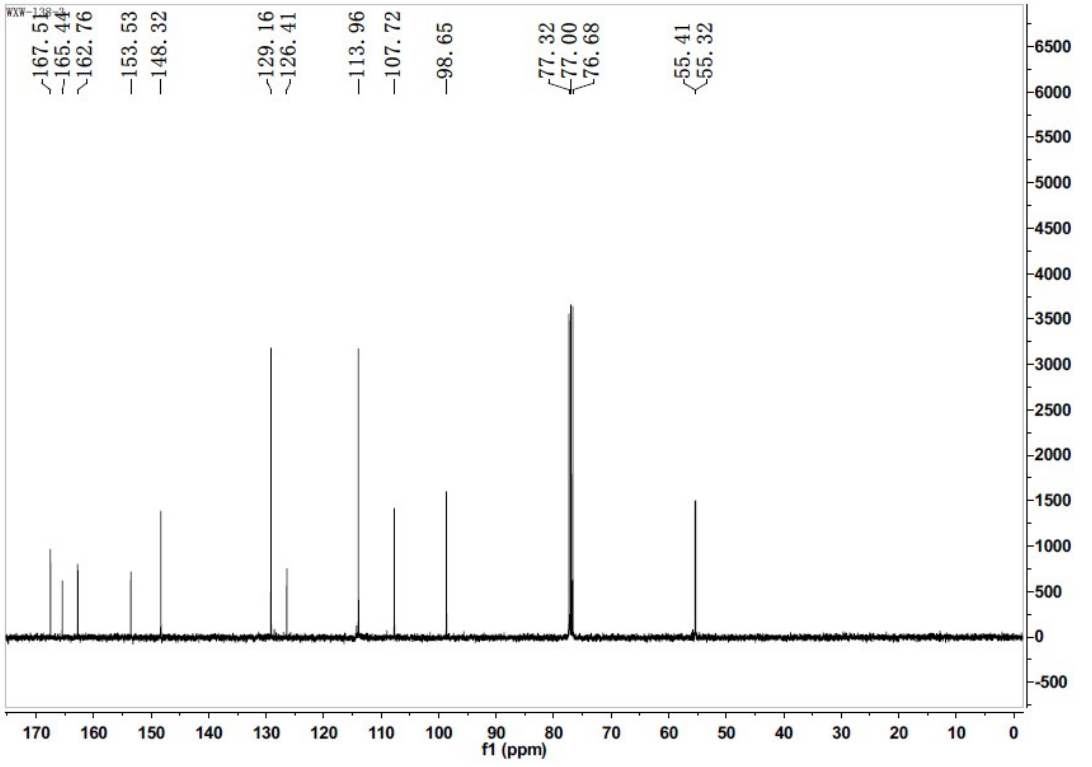
^{1}H NMR and ^{13}C NMR of *N*-(4-methoxypyridin-2-yl)-4-methylbenzamide (4h)



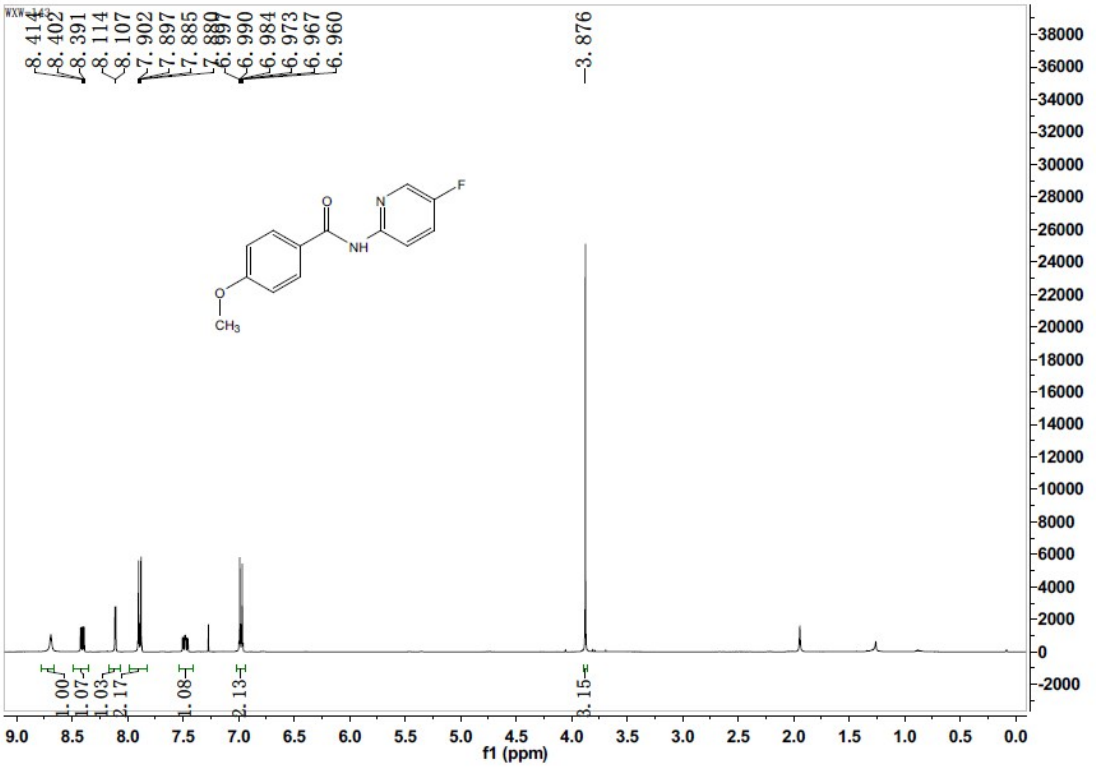


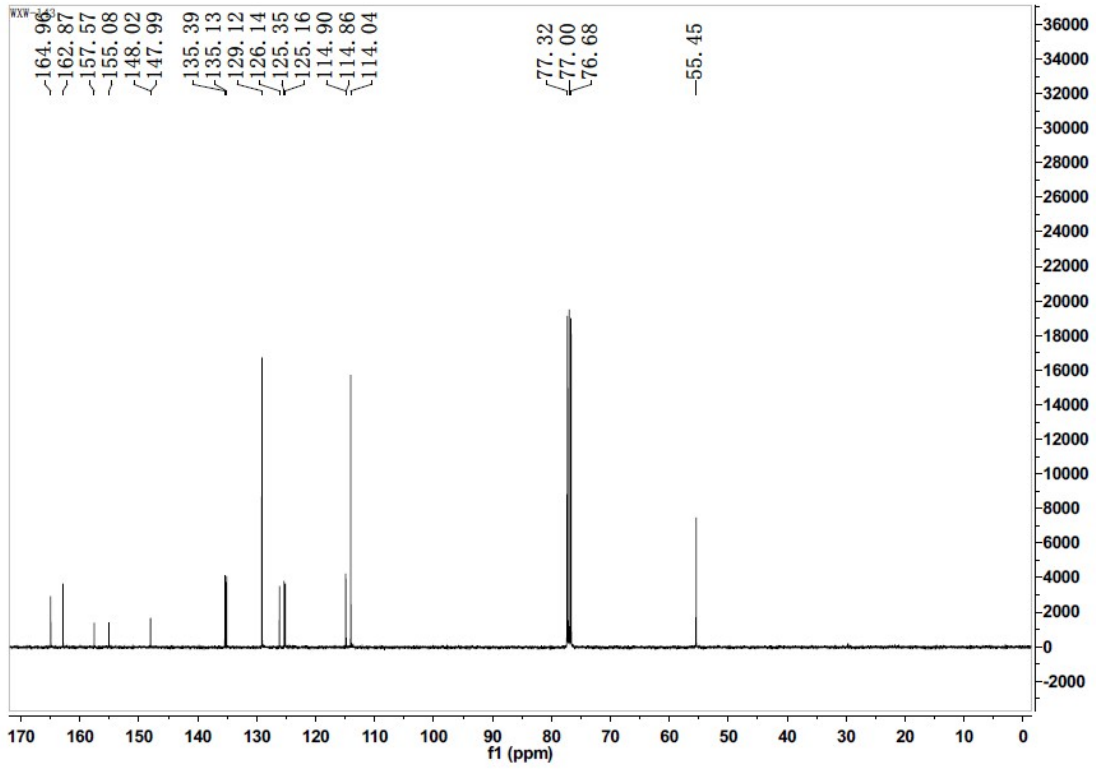
^{1}H NMR and ^{13}C NMR of 4-methoxy-*N*-(4-methoxypyridin-2-yl)benzamide (4i)



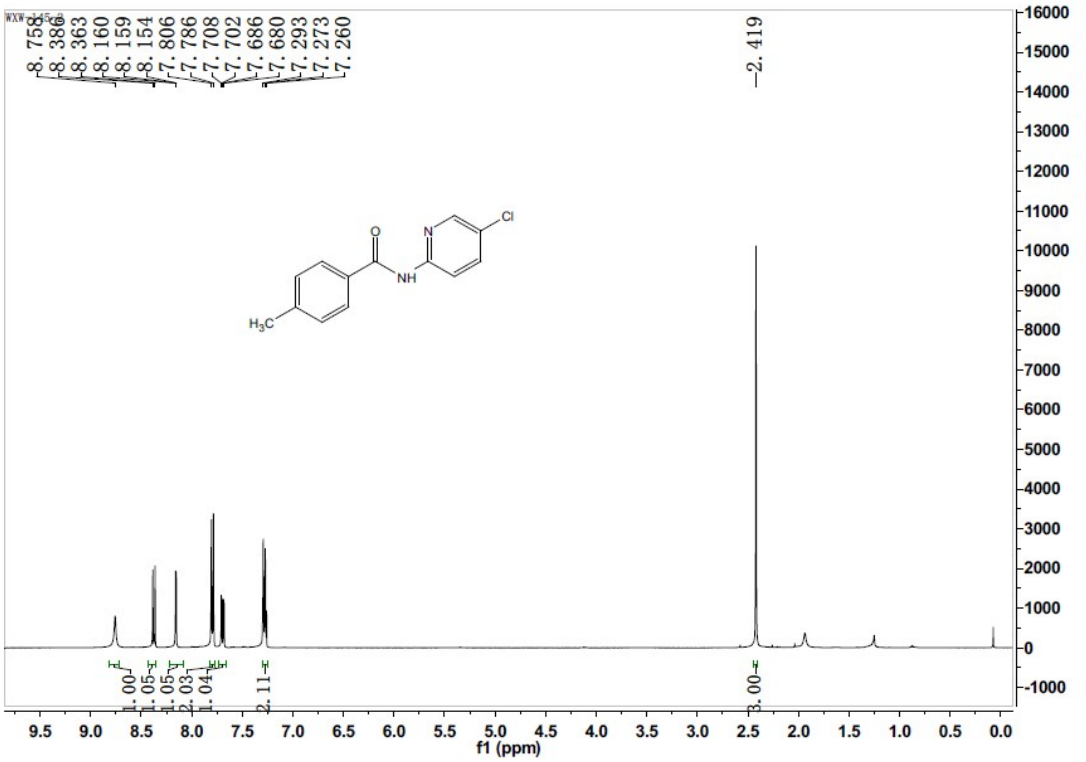


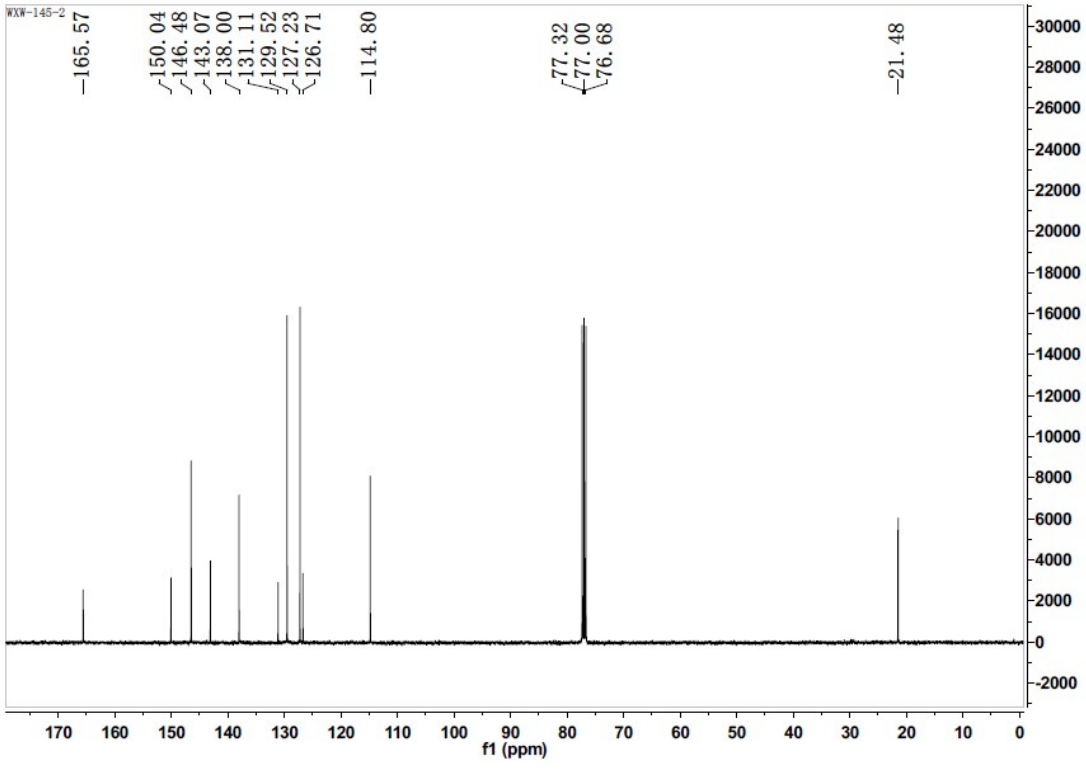
^{1}H NMR and ^{13}C NMR of *N*-(5-fluoropyridin-2-yl)-4-methoxybenzamide (4j)



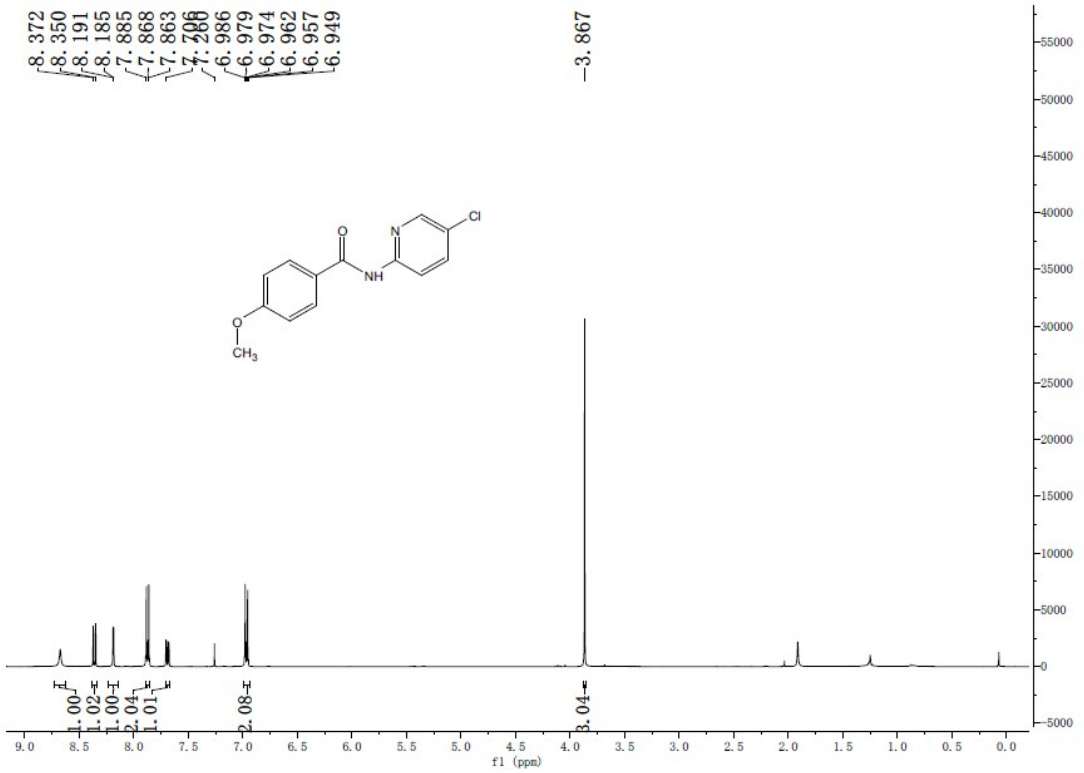


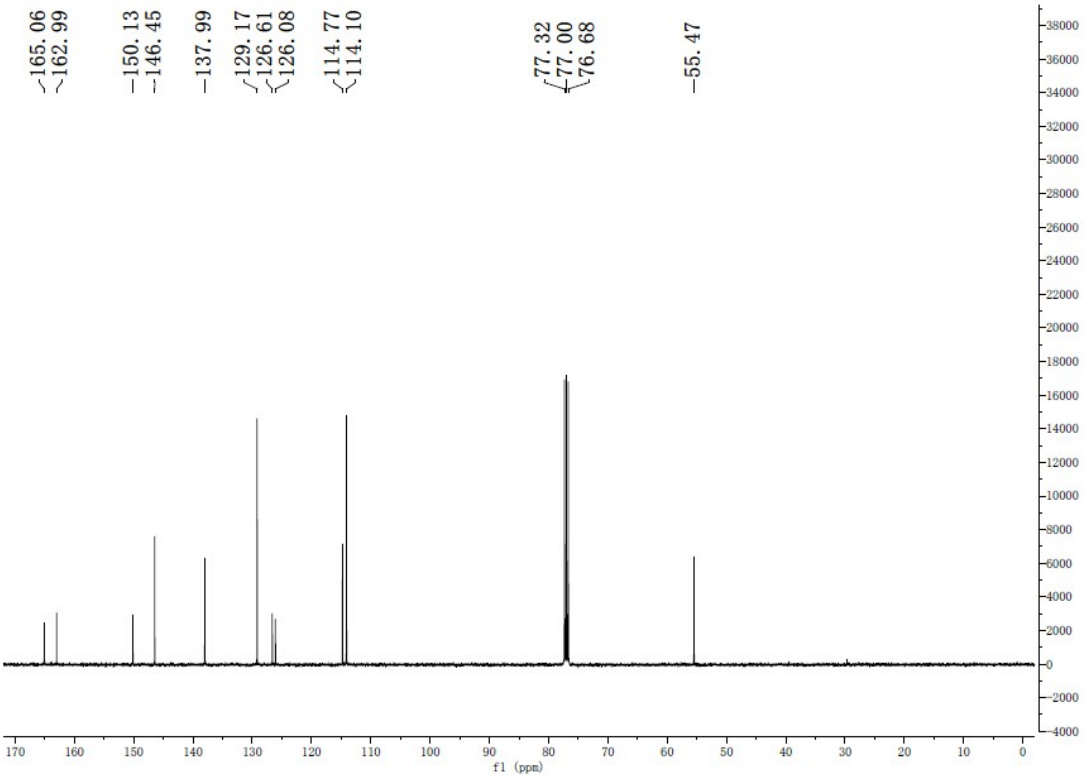
^{1}H NMR and ^{13}C NMR of *N*-(5-chloropyridin-2-yl)-4-methylbenzamide (4k)



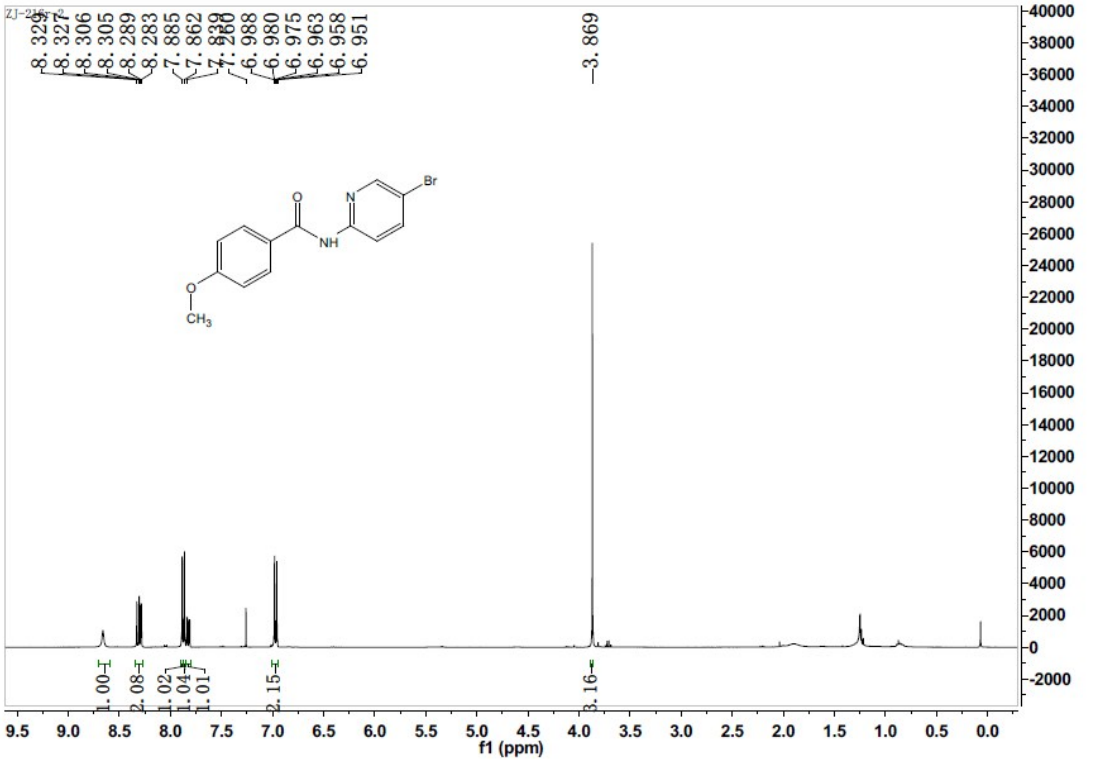


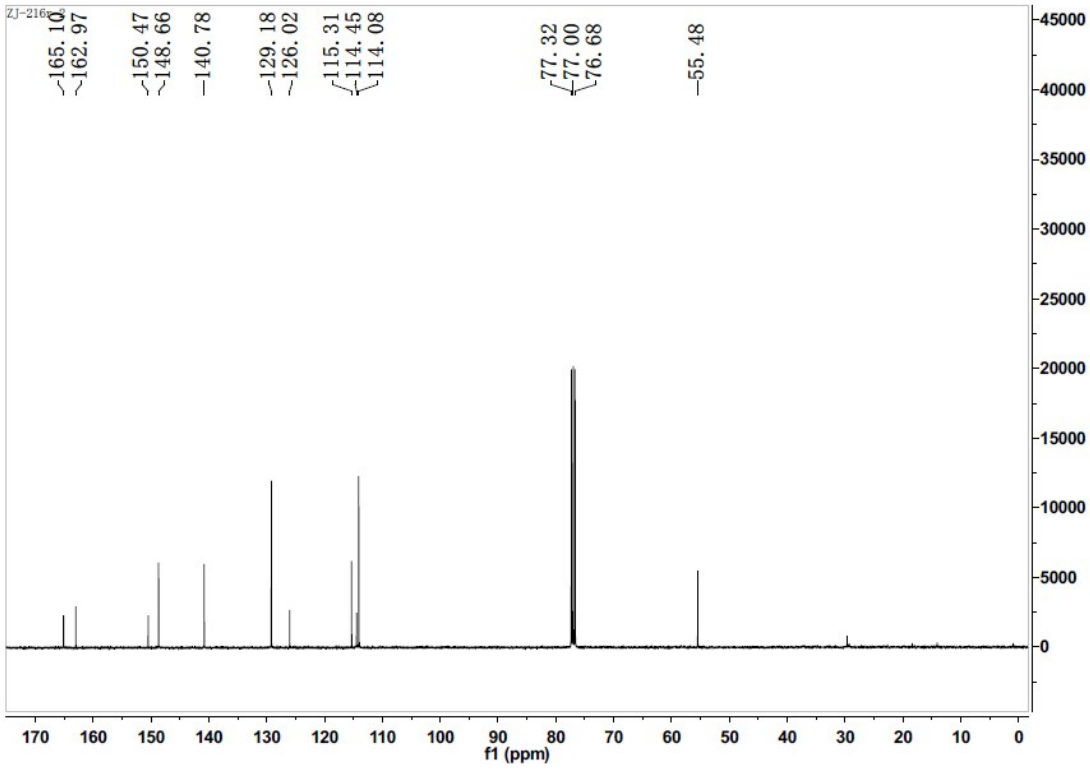
^{1}H NMR and ^{13}C NMR of *N*-(5-chloropyridin-2-yl)-4-methoxybenzamide (4l)



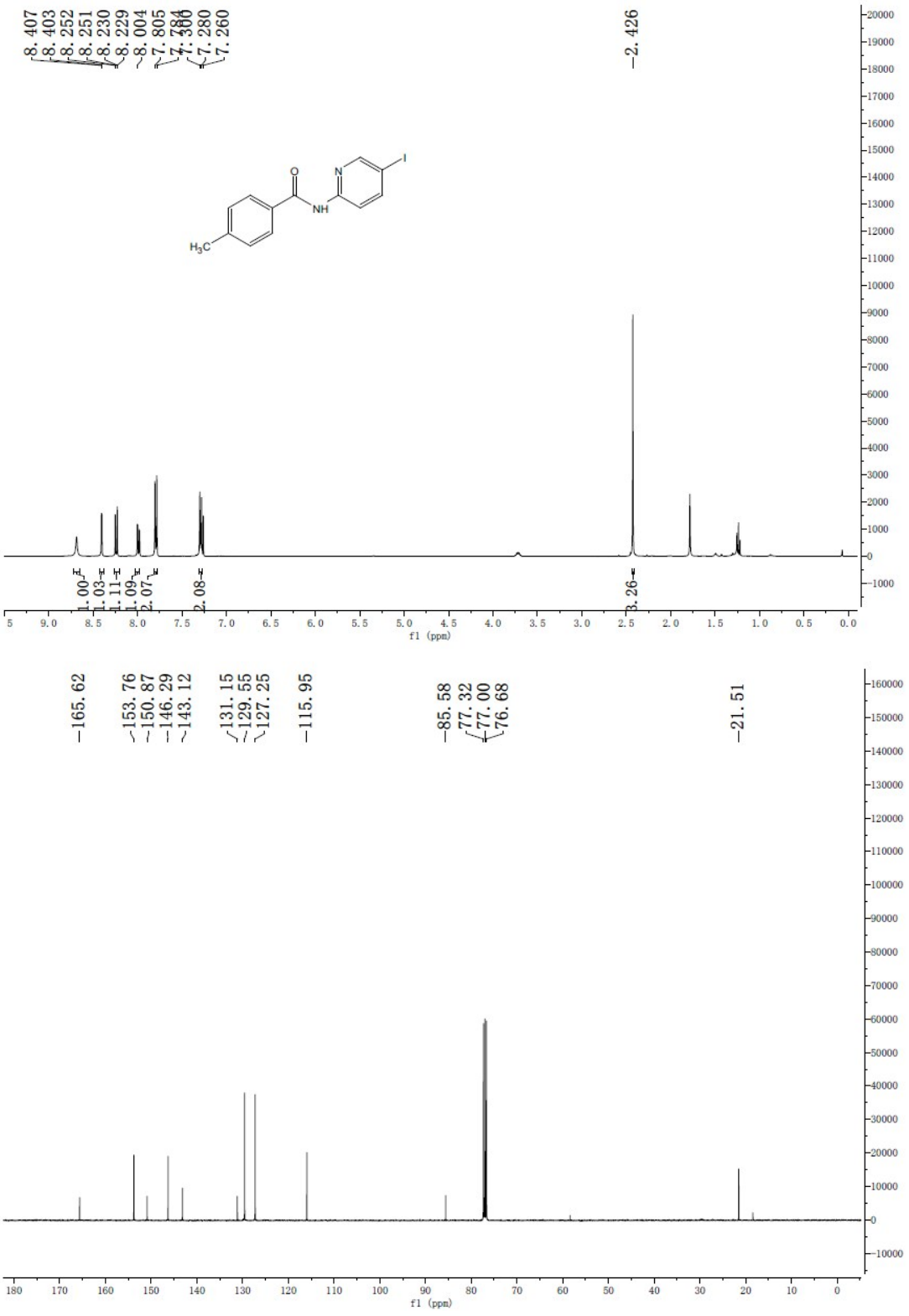


^{1}H NMR and ^{13}C NMR of *N*-(5-bromopyridin-2-yl)-4-methoxybenzamide (4m)



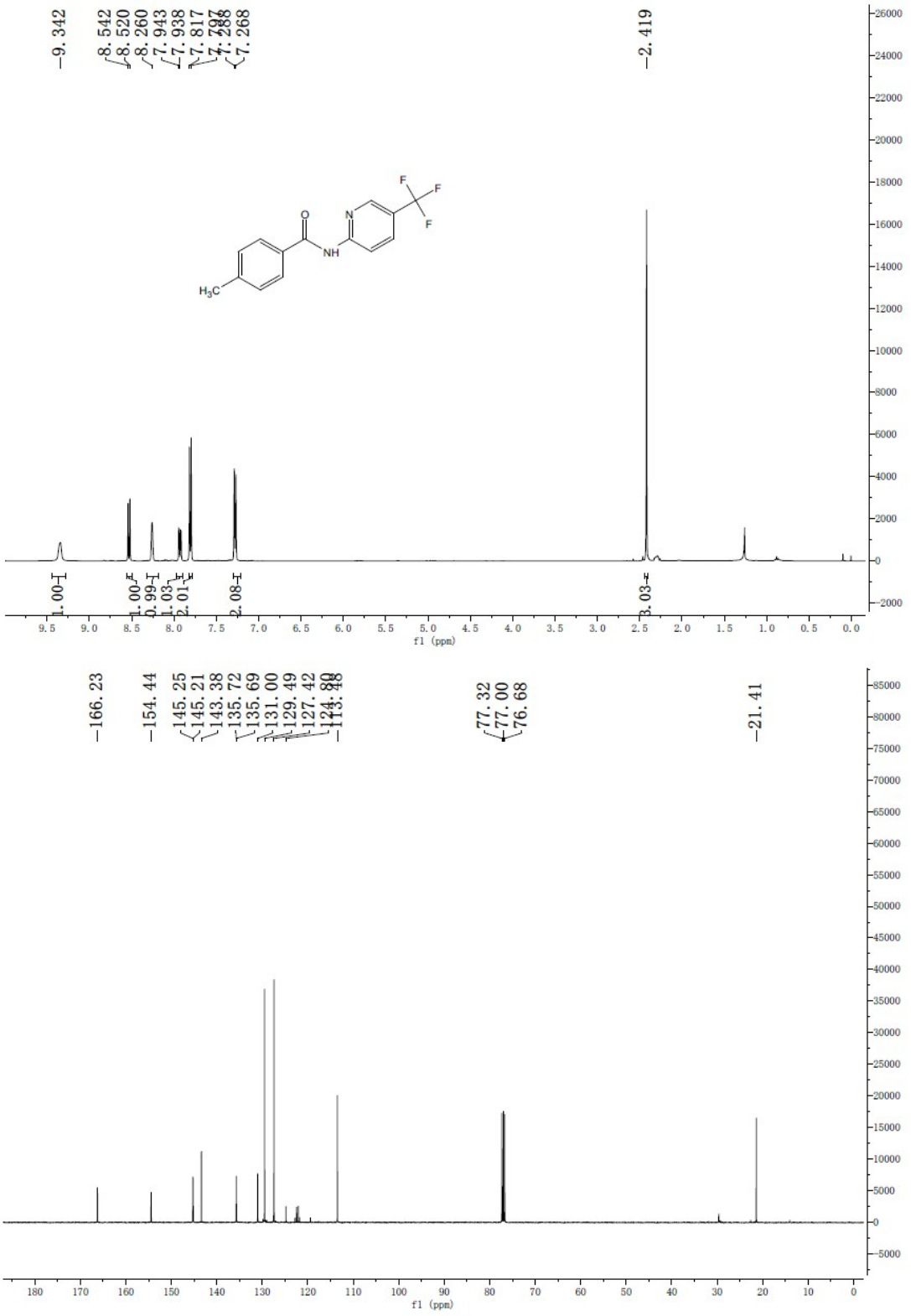


^{1}H NMR and ^{13}C NMR of *N*-(5-iodopyridin-2-yl)-4-methylbenzamide (4n)



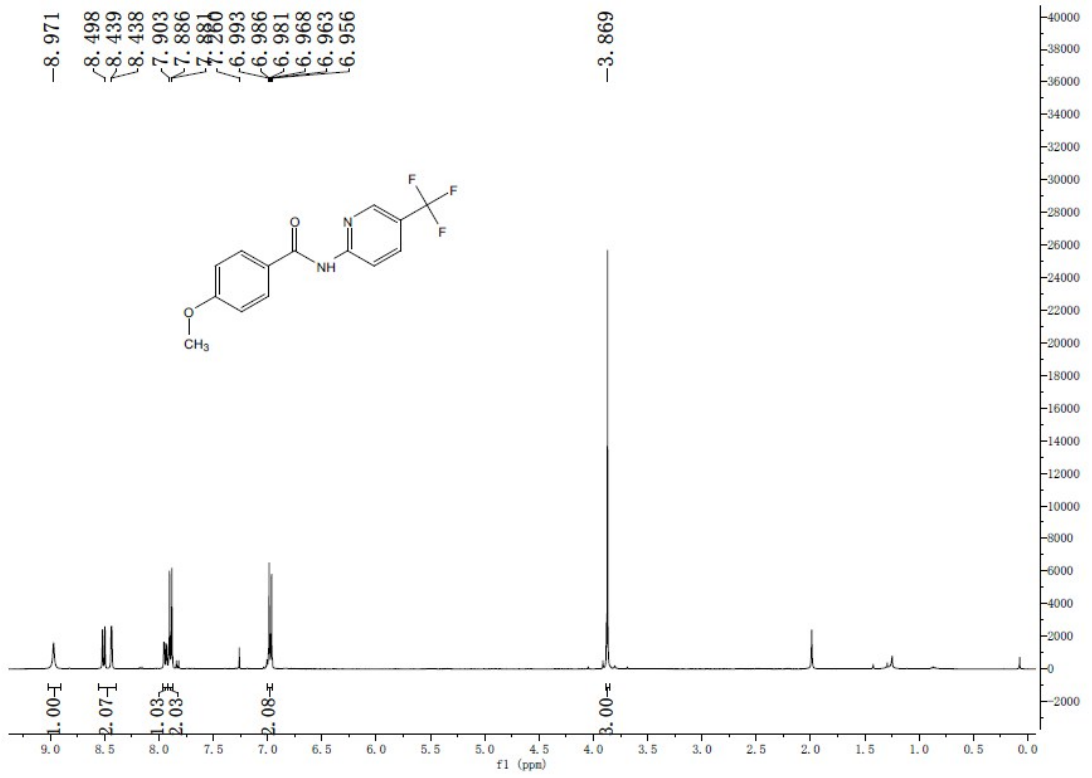
^{1}H NMR and ^{13}C NMR of 4-methyl-*N*-(5-(trifluoromethyl)pyridin-2-

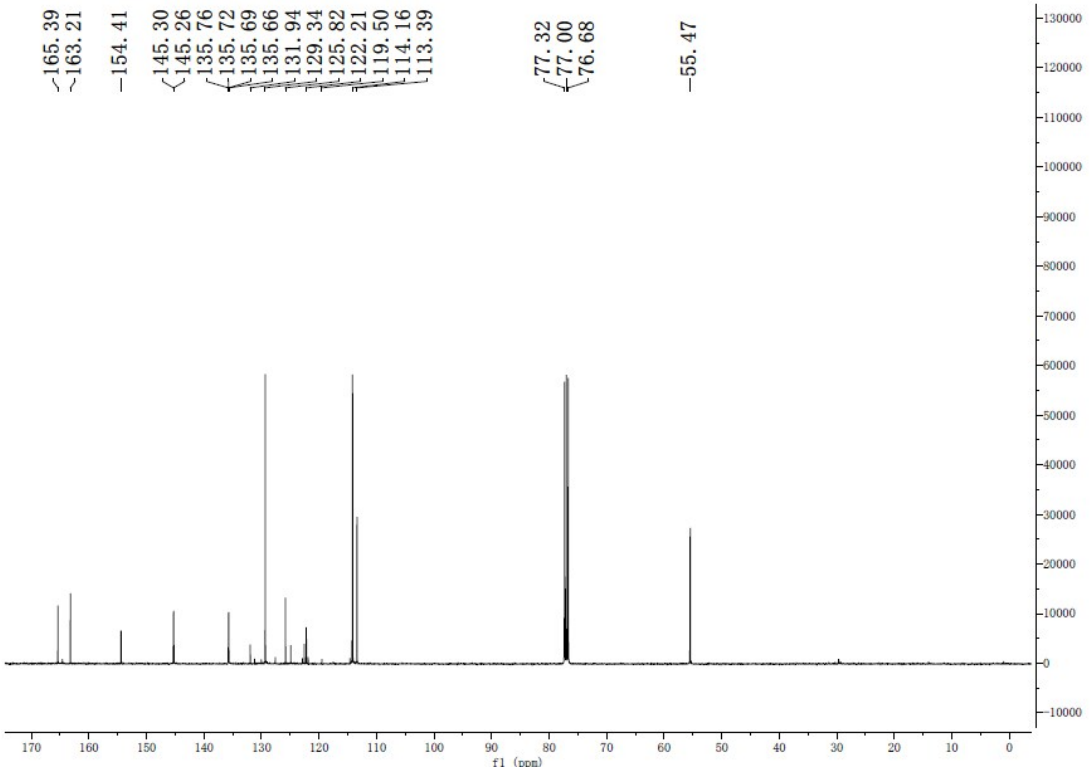
yl)benzamide (4o)



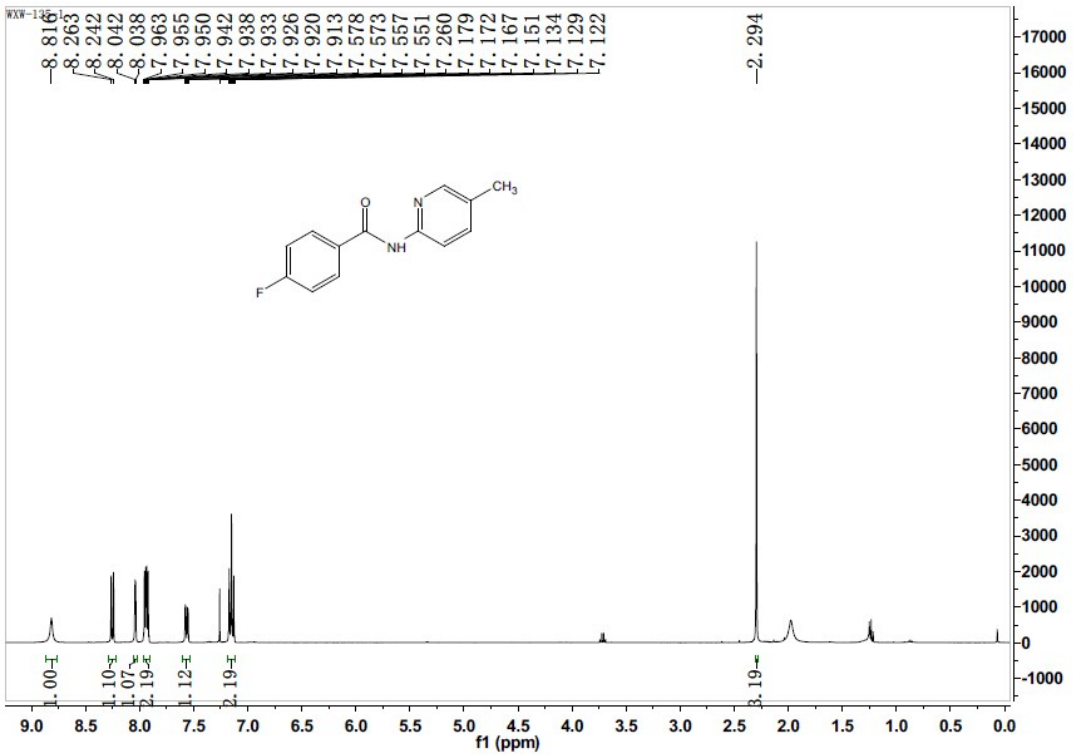
^{1}H NMR and ^{13}C NMR of 4-methoxy-*N*-(5-(trifluoromethyl)pyridin-2-

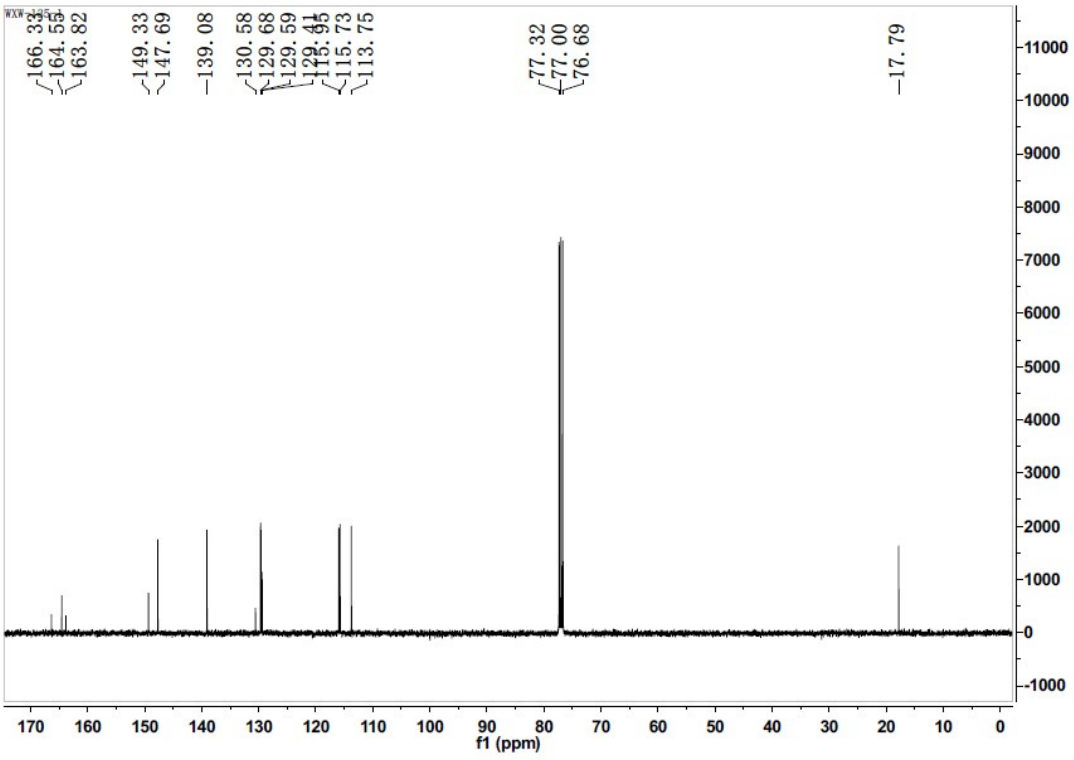
yl)benzamide (4p)



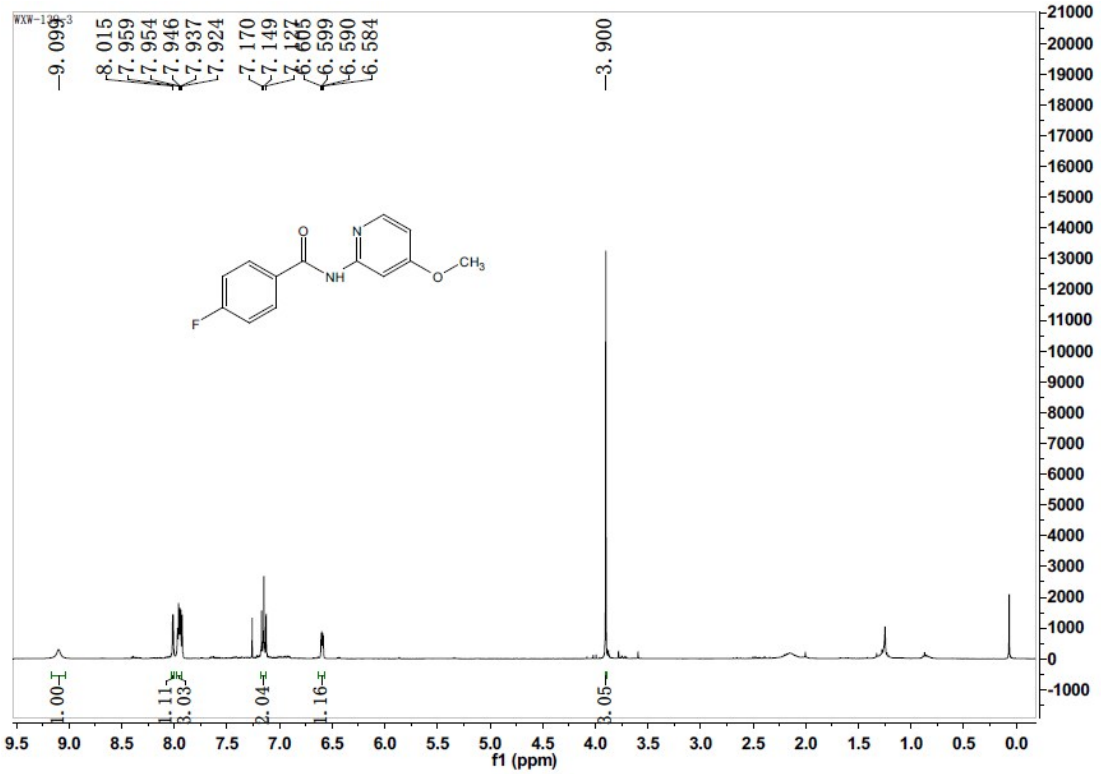


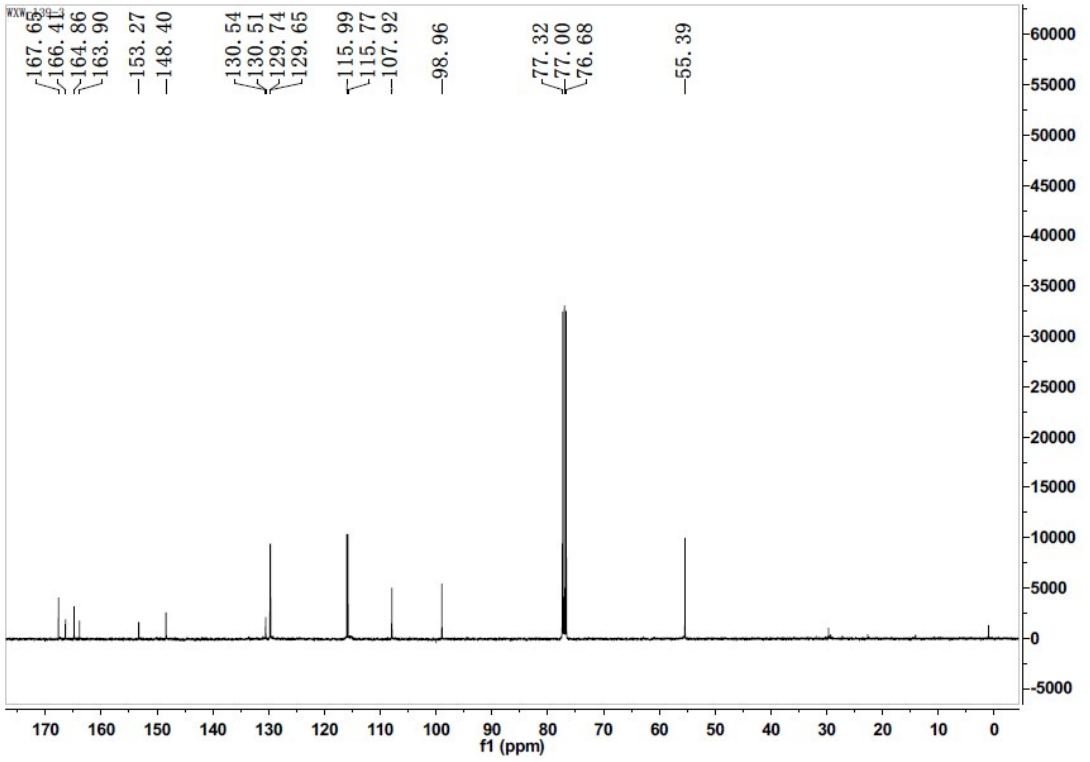
^{1}H NMR and ^{13}C NMR of 4-fluoro-*N*-(5-methylpyridin-2-yl)benzamide (4q)



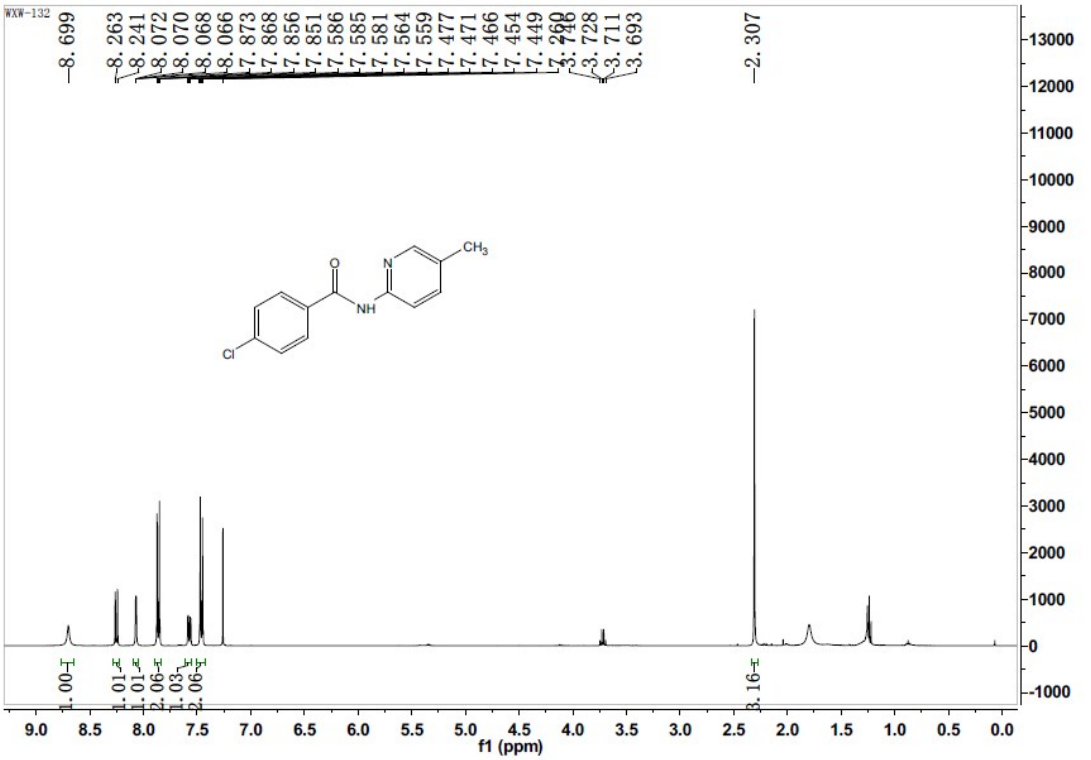


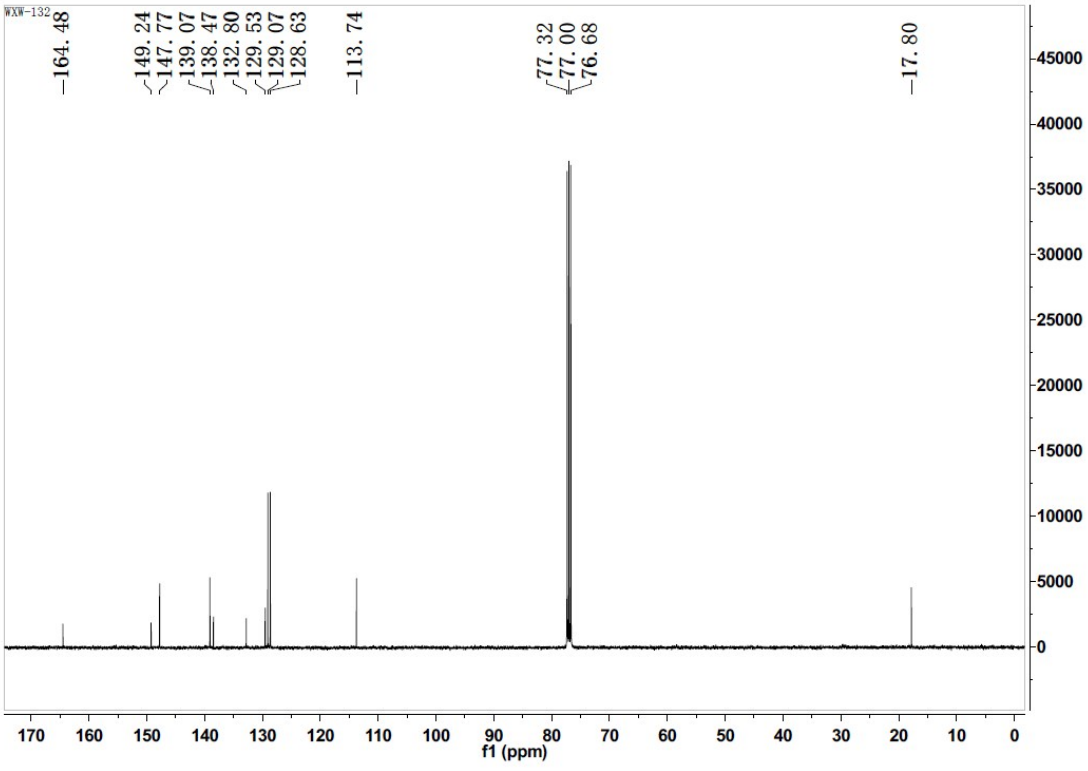
^{1}H NMR and ^{13}C NMR of 4-fluoro-*N*-(4-methoxypyridin-2-yl)benzamide (4r)



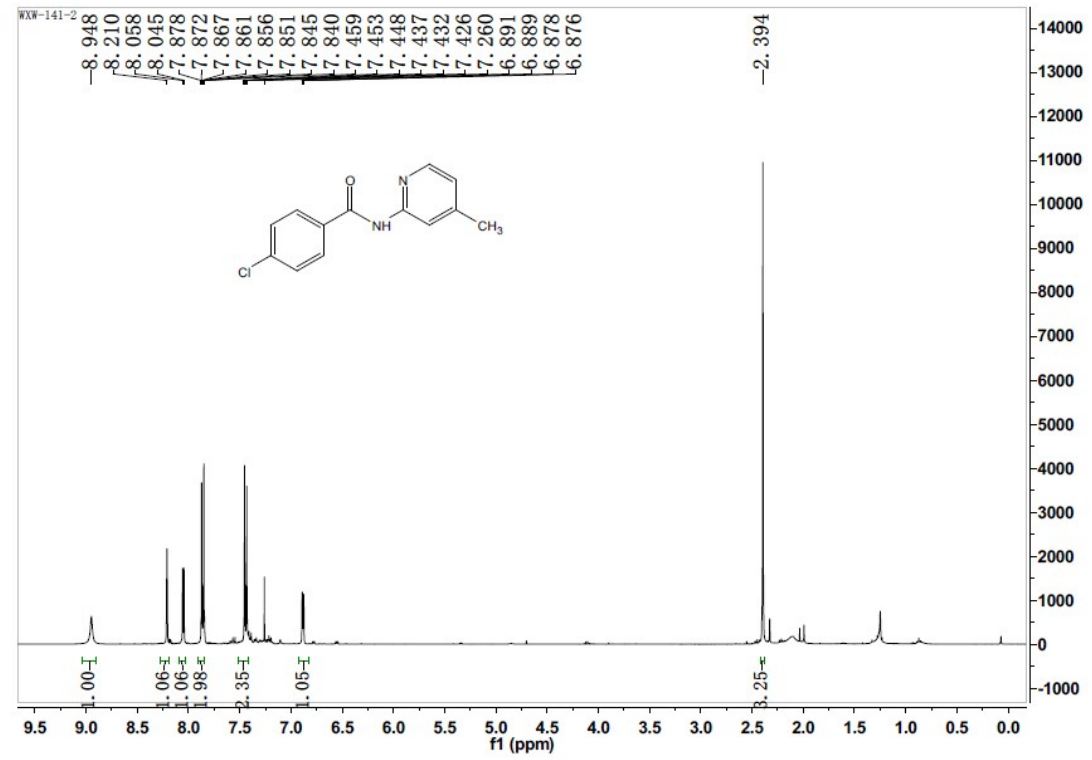


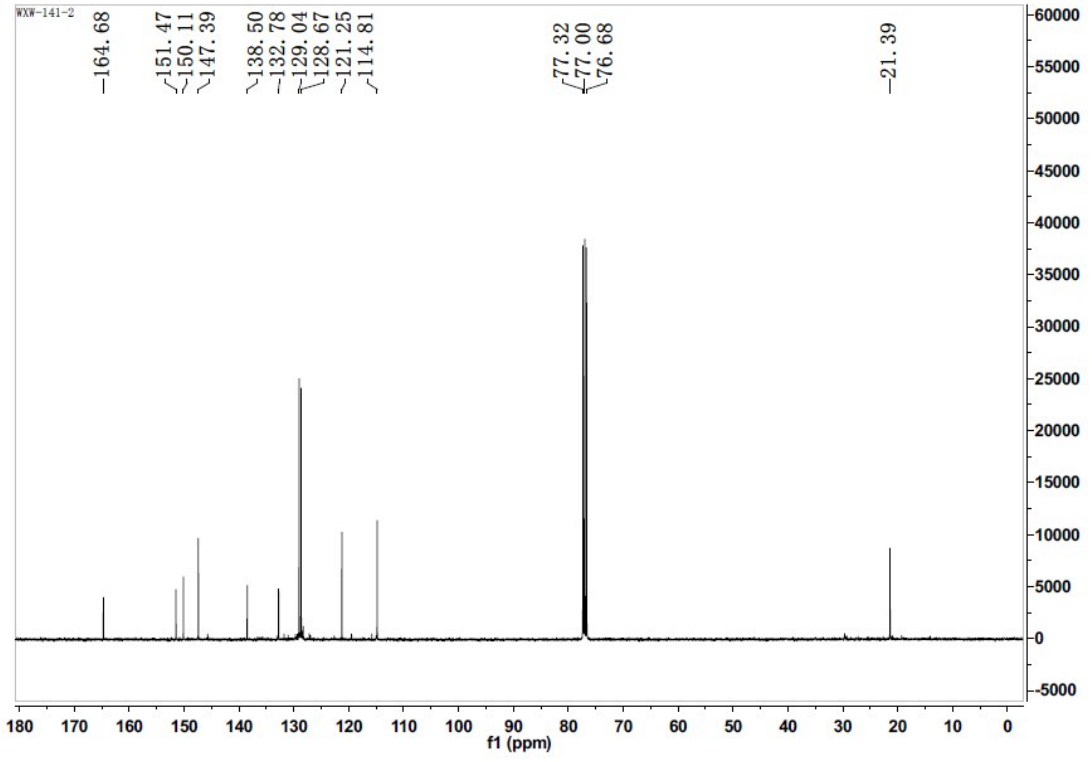
^{1}H NMR and ^{13}C NMR of 4-chloro-*N*-(5-methylpyridin-2-yl)benzamide (4s)



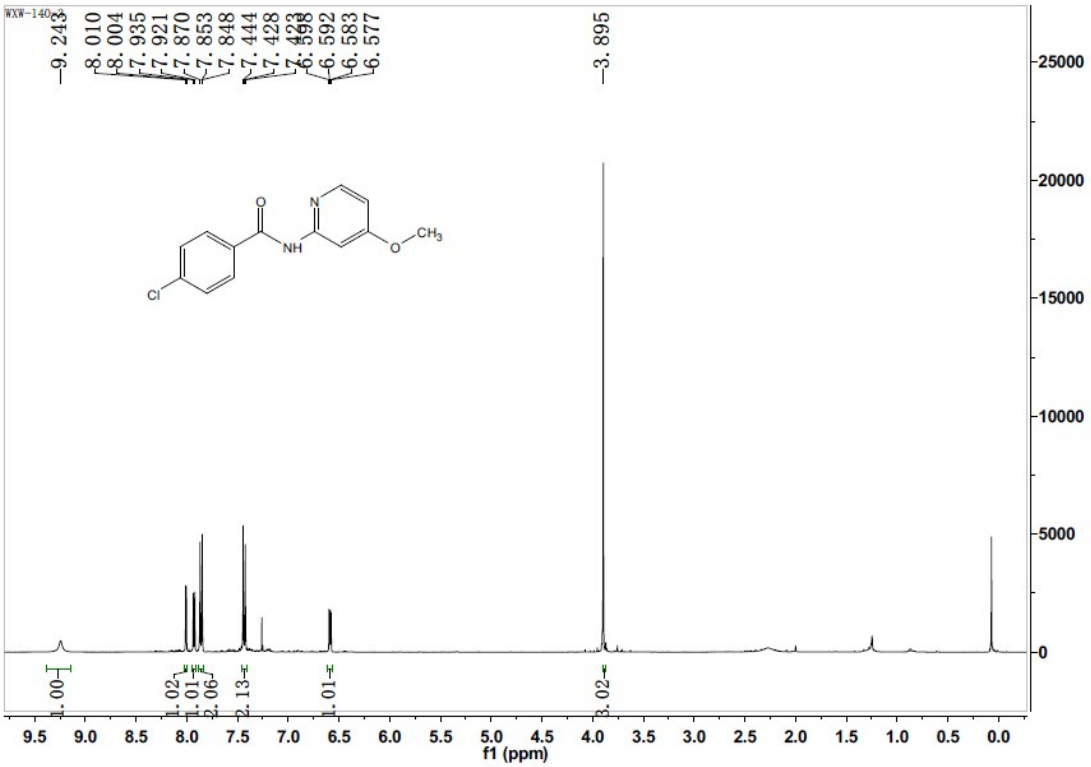


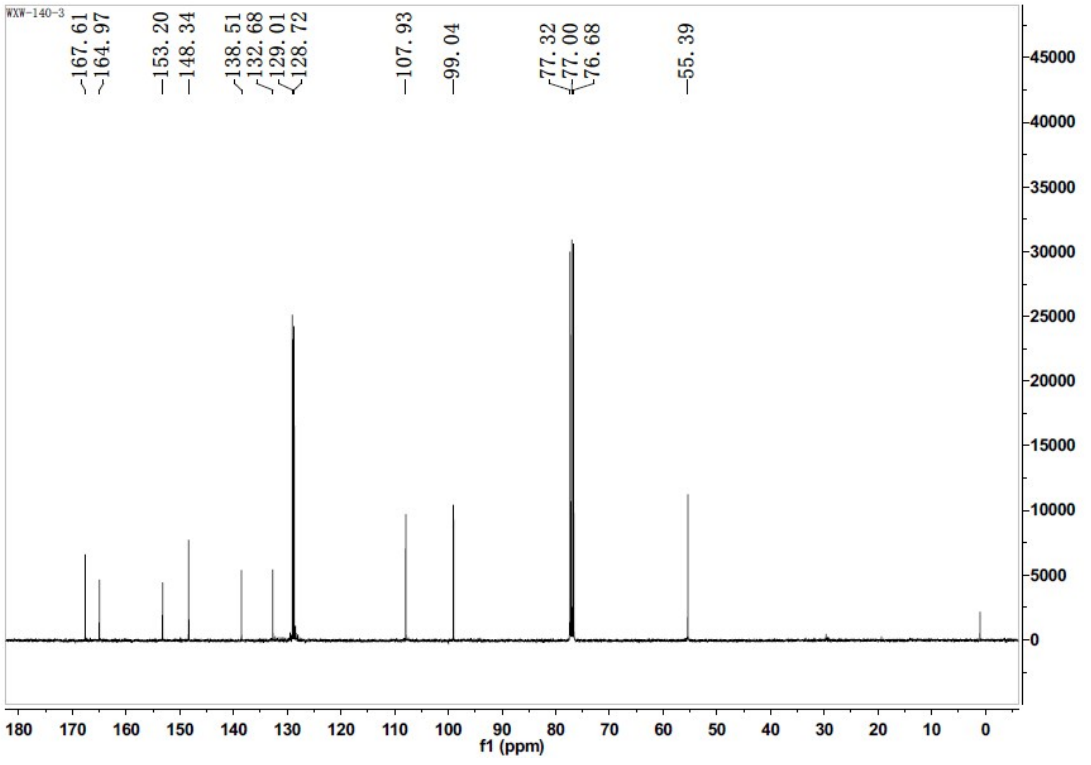
^{1}H NMR and ^{13}C NMR of 4-chloro-*N*-(4-methylpyridin-2-yl)benzamide (4t)



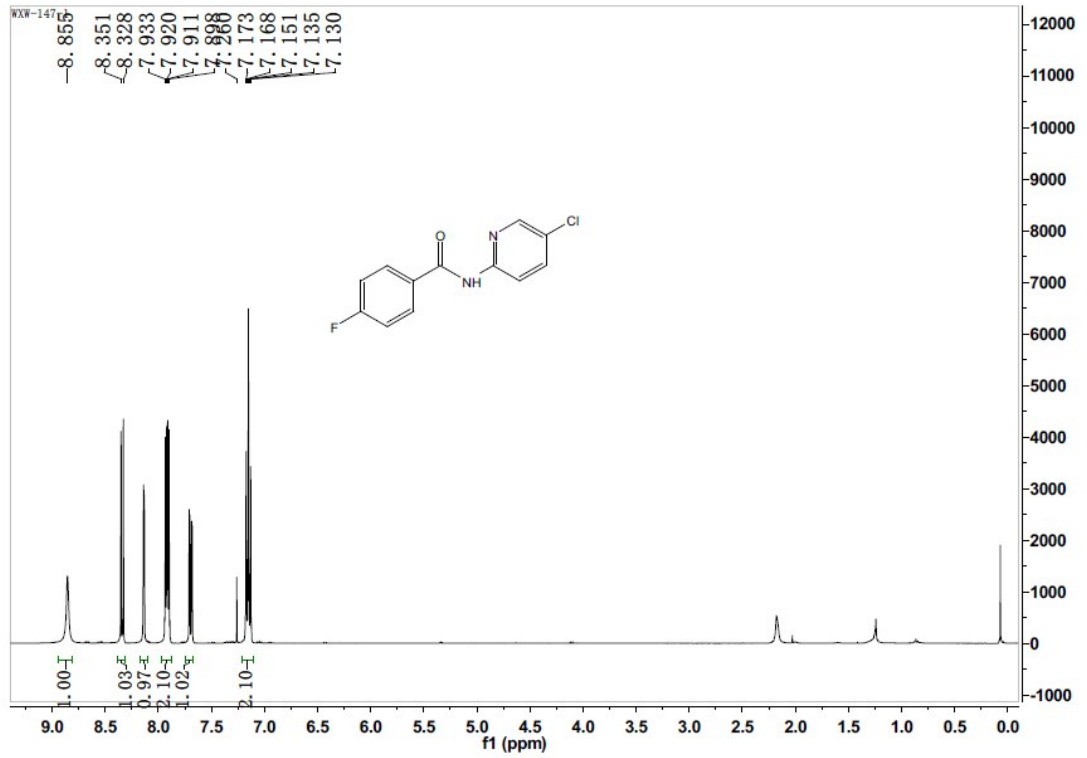


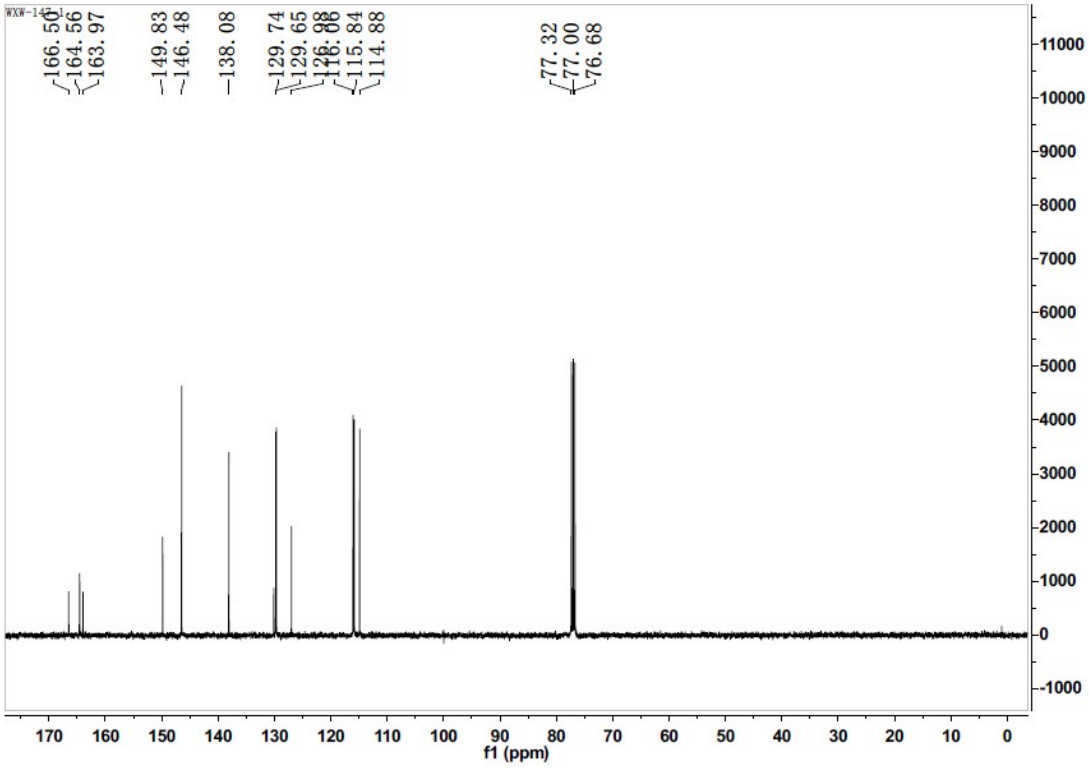
^{1}H NMR and ^{13}C NMR of 4-chloro-*N*-(4-methoxypyridin-2-yl)benzamide (4u)



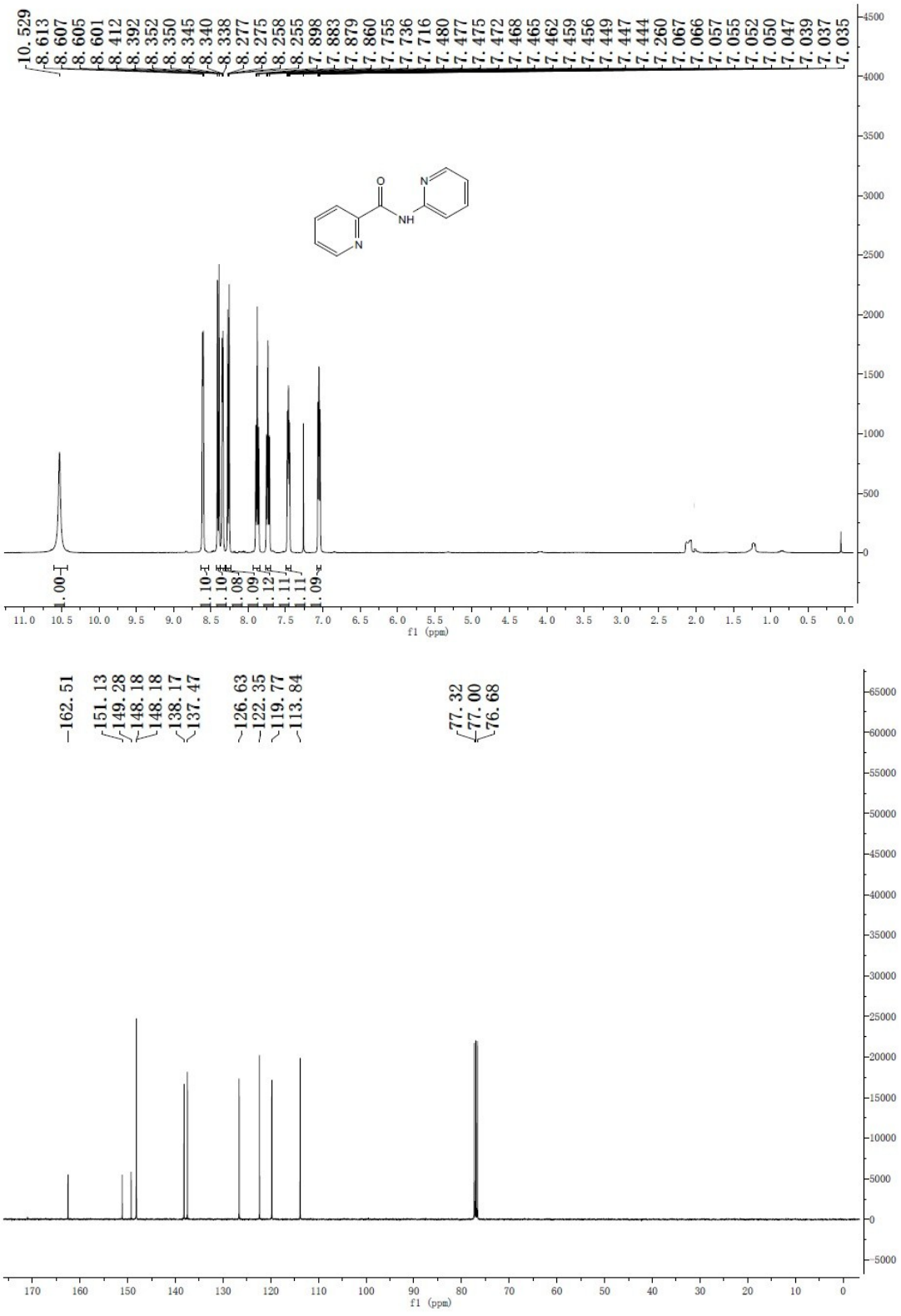


^{1}H NMR and ^{13}C NMR of *N*-(5-chloropyridin-2-yl)-4-fluorobenzamide (4v)

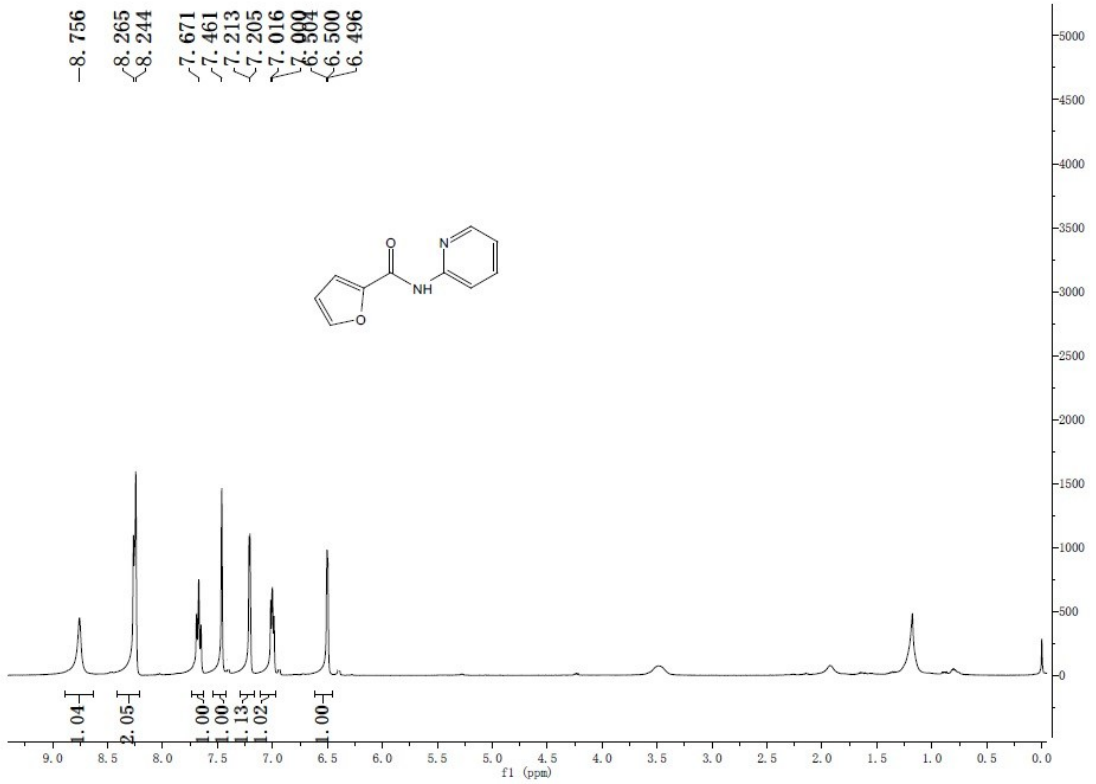


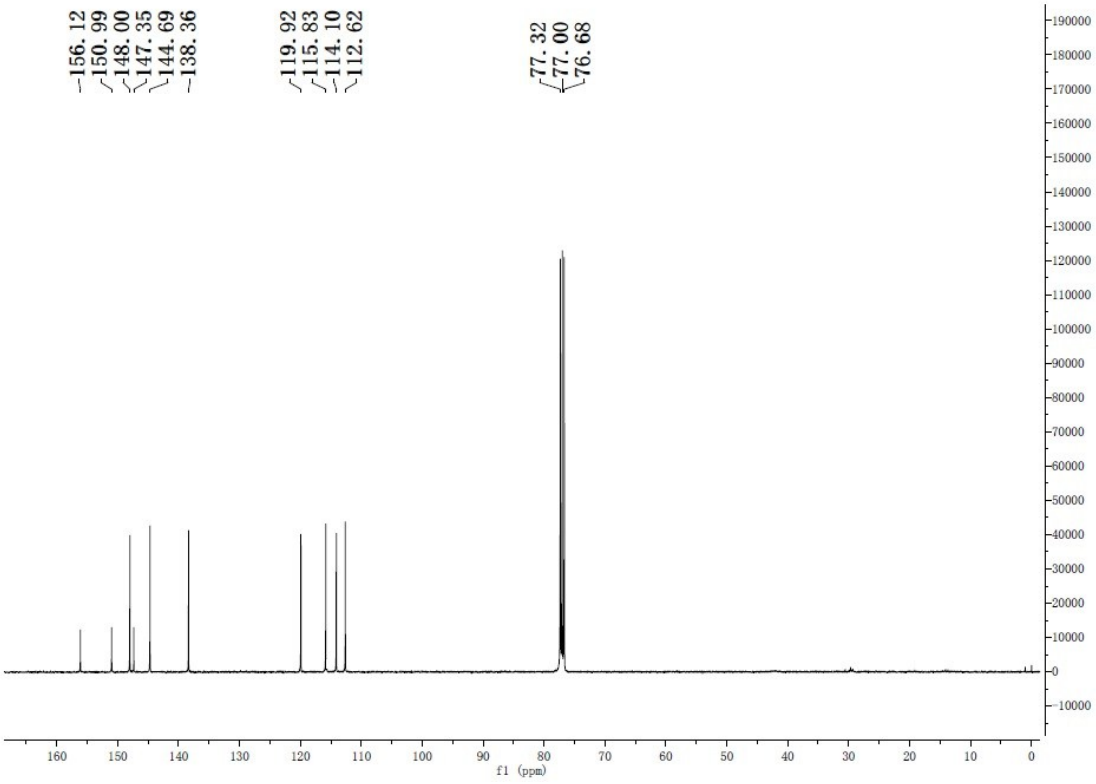


^{1}H NMR and ^{13}C NMR of *N*-(pyridin-2-yl)picolinamide (4w)

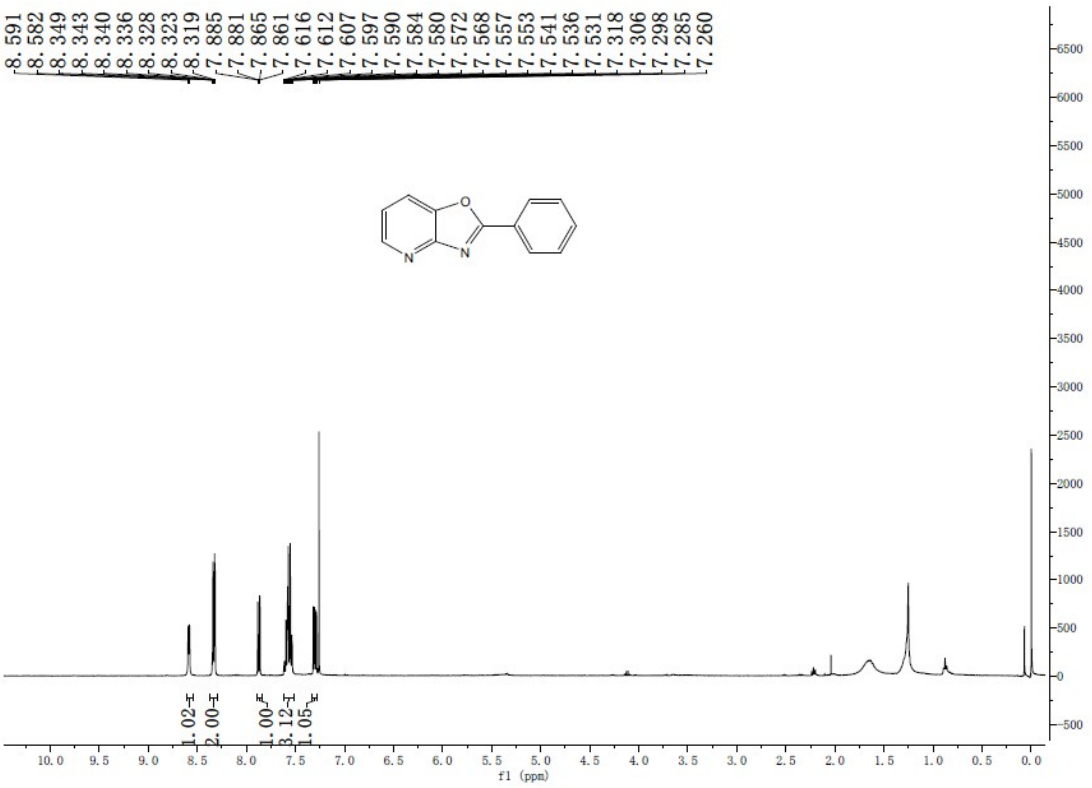


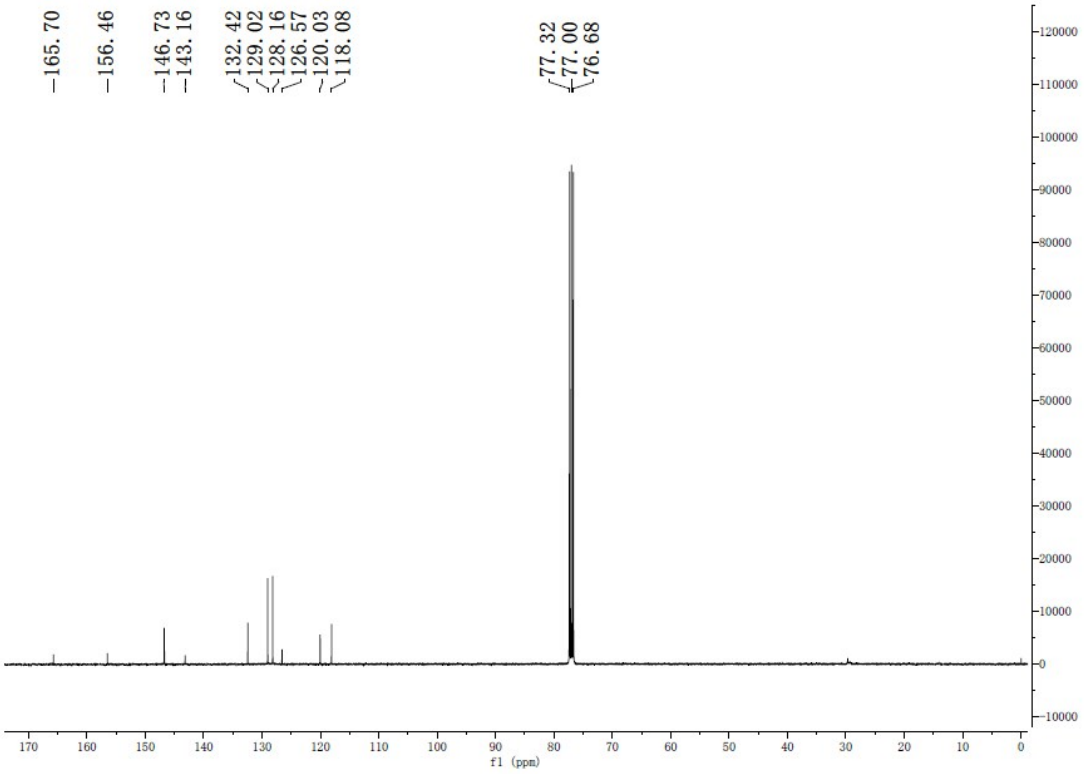
^{1}H NMR and ^{13}C NMR of *N*-(pyridin-2-yl)furan-2-carboxamide (4x)



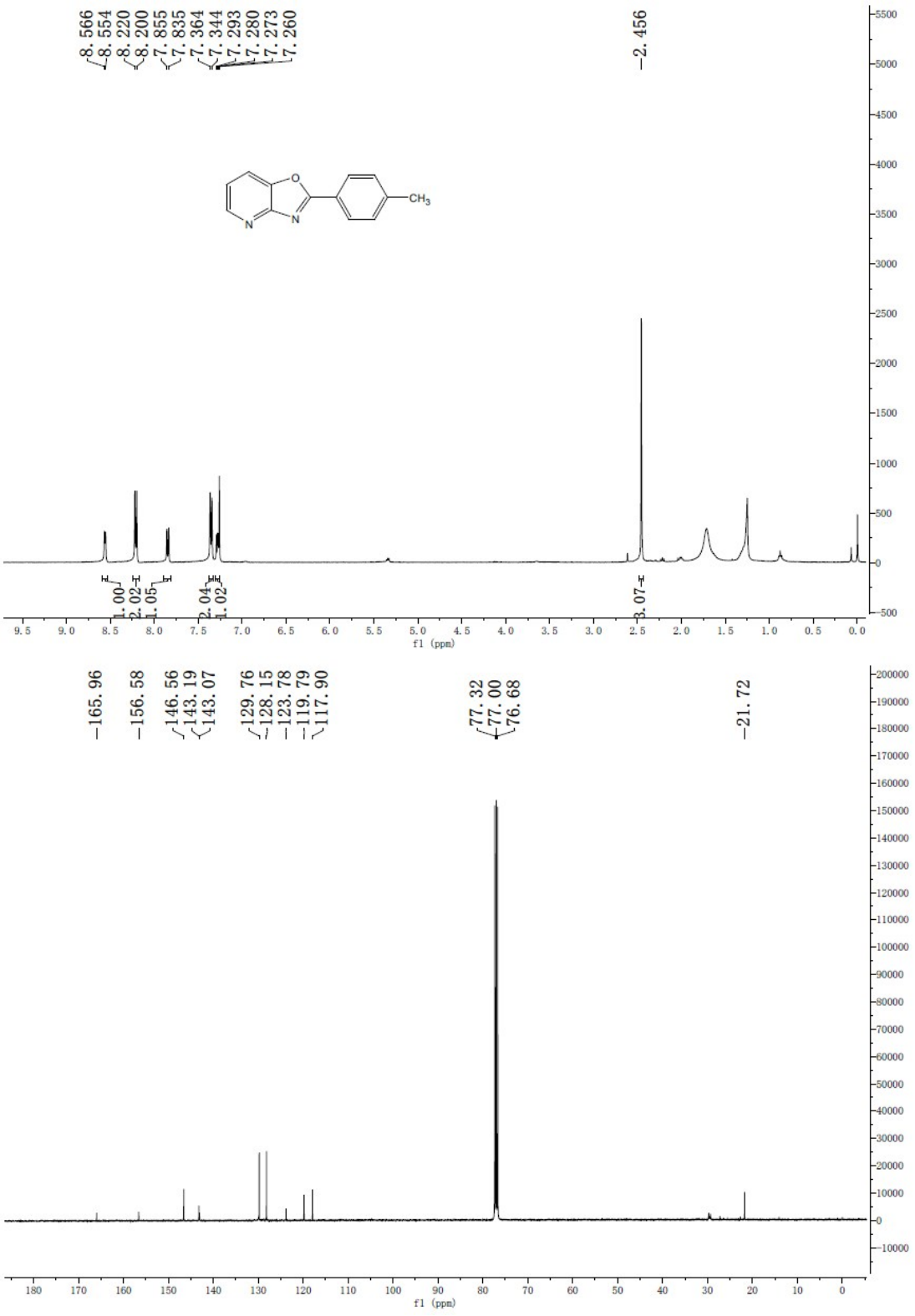


^{1}H NMR and ^{13}C NMR of 2-phenyloxazolo[4,5-b]pyridine (5a)

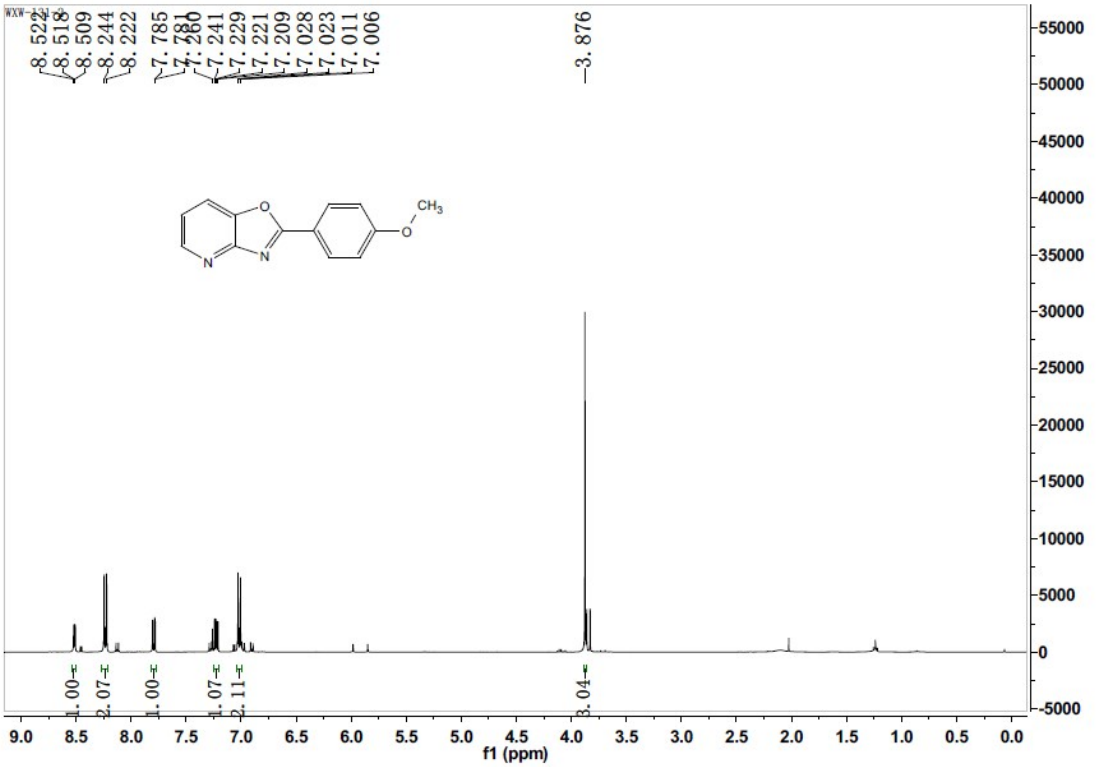


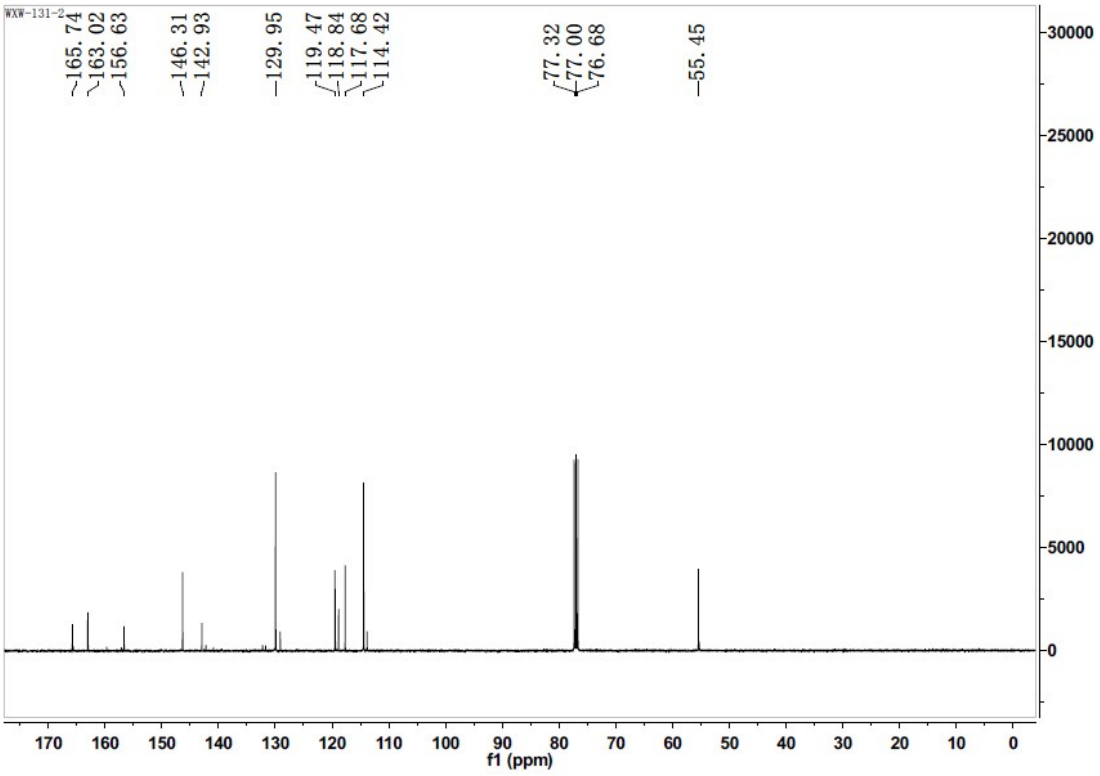


^{1}H NMR and ^{13}C NMR of 2-(*p*-tolyl)oxazolo[4,5-b]pyridine (5b)

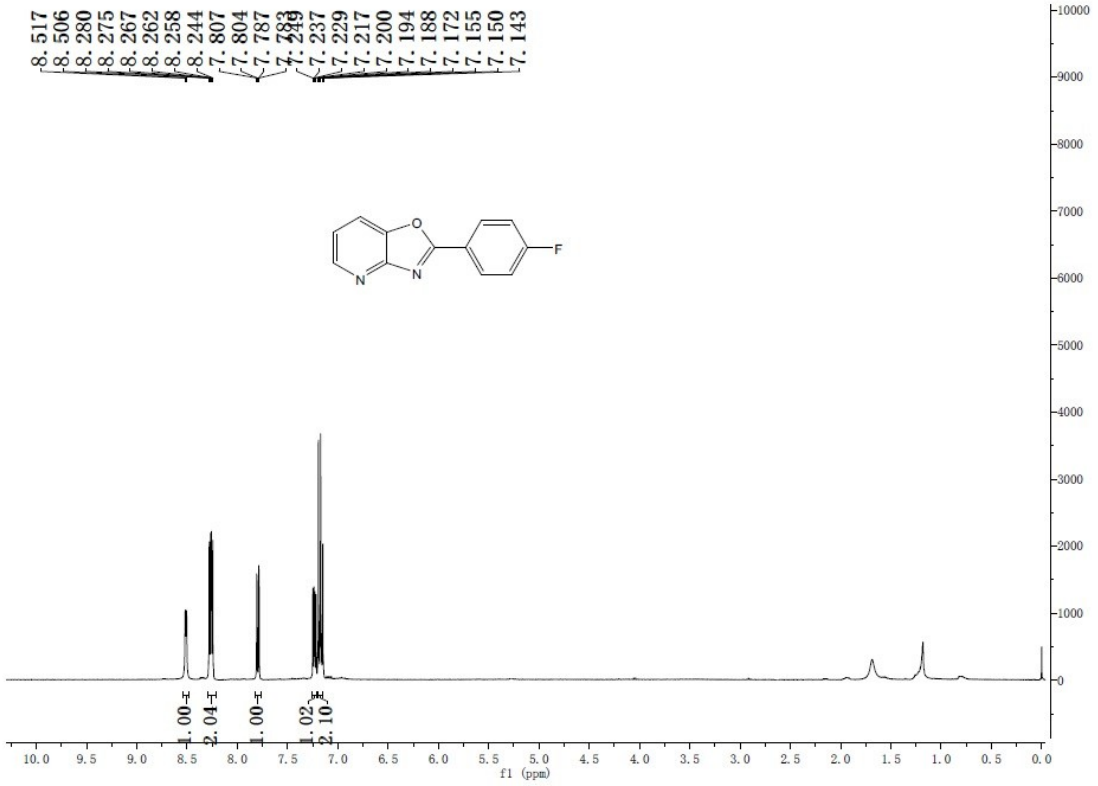


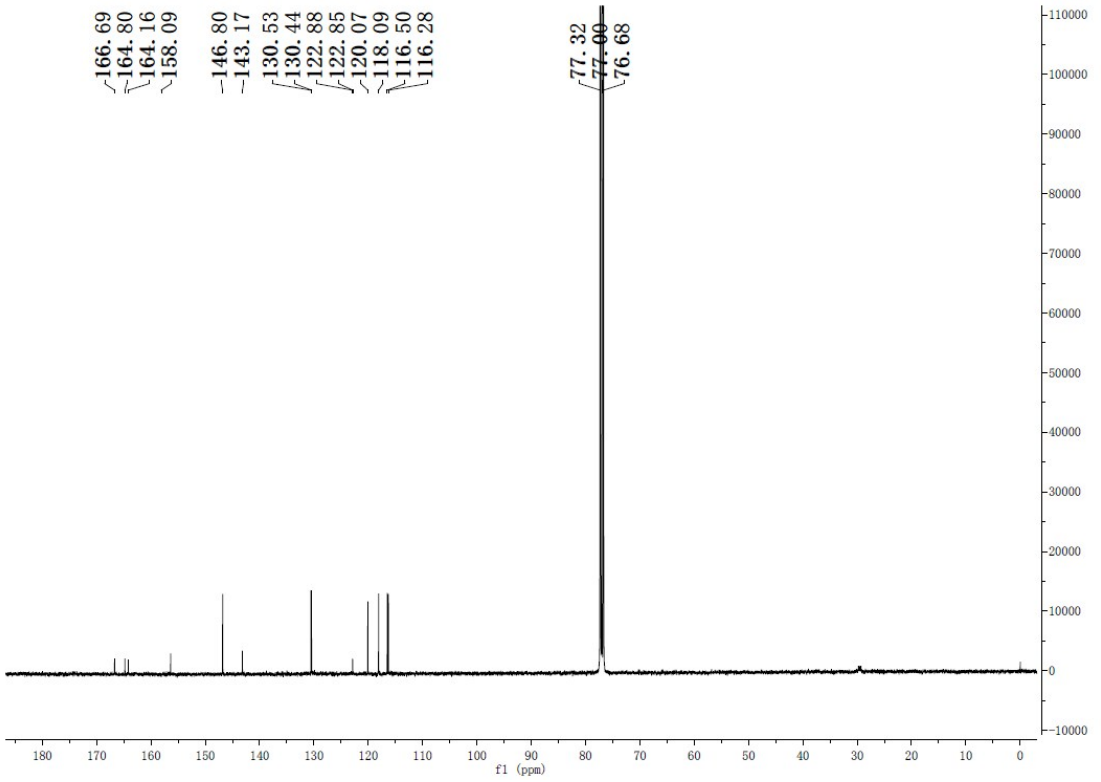
^{1}H NMR and ^{13}C NMR of 2-(4-methoxyphenyl)oxazolo[4,5-b]pyridine (5c)



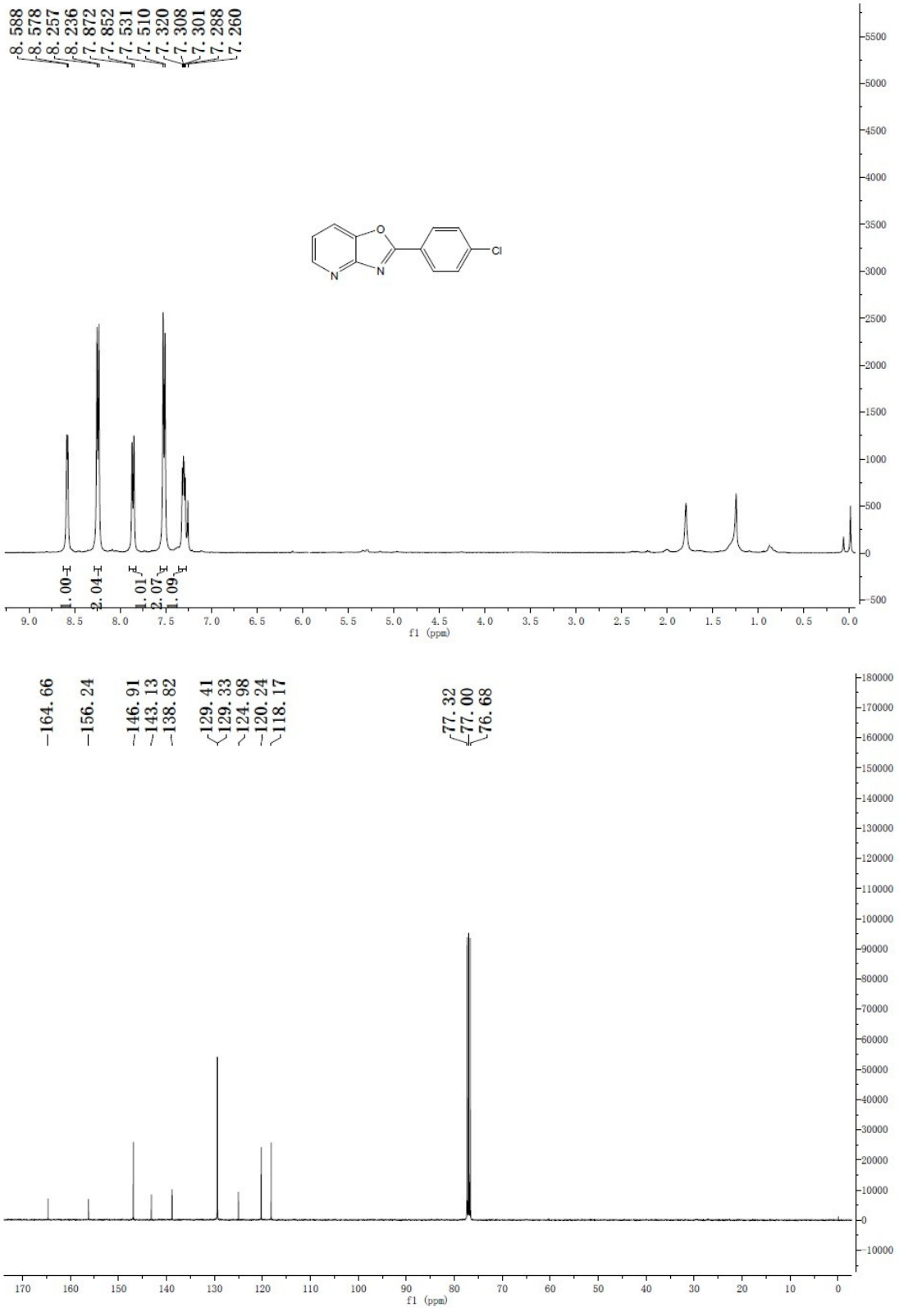


^{1}H NMR and ^{13}C NMR of 2-(4-fluorophenyl)oxazolo[4,5-b]pyridine (5d)

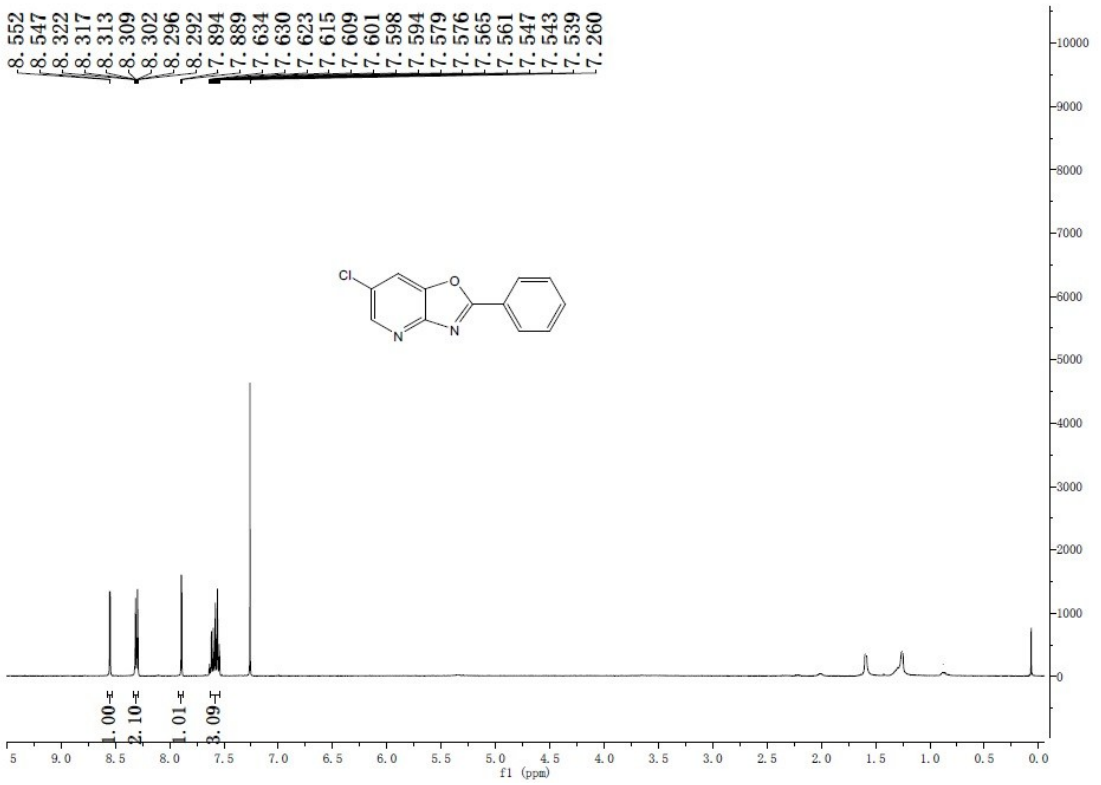


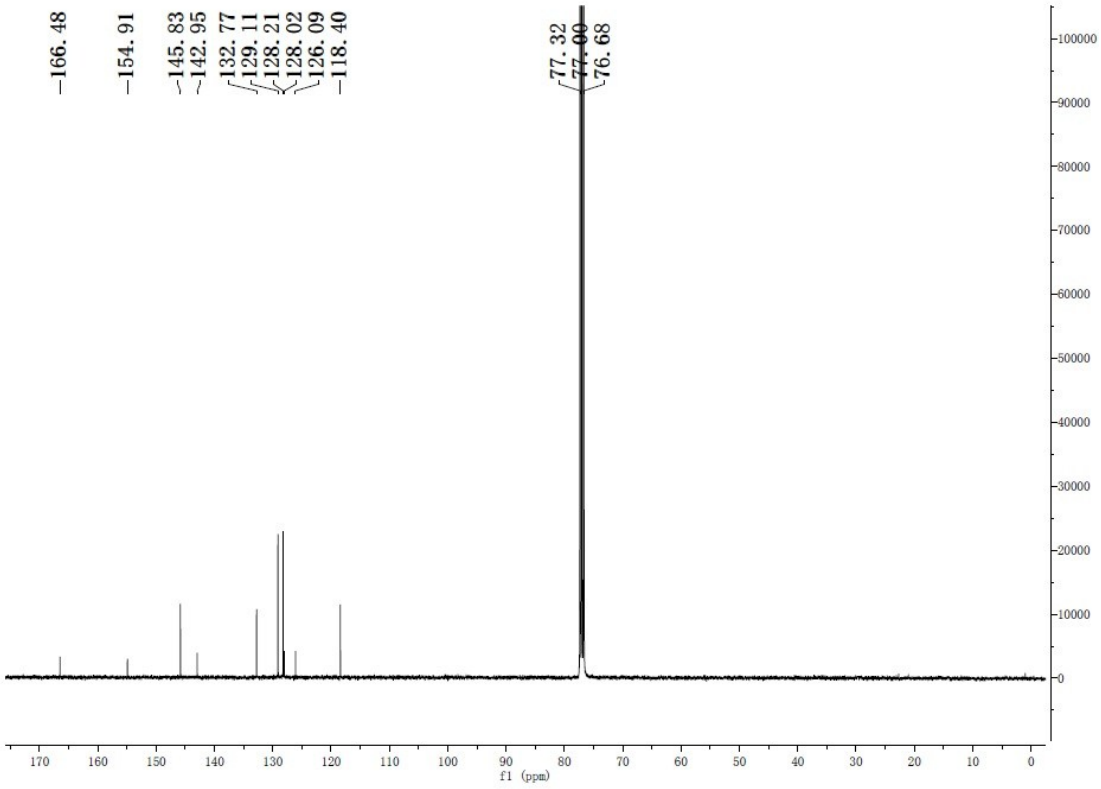


^{1}H NMR and ^{13}C NMR of 2-(4-chlorophenyl)oxazolo[4,5-b]pyridine (5e)

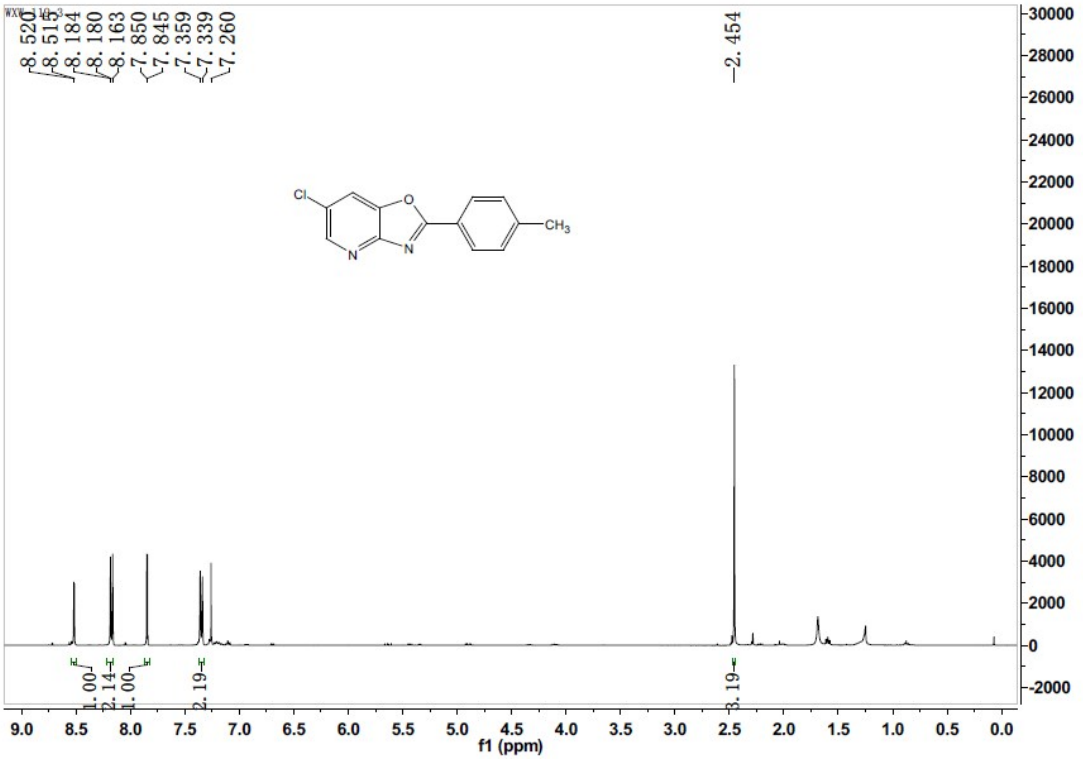


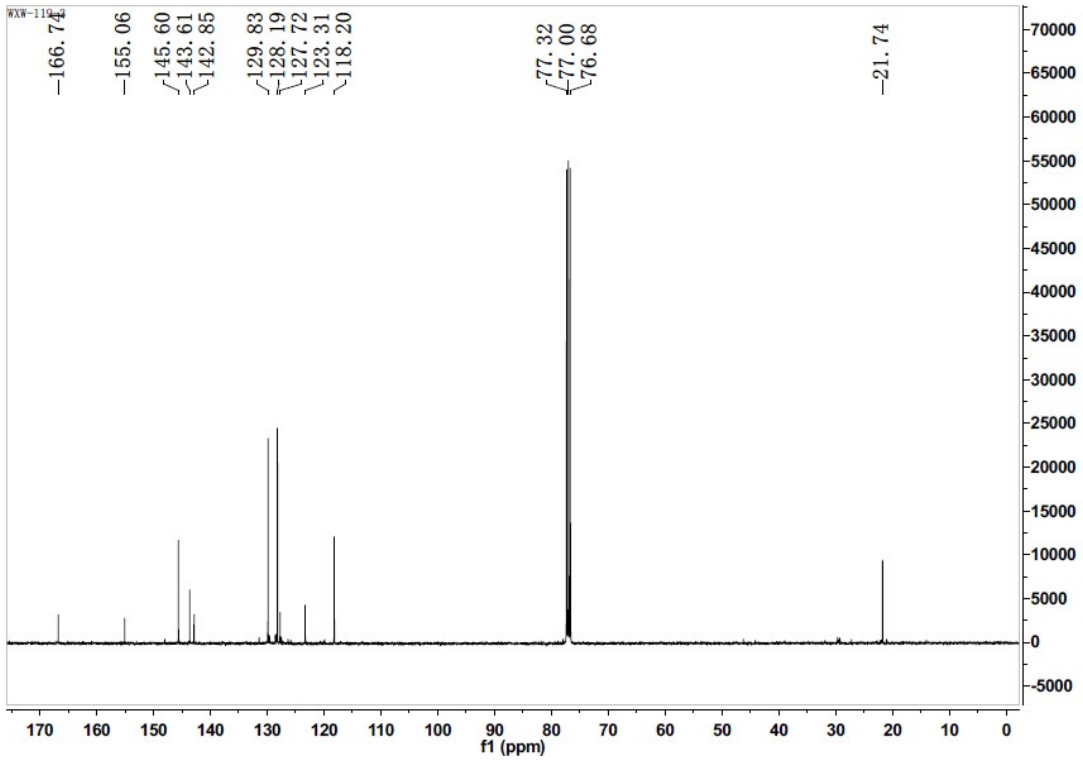
^{1}H NMR and ^{13}C NMR of 6-chloro-2-phenyloxazolo[4,5-b]pyridine (5f)





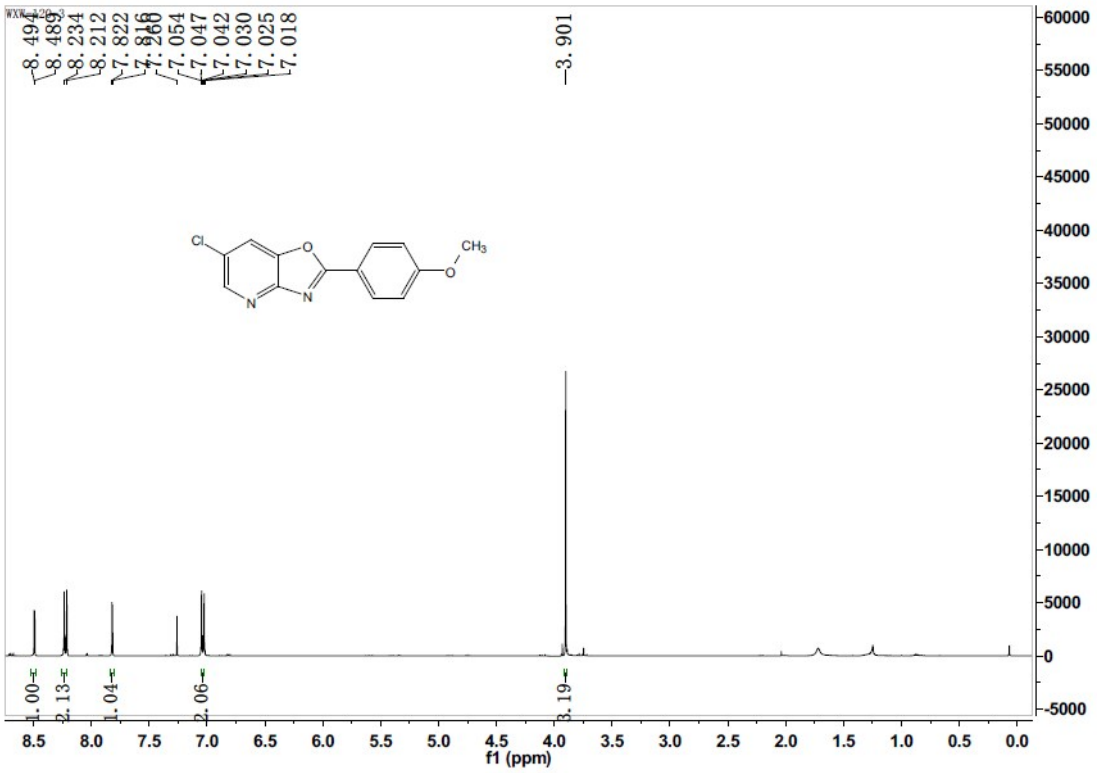
^{1}H NMR and ^{13}C NMR of6-chloro-2-(*p*-tolyl)oxazolo[4,5-b]pyridine (5g)

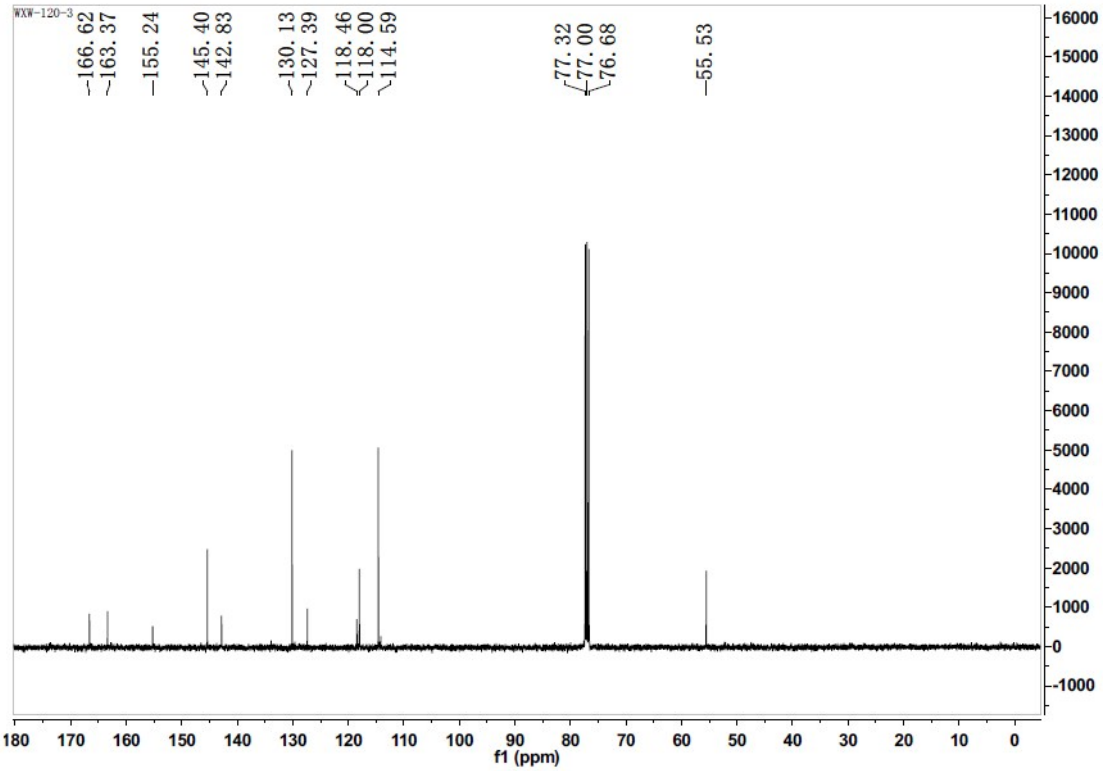




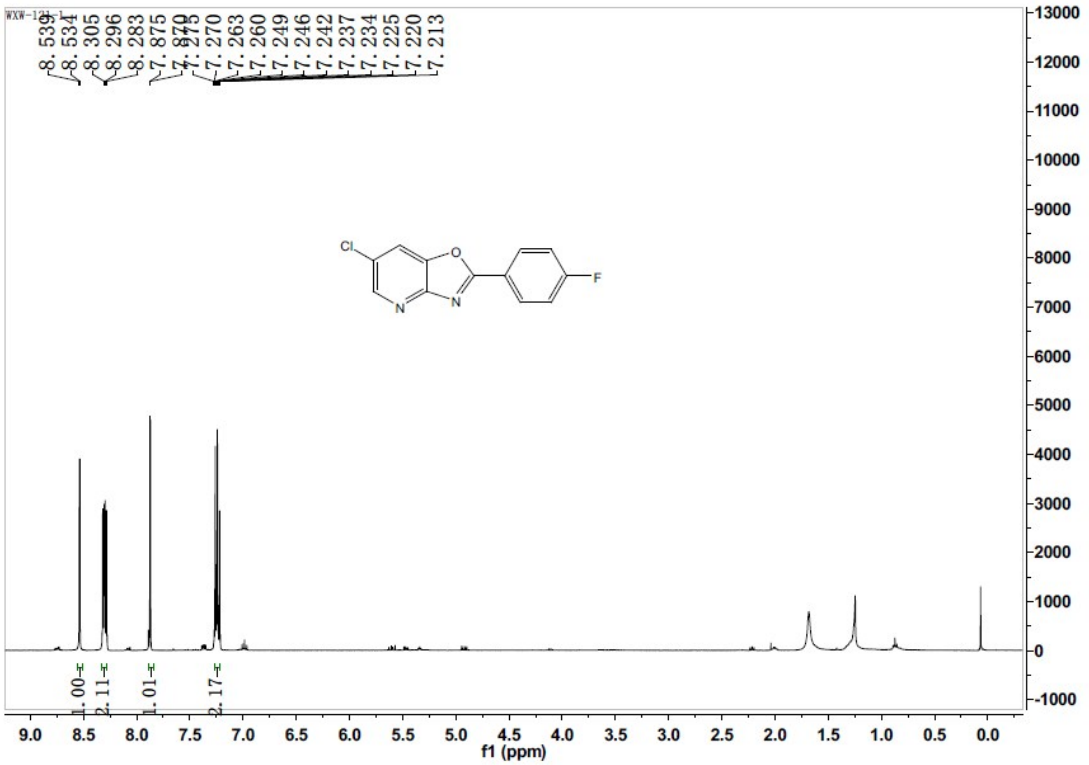
^{1}H NMR and ^{13}C NMR of 6-chloro-2-(4-methoxyphenyl)oxazolo[4,5-b]pyridine

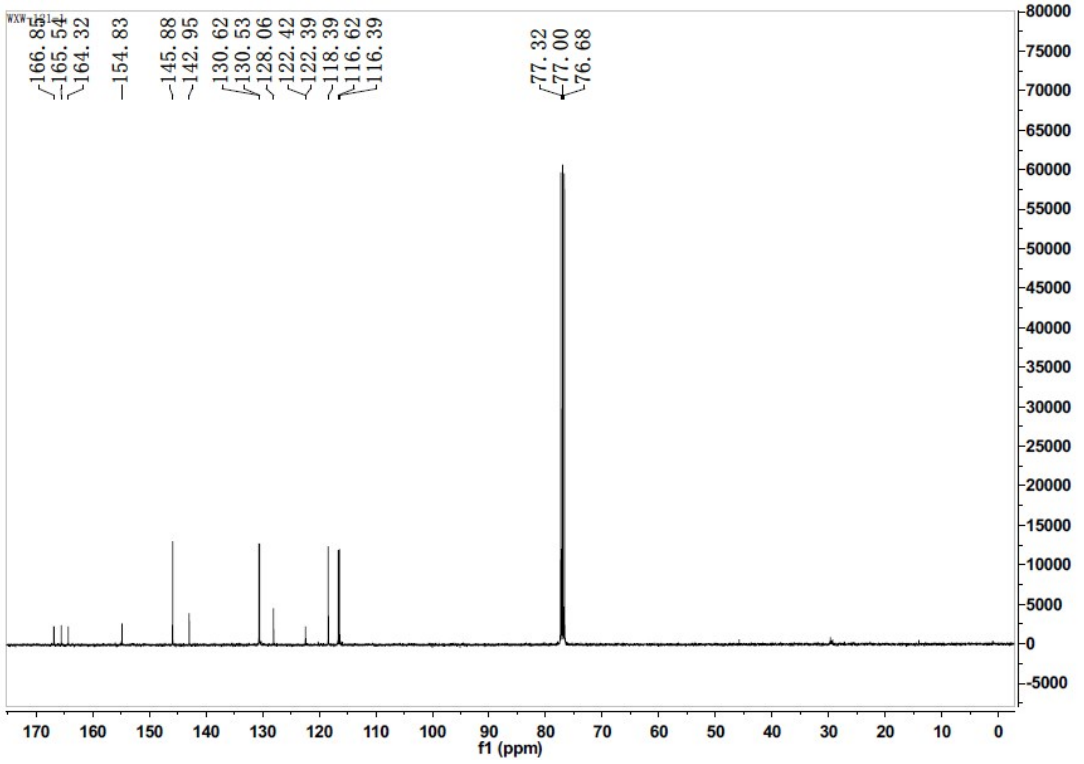
(5h)



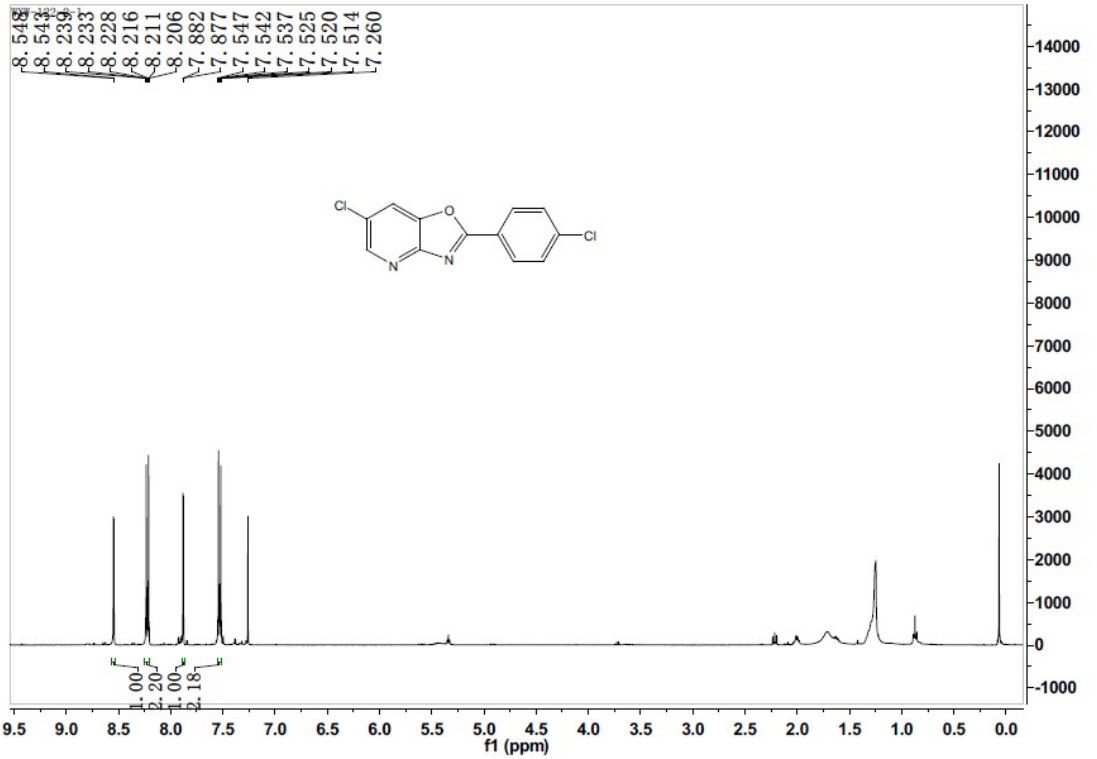


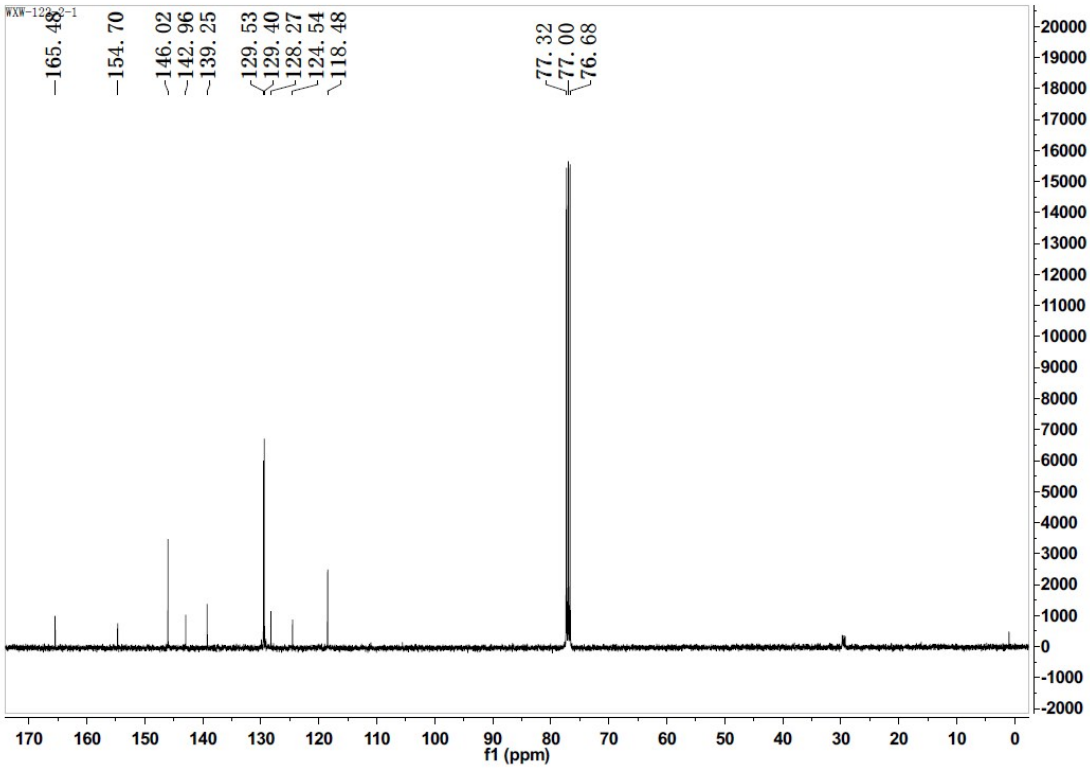
^{1}H NMR and ^{13}C NMR of 6-chloro-2-(4-fluorophenyl)oxazolo[4,5-b]pyridine (5i)



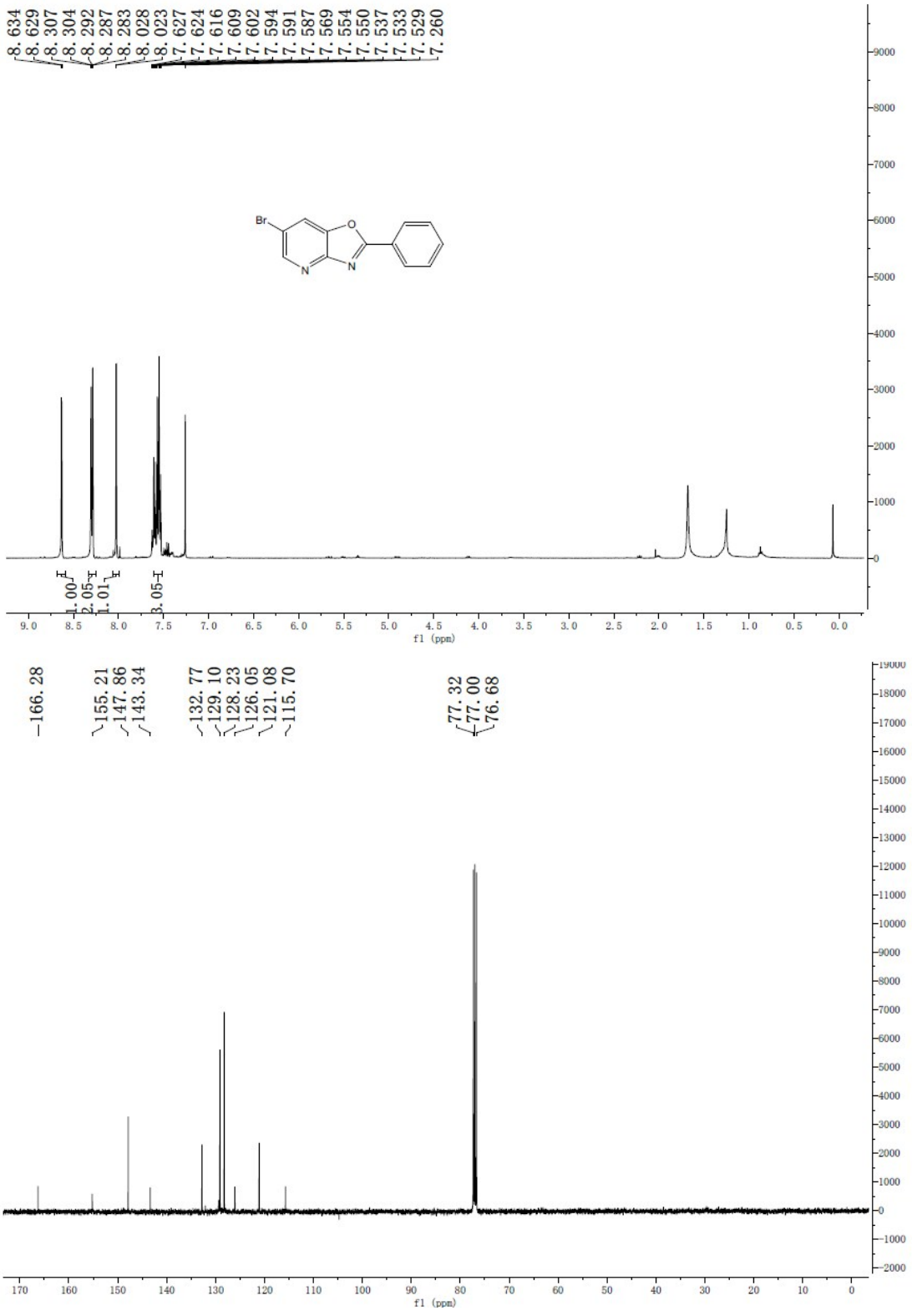


^{1}H NMR and ^{13}C NMR of 6-chloro-2-(4-chlorophenyl)oxazolo[4,5-b]pyridine (5j)

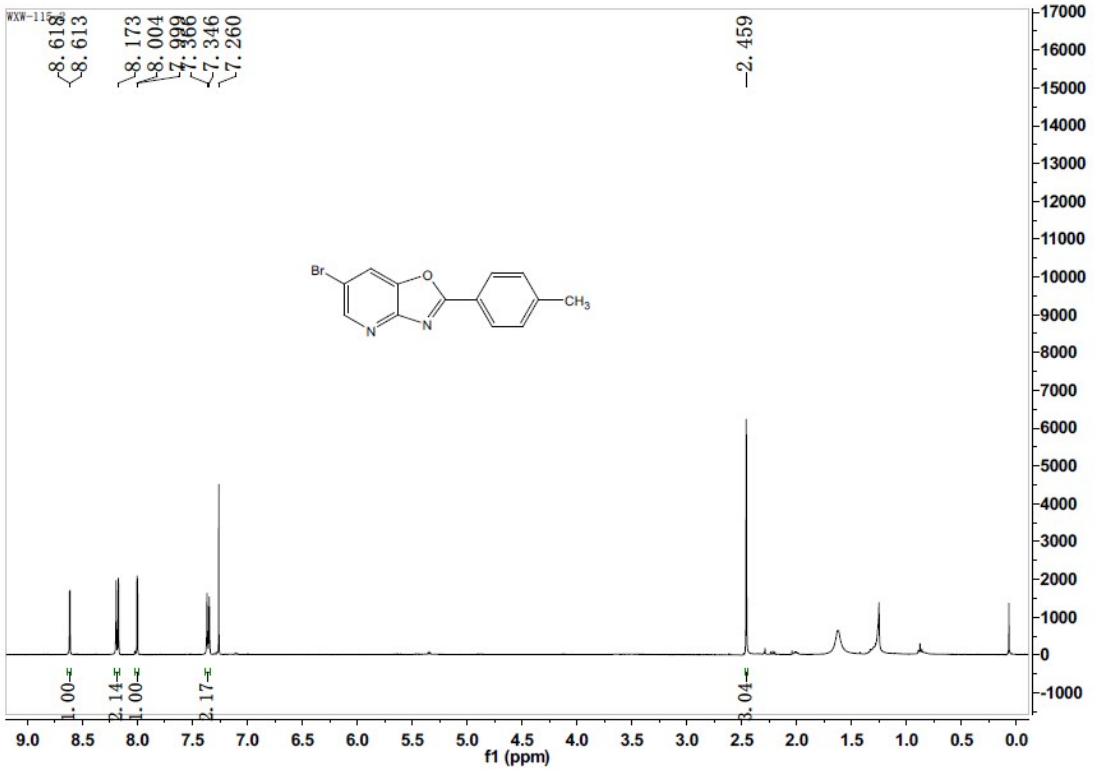


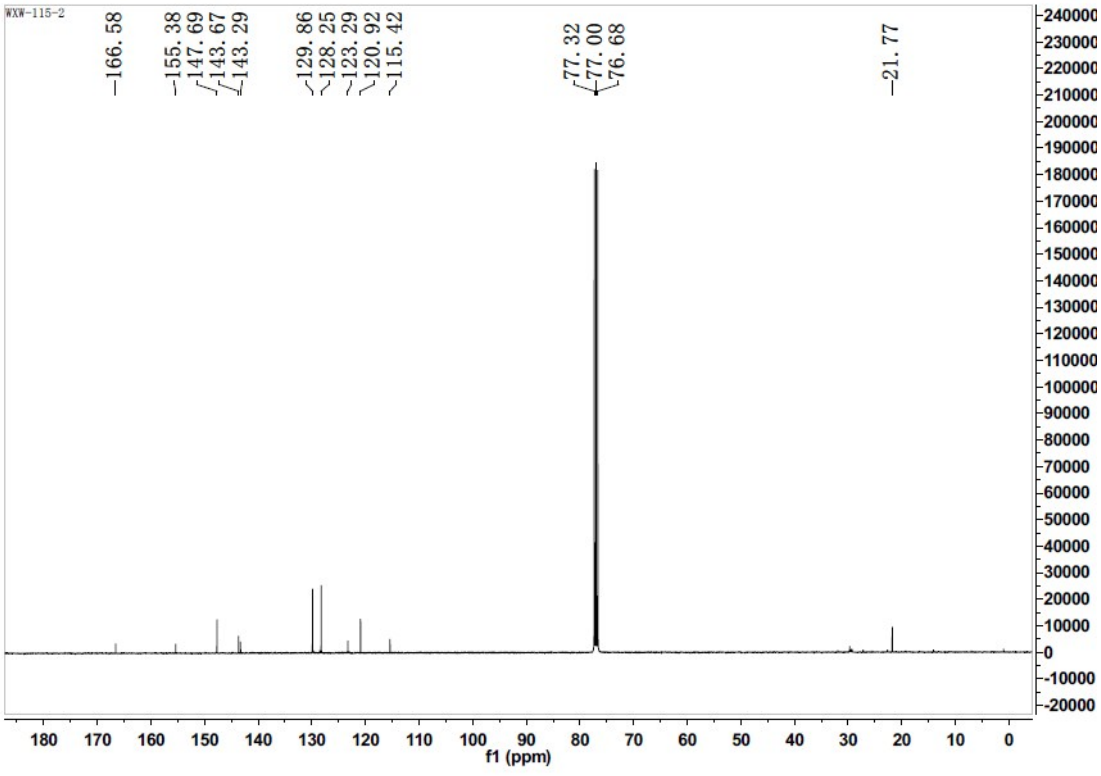


^{1}H NMR and ^{13}C NMR of 6-bromo-2-phenyloxazolo[4,5-b]pyridine (5k)



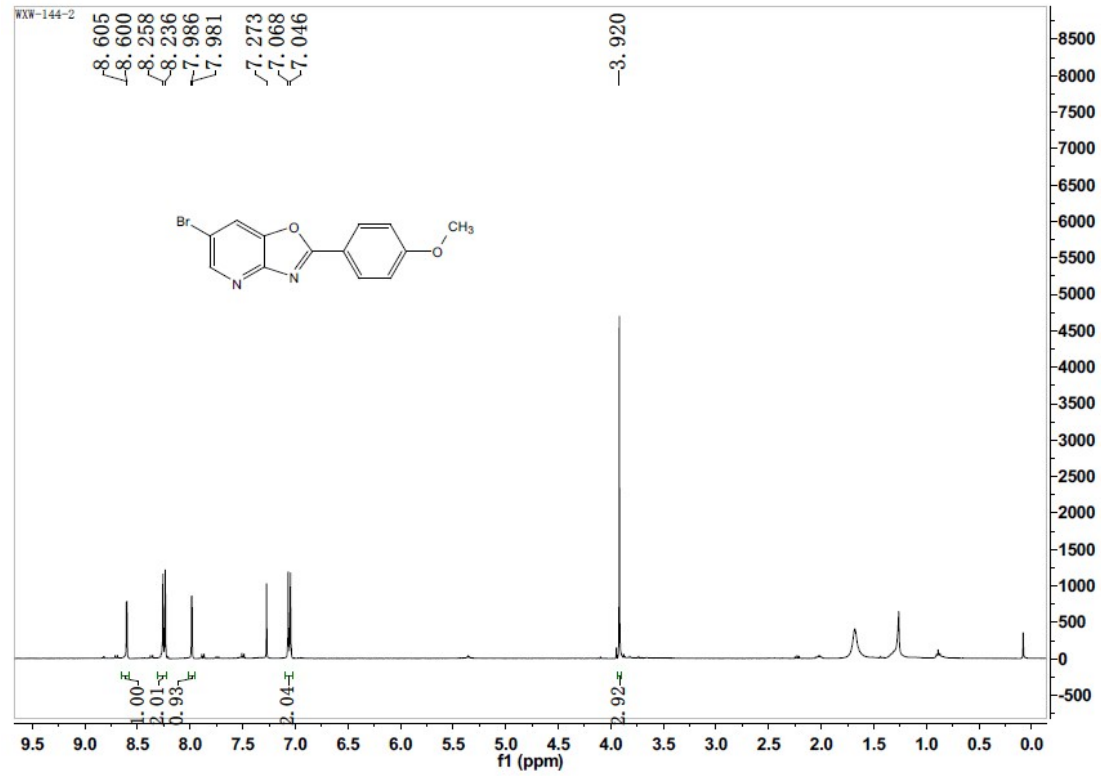
^{1}H NMR and ^{13}C NMR of 6-bromo-2-(*p*-tolyl)oxazolo[4,5-b]pyridine (5l)

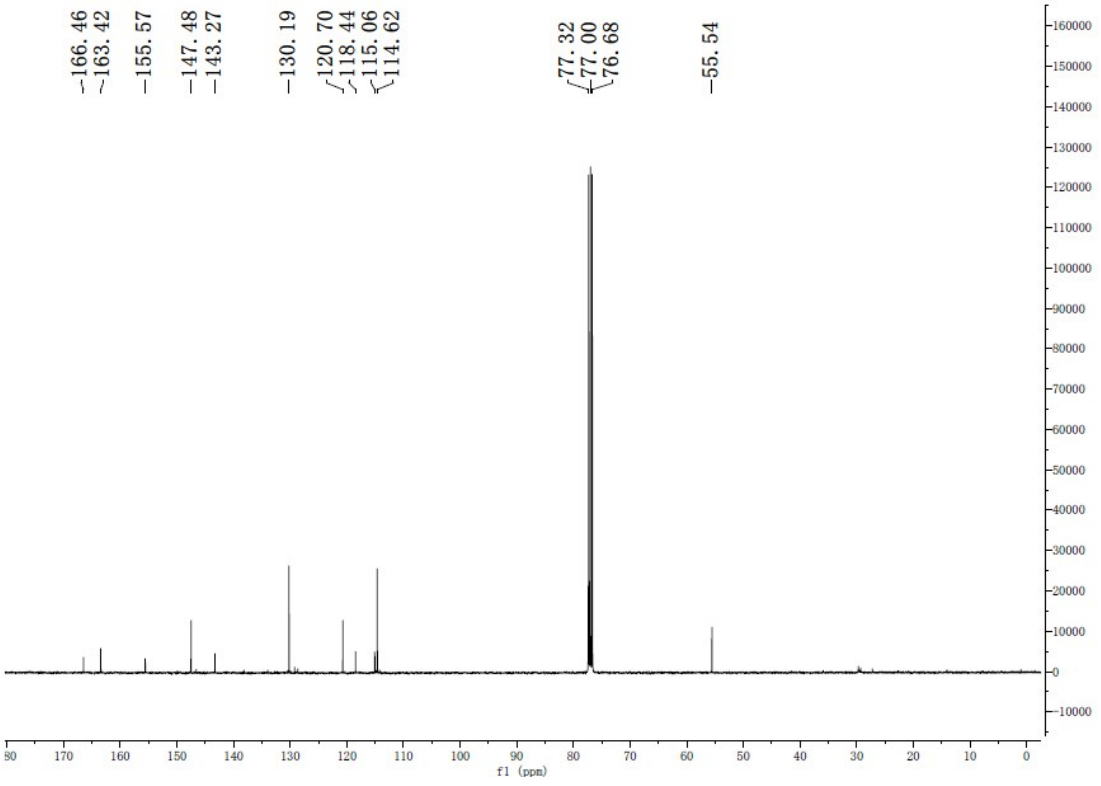




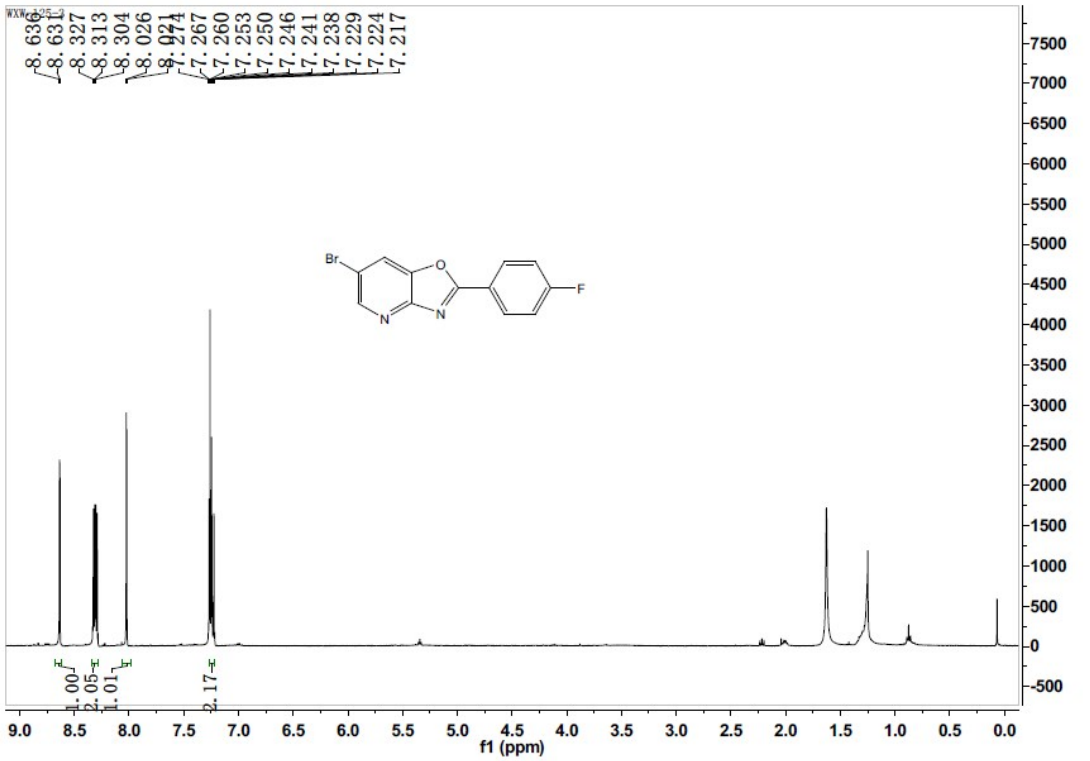
^{1}H NMR and ^{13}C NMR of 6-bromo-2-(4-methoxyphenyl)oxazolo[4,5-b]pyridine

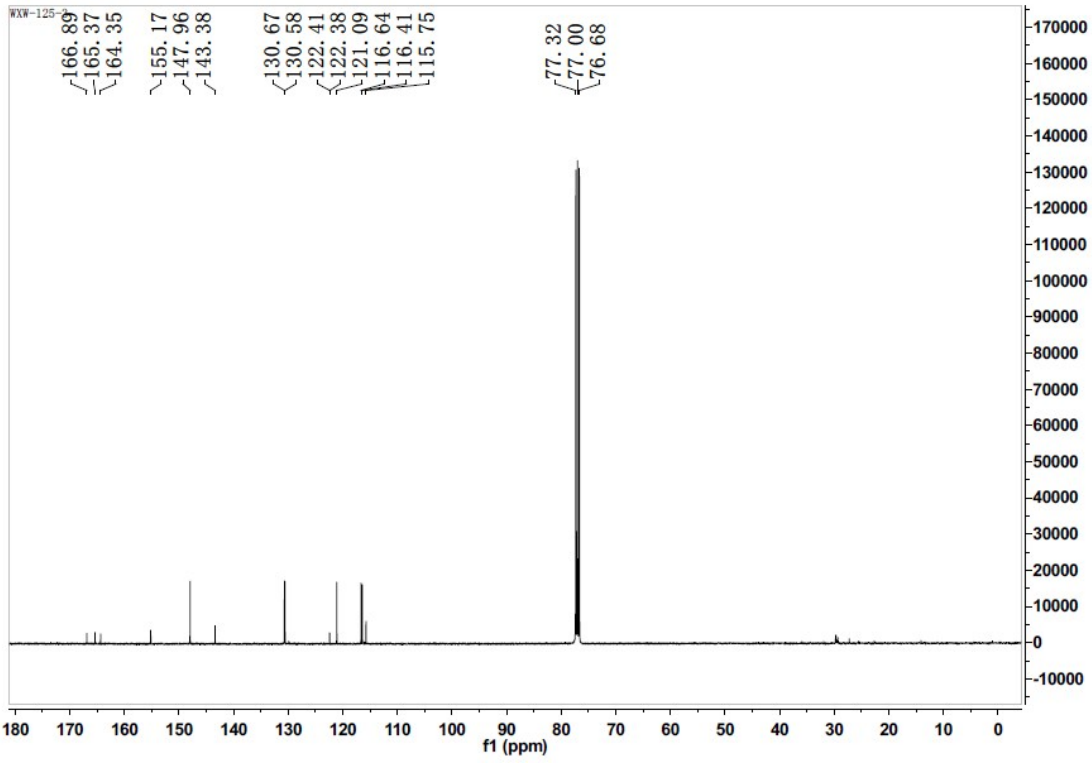
(5m)



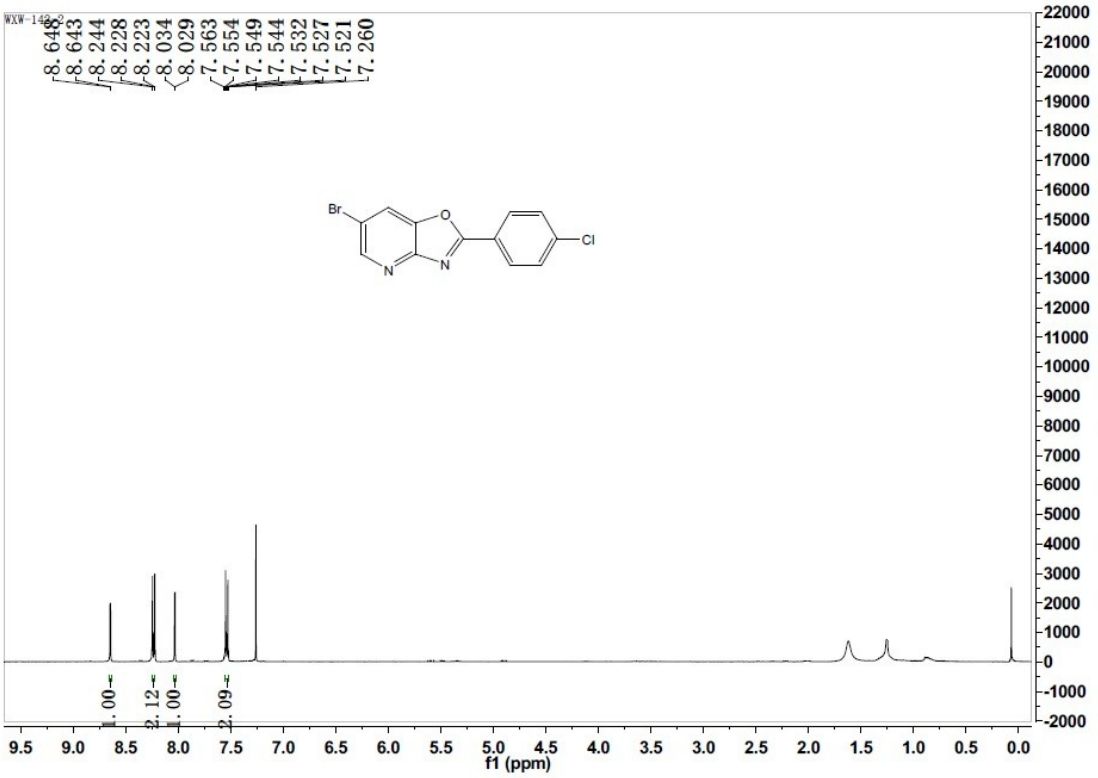


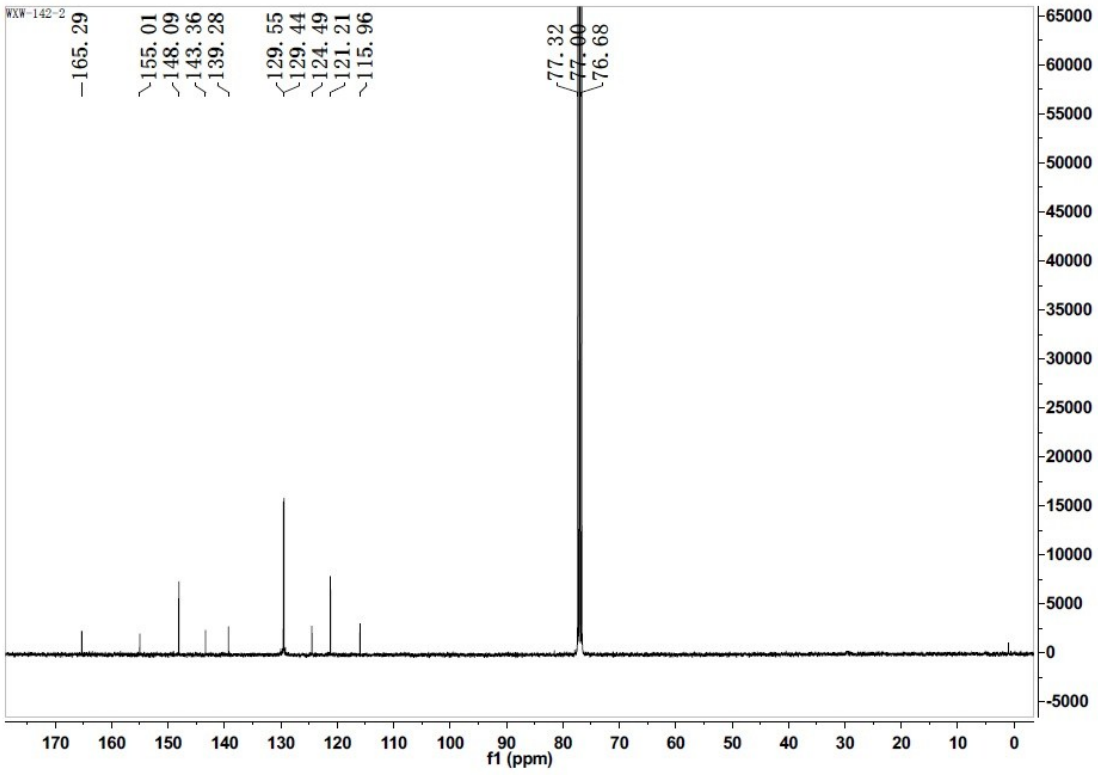
^{1}H NMR and ^{13}C NMR of 6-bromo-2-(4-fluorophenyl)oxazolo[4,5-b]pyridine (5n)



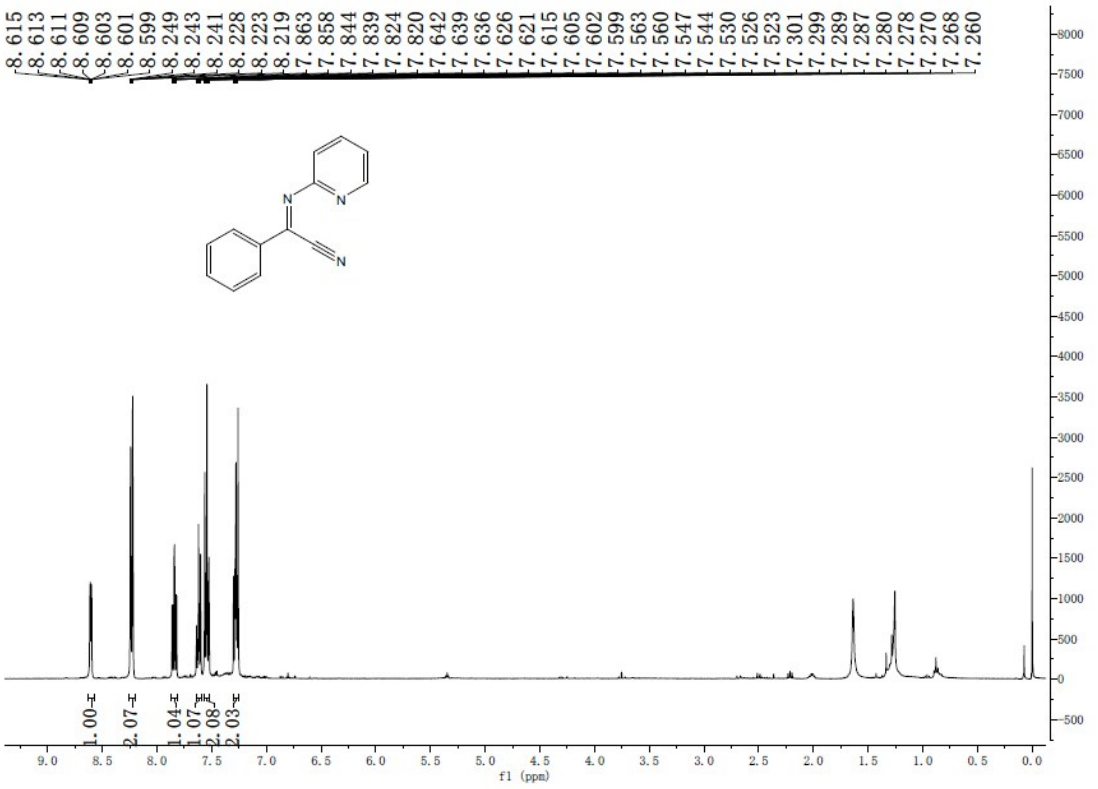


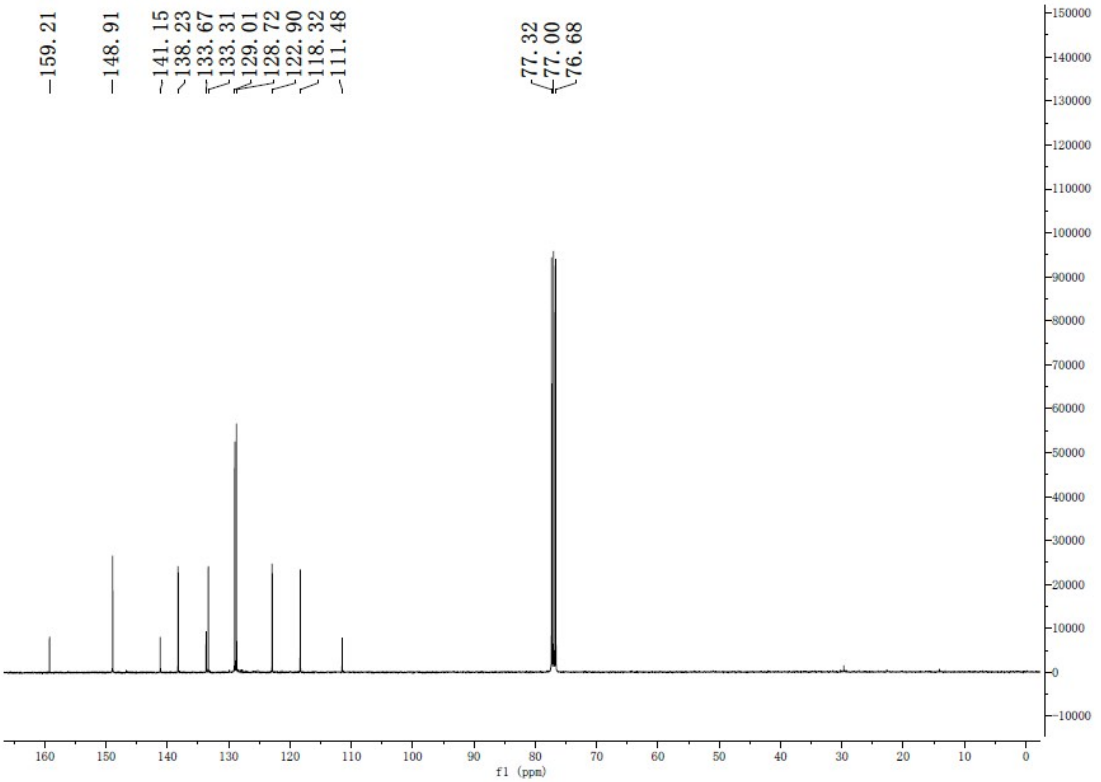
^{1}H NMR and ^{13}C NMR of 6-bromo-2-(4-chlorophenyl)oxazolo[4,5-b]pyridine (5o)





^{1}H NMR and ^{13}C NMR of (Z)-*N*-(pyridin-2-yl)benzimidoyl cyanide (F)


8.615
8.613
8.611
8.609
8.603
8.601
8.599
8.249
8.243
8.241
8.228
8.223
8.219
7.863
7.858
7.844
7.839
7.824
7.820
7.642
7.639
7.636
7.626
7.621
7.615
7.605
7.602
7.599
7.563
7.560
7.547
7.544
7.530
7.526
7.523
7.301
7.299
7.289
7.287
7.280
7.278
7.270
7.268
7.260
N
N
N
1.00
2.07
1.04
1.07
2.08
2.03
f1 (ppm)


159.21
148.91
141.15
138.23
133.67
133.31
129.01
128.72
122.90
118.32
111.48
77.32
77.00
76.68
f1 (ppm)