Electronic Supplementary Material (ESI) for ChemComm.

Supporting information

Photocatalytic cyclization of 3-(2-isocyanophenyl)quinazolin-4(3*H*)-ones for the construction of quinoxalino[2,1-*b*]quinazolinones

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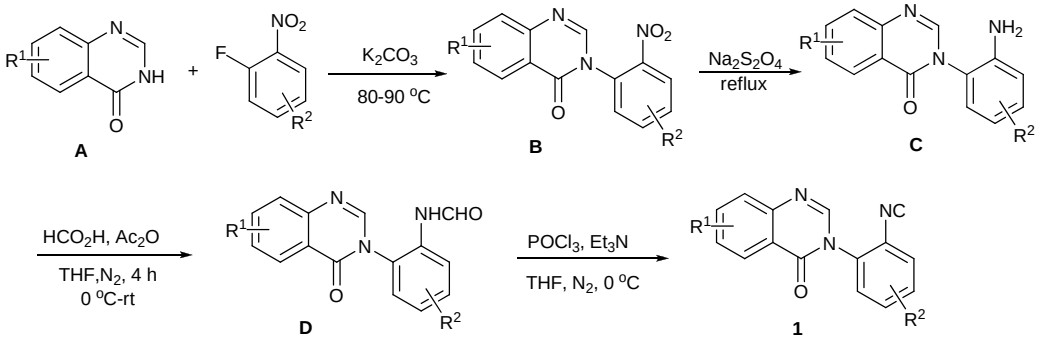
Table of Contents

1. General Considerations

General Information: Unless otherwise noted, all chemicals were purchased and used without further purification. ^{1}H NMR and ^{13}C NMR spectra were recorded at ambient temperature on a 400 MHz NMR spectrometer (101 MHz for ^{13}C). NMR experiments are reported in δ units, parts per million (ppm), and were referenced to $CDCl_3$ (*d* 7.26 or 77.0) as the internal standard. The coupling constants *J* are given in Hz. Column chromatography was performed using EM Silica gel 60 (300-400 mesh).

2. General Synthetic Procedures

2.1 General procedure for the synthesis of substrates 1:



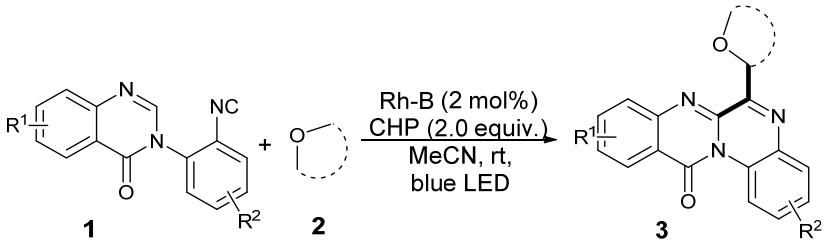
First, to a mixture of quinazolin-4(3*H*)-one **A** (10.0 mmol) in 25 mL of *N, N*-dimethylformamide (DMF) were added K_2CO_3 (15.0 mmol, 1.5 equiv) and 1-fluoro-2-nitrobenzene (12 mmol, 1.2 equiv) sequentially. The mixture was refluxed at 80-90 ℃ for 8 h in a flask equipped with a guard tube. The reaction was quenched with H_2O and extracted with ethyl acetate (3×25 mL). The combined organic layers were washed several times with H_2O and finally with brine solution, dried over anhydrous Na_2SO_4, and concentrated under vacuum. Crude product was recrystallized from ethyl acetate to obtain **B**.[1]

Then, a solution of $Na_2S_2O_4$ (40.0 mmol, 5.0 equiv) in H_2O (80 mL) was added to the solution of **B** (8.0 mmol) in dioxane (80 mL). The reaction mixture was stirred at reflux temperature for 3 h then cooled to room temperature and was poured into water. The resulting precipitate was filtered off, washed with water (2×50 mL) and dried in air to give **C**.[2]

Next, acetic formic anhydride (24.0 mmol), which was newly prepared from the reaction of acetic anhydride (2.3 mL, 24.0 mmol) with formic acid (1.1 mL, 27 mmol) at 55 °C for 2 h, was added dropwise to a mixture of **C** (4.0 mmol) in 6.0 mL THF at 0 °C. The mixture was warmed to room temperature and stirred for 3 h. Then, the reaction was quenched by saturated $NaHCO_3$ and extracted with EtOAc. The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4 and concentrated in vacuum to give the products **D**. These formamides were used for the subsequent dehydration reaction without further purification. $POCl_3$ (1.1 mL, 12.0 mmol) was added via syringe pump to a mixture of Et_3N (5.1 mL, 36.0 mmol) and **D** (4.0 mmol) in THF (6 mL) at 0 °C within 2 hours. After that, the resulting mixture was stirred at 0 °C for another 2 hours. Then, the mixture was quenched with Sat.

$NaHCO_3$ and extracted with CH_2Cl_2. The combined organic layer was washed with brine, dried over anhydrous Na_2SO_4 and concentrated in vacuum. The residue was purified by chromatography on silica gel using petroleum ether/ethyl acetate as eluent to afford the products **1** in 30-70% yield.[3]

2.2 General procedure for the synthesis of products 3.



The mixture of 3-(2-Isocyanophenyl)quinazolin-4(3*H*)-ones **1** (0.2 mmol), Rhodamine B (2 mol%, 1.9 mg), CHP (2.0 equiv, 60.9 mg), THF (1 mL) and MeCN (1 mL) was added into a Schlenk tube and sealed. The tube was evacuated and backfilled with nitrogen (repeated five times). The mixture was stirred at room temperature for 12 hours under the irradiation of 10 W blue LED. Then, the solvent was evaporated under reduced pressure, and purified by silica gel flash column chromatography to give the products **3**.

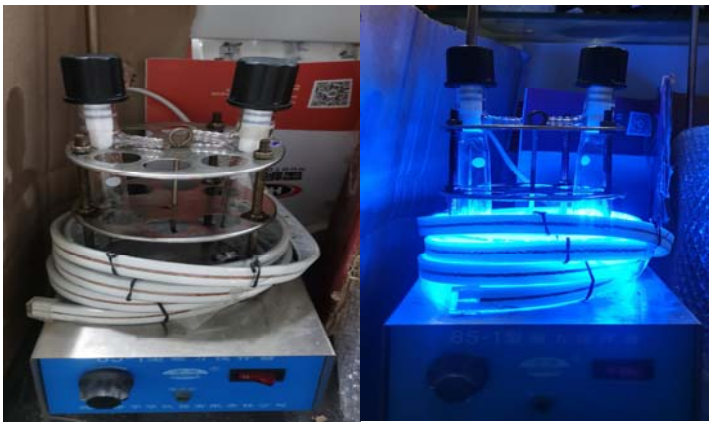
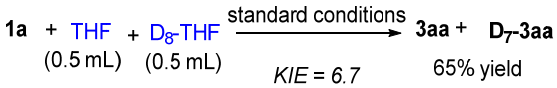


Figure S1 Photoreactor used in this work.

3. Mechanism Studies

3.1 The KIE experiment:



The mixture of **1a** (0.2 mmol), Rhodamine B (2 mol%, 1.9 mg), CHP (2.0 equiv, 60.9 mg), THF (0.5 mL), D_8-THF (0.5 mL) and MeCN (1 mL) was added into a Schlenk tube and sealed. The tube was evacuated and backfilled with nitrogen (repeated for five times). The mixture was stirred at room temperature for 8 hours under the irradiation of 10 W blue LEDs. Then, the solvent was evaporated under reduced pressure, and purified by silica gel flash column chromatography to give product **3aa** and **D_7-3aa** in 65% total yield. A KIE value of

6.7 was observed from ^{1}H NMR spectrum.

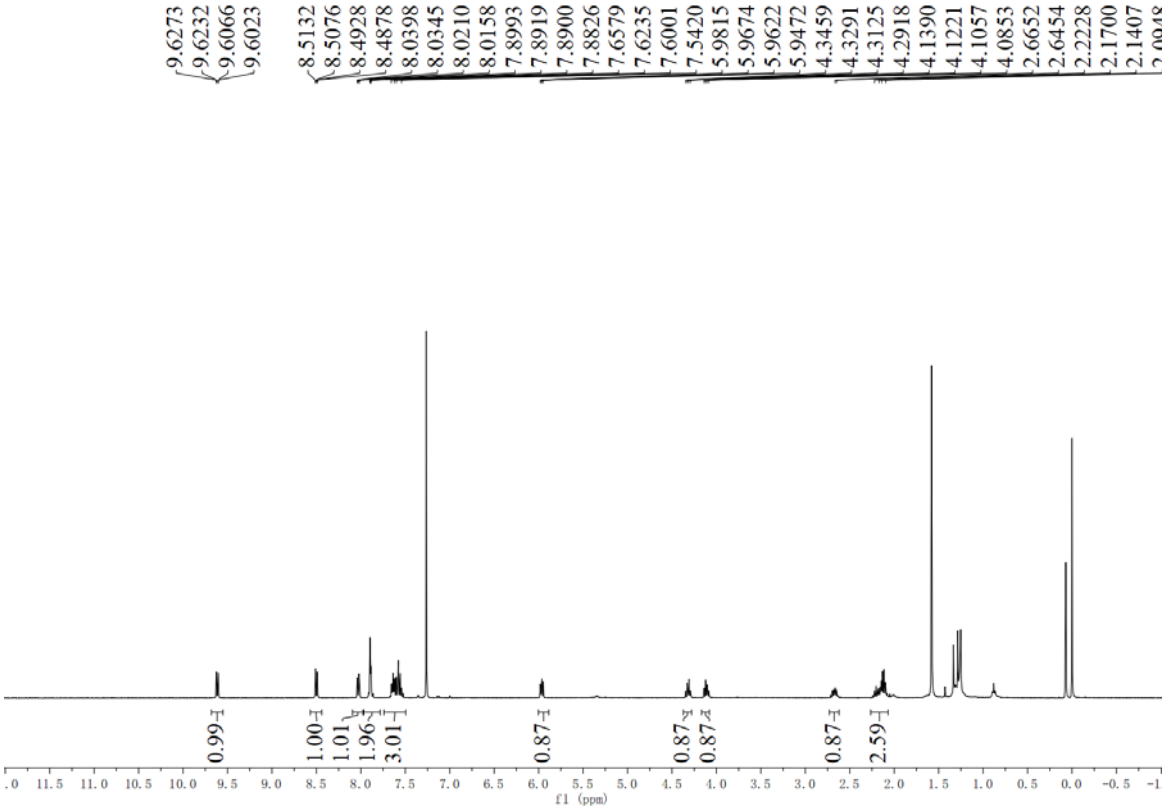
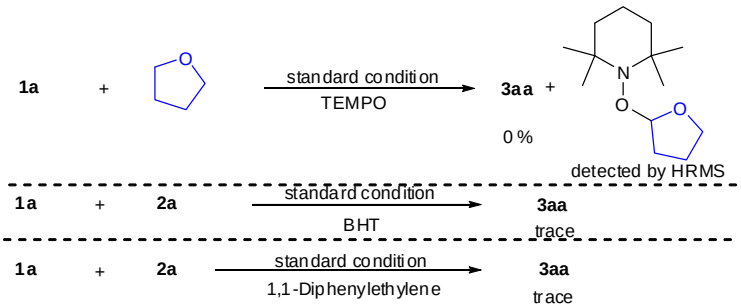


Figure S2. ^{1}H NMR spectrum of the KIE experiment

3.2 Radical inhibiting and trapping experiment



Under standard conditions, TEMPO (2.0 equiv., 0.4 mmol, 62.5 mg; or 1 equiv., 0.2 mmol, 31.2 mg), BHT (2.0 equiv, 0.4 mmol, 88.1 mg; or 1 equiv, 0.2 mmol, 44 mg) or 1,1-diphenylethylene (2.0 equiv, 0.4 mmol, 72.0 mg; or 1 equiv., 0.2 mmol, 36 mg) was added into a Schlenk tube and sealed. The tube was evacuated and backfilled with nitrogen (repeated five times). The mixture was stirred at room temperature for 12 hours under the irradiation of 10 W blue LEDs.

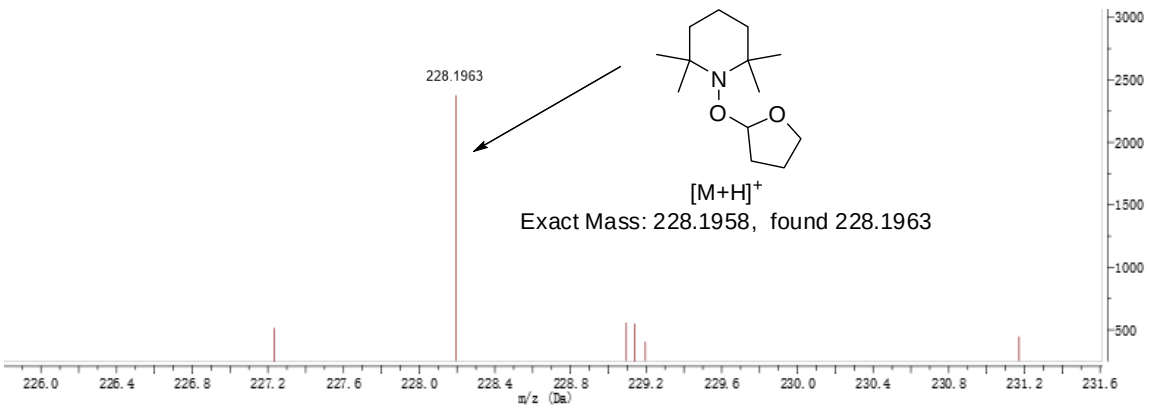


Figure S3. The adduct of TEMPO and tetrahydrofuran-2-yl radical detected by HRMS.

3.3 Cyclic voltammetry study

Cyclic voltammetry measurements were performed in a three-electrode cell (volume 5 mL) with glassy carbon as the working electrode, Pt wire as the auxiliary electrode, and SCE (saturated calomel electrode) as the reference electrode. The electrodes are first polished with sandpaper, then with alumina powder until the surface of the electrodes is mirror-like. Finally, the electrodes are washed with distilled water and ultrasonication. The solvent (MeCN) exhaust employs a nitrogen blast for 30 min. CHP (1 mM) was tested with tetrabutylammonium hexafluorophosphate (0.1 M) as the supporting electrolyte in 30 mL MeCN, respectively. Solutions were kept under positive pressure of nitrogen during the measurements. Cyclic voltammetry (CV) with the following settings: Scan Rates = 0.1 V/s, Sweep Segments = 10, Sample Interval = 0.001 V, Quiet Time = 2 sec. The redox potentials of CHP is $E_{1/2}^{red}$ = -0.89 V vs SCE.

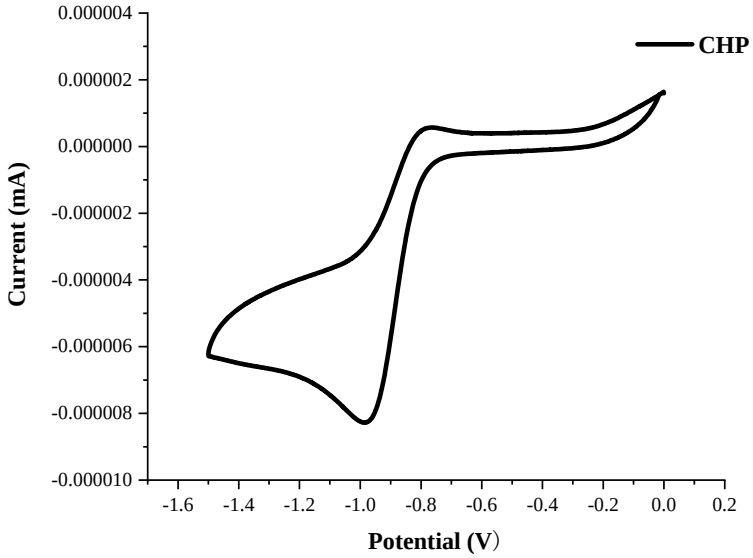
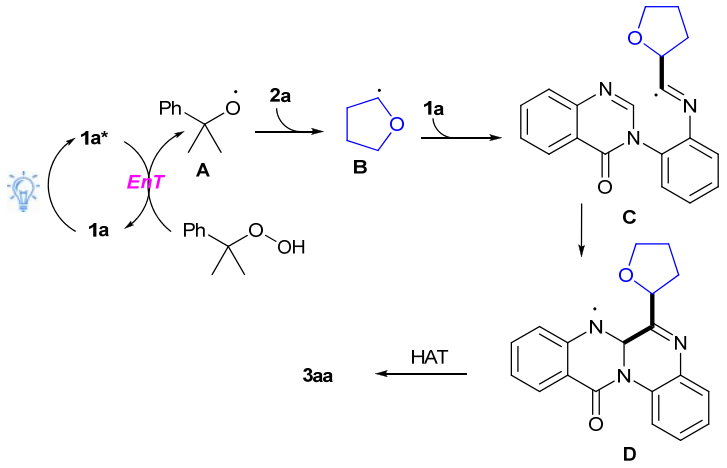


Figure S4.Cyclic voltammetry plots of CHP. Scan direction: from 0 V to -1.5 V, then back to 0 V

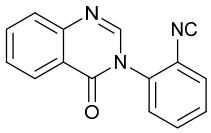
3.4 Alternative mechanism

Control experiments indicated that 23% yield of **3aa** was obtained in the absence of photocatalyst, and no reaction occurred in the absence of both photocatalyst and light irradiation. Moreover, the reaction did not occur in the presence of ambient oxygen or (*E*)-stilbene. Those results indicated that an energy transfer process maybe involved as proposed in Scheme S1.

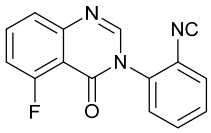


Scheme S1. Alternative mechanism involving the EnT process.

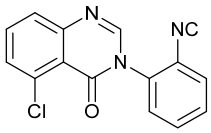
4. Characterization Data for the Substrates and Products



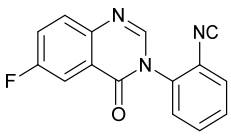
3-(2-Isocyanophenyl)quinazolin-4(3*H*)-one (**1a**, 692.3 mg, 70% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.37-8.34 (m, 1H), 7.99 (s, 1H), 7.85-7.77 (m, 2H), 7.62-7.54 (m, 4H), 7.49-7.47 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.3, 156.0, 147.8, 144.9, 135.1, 133.8, 130.7, 130.6, 129.3, 128.2, 128.1, 127.9, 127.3, 124.9, 122.1; HRMS (ESI) m/z calcd for $C_{15}H_{10}N_3O$ $[M+H]^+$ 248.0818, found 248.0811.



5-Fluoro-3-(2-isocyanophenyl)quinazolin-4(3*H*)-one (**1b**, 689.6 mg, 65% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.97 (s, 1H), 7.79-7.74 (m, 1H), 7.63-7.57 (m, 4H), 7.49-7.47 (m, 1H), 7.24-7.19 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.5, 161.6 (d, $J_{C\text{-}F}$ = 268.7 Hz), 156.9 (d, $J_{C\text{-}F}$ = 4.1 Hz), 149.8, 145.7, 135.7, 135.6 (d, $J_{C\text{-}F}$ = 10.4 Hz), 133.4, 130.8, 130.7, 129.4, 128.1, 123.8 (d, $J_{C\text{-}F}$ = 4.2 Hz), 114.9 (d, $J_{C\text{-}F}$ = 20.8 Hz), 111.9 (d, $J_{C\text{-}F}$ = 6.1 Hz); HRMS (ESI) m/z calcd for $C_{15}H_8FN_3O$ $[M+Na]^+$ 288.0544, found 288.0556.

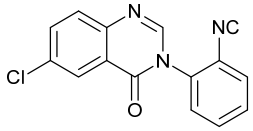


5-Chloro-3-(2-isocyanophenyl)quinazolin-4(3*H*)-one (**1c**, 709.9 mg, 63% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.98 (s, 1H), 7.68-7.67 (m, 2H), 7.61-7.54 (m, 4H), 7.50-7.48 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.4, 158.1, 150.2, 145.5, 134.9, 134.5, 133.5, 130.9, 130.8, 130.7, 129.4, 128.1, 127.2, 124.9, 119.4; HRMS (ESI) m/z calcd for $C_{15}H_8ClN_3O$ $[M+H]^+$ 282.0429, found 282.0417.

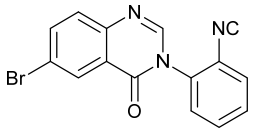


6-Fluoro-3-(2-isocyanophenyl)quinazolin-4(3*H*)-one (**1d**, 647.2 mg, 61% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.00-7.96 (m, 2H), 7.82-7.79 (m, 1H), 7.64-7.52 (m, 4H),

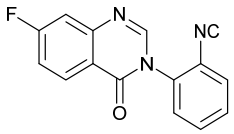
7.50-7.47 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.4, 161.6 (d, $J_{C\text{-}F}$ = 251.1 Hz), 159.3 (d, $J_{C\text{-}F}$ = 3.2 Hz), 144.4 (d, $J_{C\text{-}F}$ = 2.1 Hz), 144.2 (d, $J_{C\text{-}F}$ = 2.5 Hz), 133.6, 130.8, 130.7, 130.4 (d, $J_{C\text{-}F}$ = 8.2 Hz), 129.2, 128.2, 123.6 (d, $J_{C\text{-}F}$ = 24.0 Hz), 123.5, 112.4 (d, $J_{C\text{-}F}$ = 24.1 Hz); HRMS (ESI) m/z calcd for $C_{15}H_8FN_3O$ $[M+H]^+$ 266.0724, found 266.0715.



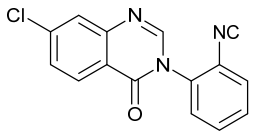
6-Chloro-3-(2-isocyanophenyl)quinazolin-4(3*H*)-one (**1e**, 619.7 mg, 55% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.31 (m, 1H), 7.98 (s, 1H), 7.78-7.72 (m, 2H), 7.63-7.58 (m, 3H), 7.49-7.47 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.5, 159.0, 146.3, 145.0, 135.5, 134.0, 133.5, 130.9, 130.8, 129.6, 129.1, 128.2, 126.7, 124.8, 123.2; HRMS (ESI) m/z calcd for $C_{15}H_8ClN_3O$ $[M+H]^+$ 282.0429, found 282.0421.



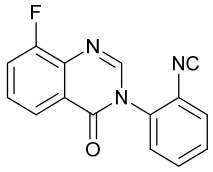
6-Bromo-3-(2-isocyanophenyl)quinazolin-4(3*H*)-one (**1f**, 769.7 mg, 59% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.46 (d, J = 2.3 Hz, 1H), 7.99 (s, 1H), 7.90 (m, 1H), 7.67-7.58 (m, 4H), 7.52–7.43 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.5, 158.8, 146.6, 145.2, 138.3, 133.5, 130.9, 130.8, 129.8, 129.7, 129.1, 128.2, 127.2, 123.5, 121.8; HRMS (ESI) m/z calcd for $C_{15}H_8BrN_3O$ $[M+H]^+$ 325.9924, found 325.9929.



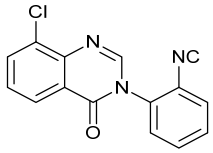
7-Fluoro-3-(2-isocyanophenyl)quinazolin-4(3*H*)-one (**1g**, 498.7 mg, 47% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.39 (m, 1H), 8.02 (s, 1H), 7.65-7.59 (m, 3H), 7.51-7.43 (m, 2H), 7.32-7.27 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.4, 166.8 (d, $J_{C\text{-}F}$ = 256.9 Hz), 159.2, 150.0 (d, $J_{C\text{-}F}$ = 12.9 Hz), 146.1, 133.5, 130.8, 130.7, 130.1 (d, $J_{C\text{-}F}$ = 10.8 Hz), 129.2, 128.2, 118.8 (d, $J_{C\text{-}F}$ = 2.2 Hz), 116.8 (d, $J_{C\text{-}F}$ = 23.6 Hz), 113.5 (d, $J_{C\text{-}F}$ = 22.3 Hz); HRMS (ESI) m/z calcd for $C_{15}H_8FN_3O$ $[M+H]^+$ 266.0724, found 266.0719.



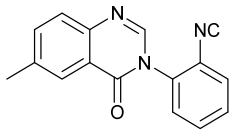
7-Chloro-3-(2-isocyanophenyl)quinazolin-4(3*H*)-one (**1h**, 439.5 mg, 39% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.28 (d, J = 8.5 Hz, 1H), 8.00 (s, 1H), 7.77 (d, J = 2.0 Hz, 1H), 7.63-7.57 (m, 3H), 7.53-7.46 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.5, 159.4, 148.7, 146.1, 141.4, 133.5, 130.9, 130.8, 129.2, 128.8, 128.7, 128.2, 127.5, 124.8, 120.6; HRMS (ESI) m/z calcd for $C_{15}H_8ClN_3NaO$ $[M+Na]^+$ 304.0248, found 304.0241.



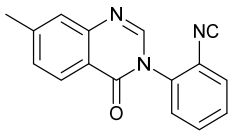
8-Fluoro-3-(2-isocyanophenyl)quinazolin-4(3*H*)-one (**1i**, 424.4 mg, 40% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.15-8.12 (m, 1H), 8.03 (s, 1H), 7.64-7.48 (m, 6H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.5, 159.0 (d, $J_{C\text{-}F}$ = 3.1 Hz), 157.2 (d, $J_{C\text{-}F}$ = 257.8 Hz), 145.4, 137.1 (d, $J_{C\text{-}F}$ = 12.2 Hz), 133.5, 130.9, 130.8, 129.1, 128.4 (d, $J_{C\text{-}F}$ = 7.8 Hz), 128.2, 123.9, 122.8 (d, $J_{C\text{-}F}$ = 4.3 Hz), 120.7 (d, $J_{C\text{-}F}$ = 19.0 Hz); HRMS (ESI) m/z calcd for $C_{15}H_8FN_3NaO$ $[M+Na]^+$ 288.0544, found 288.0546.



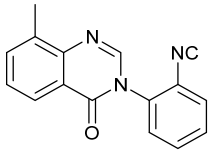
8-Chloro-3-(2-isocyanophenyl)quinazolin-4(3*H*)-one (**1j**, 473.3 mg, 42% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.28-8.25 (m, 1H), 8.10 (s, 1H), 7.91-7.89 (m, 1H), 7.64-7.56 (m, 3H), 7.51-7.47 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.6, 159.4, 145.6, 144.5, 135.4, 133.4, 132.2, 131.0, 130.8, 129.1, 128.3, 128.2, 126.2, 124.8, 123.7; HRMS (ESI) m/z calcd for $C_{15}H_8ClN_3O$ $[M+H]^+$ 282.0429, found 282.0417.



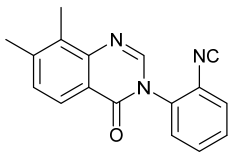
3-(2-Isocyanophenyl)-6-methylquinazolin-4(3*H*)-one (**1k**, 606.2 mg, 58% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.14 (s, 1H), 7.94 (s, 1H), 7.68-7.53 (m, 5H), 7.48-7.46 (m, 1H), 2.50 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.2, 160.0, 145.7, 144.1, 138.5, 136.7, 134.0, 130.7, 130.6, 129.2, 128.1, 127.7, 126.7, 124.9, 121.8, 21.4; HRMS (ESI) m/z calcd for $C_{16}H_{11}N_3O$ $[M+H]^+$ 262.0975, found 262.0975.



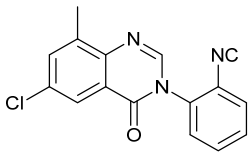
3-(2-Isocyanophenyl)-7-methylquinazolin-4(3*H*)-one (**1l**, 459.9 mg, 44% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.24 (d, J = 8.1 Hz, 1H), 7.97 (s, 1H), 7.62-7.54 (m, 4H), 7.49-7.47 (m, 1H), 7.38 (d, J = 8.1 Hz, 1H), 2.53 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.2, 160.0, 147.9, 146.3, 144.9, 133.9, 130.7, 130.6, 129.6, 129.3, 128.1, 127.7, 127.1, 125.0, 119.6, 22.0; HRMS (ESI) m/z calcd for $C_{16}H_{11}N_3O$ $[M+H]^+$ 262.0975, found 262.0979.



3-(2-Isocyanophenyl)-8-methylquinazolin-4(3*H*)-one (**1m**, 658.4 mg, 63% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.22-8.19 (m, 1H), 8.01 (s, 1H), 7.67 (d, J = 7.4 Hz, 1H), 7.62-7.53 (m, 3H), 7.49-7.42 (m, 2H), 2.65 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.2, 160.4, 146.3, 143.6, 136.4, 135.8, 134.0, 130.7, 130.6, 129.3, 128.1, 127.6, 125.0, 123.8, 122.1, 17.6; HRMS (ESI) m/z calcd for $C_{16}H_{11}N_3O$ $[M+H]^+$ 262.0975, found 262.0968.

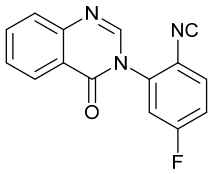


3-(2-Isocyanophenyl)-7,8-dimethylquinazolin-4(3*H*)-one (**1n**, 649.7 mg, 59% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.12 (d, J = 8.1 Hz, 1H), 7.98 (s, 1H), 7.62-7.54 (m, 3H), 7.49-7.47 (m, 1H), 7.37 (d, J = 8.1 Hz, 1H), 2.59 (s, 3H), 2.47 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.1, 160.5, 146.1, 144.4, 143.3, 134.5, 134.1, 130.6, 130.5, 129.9, 129.3, 128.1, 124.9, 124.1, 120.0, 21.2, 13.3; HRMS (ESI) m/z calcd for $C_{17}H_{13}N_3O$ $[M+H]^+$ 276.1131, found 276.1120.

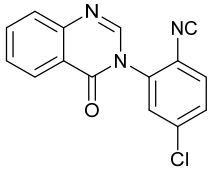


6-Chloro-3-(2-isocyanophenyl)-8-methylquinazolin-4(3*H*)-one (**1o**, 674.3 mg, 57% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.15 (d, J = 2.5 Hz, 1H), 7.98 (s, 1H), 7.62-7.57 (m, 4H), 7.48-7.46 (m, 1H), 2.63 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.4, 159.4, 145.0,

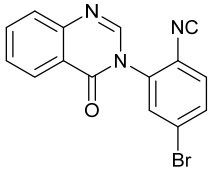
143.8, 138.8, 135.8, 133.6, 133.4, 130.78, 130.75, 129.1, 128.2, 124.8, 124.2, 123.2, 17.5; HRMS (ESI) m/z calcd for $C_{16}H_{10}ClN_3O$ $[M+H]^+$ 296.0585, found 296.0593.



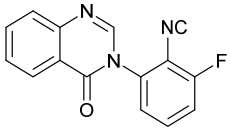
3-(5-Fluoro-2-isocyanophenyl)quinazolin-4(3*H*)-one (**1p**, 456.2 mg, 43% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.38-8.36 (m, 1H), 7.99 (s, 1H), 7.88-7.79 (m, 2H), 7.65-7.58 (m, 2H), 7.33-7.26 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.6, 162.2 (d, $J_{C\text{-}F}$ = 256.9 Hz), 159.7, 147.6, 144.2, 135.4, 135.3, 129.7 (d, $J_{C\text{-}F}$ = 9.5 Hz), 128.3, 128.0, 127.3, 122.0, 118.0 (d, $J_{C\text{-}F}$ = 23.1 Hz), 117.3 (d, $J_{C\text{-}F}$ = 25.2 Hz); HRMS (ESI) m/z calcd for $C_{15}H_8FN_3O$ $[M+H]^+$ 266.0724, found 266.0715.



3-(5-Chloro-2-isocyanophenyl)quinazolin-4(3*H*)-one (**1q**, 450.7 mg, 40% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.38-8.35 (m, 1H), 7.97 (s, 1H), 7.87-7.79 (m, 2H), 7.61-7.52 (m, 4H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 171.7, 159.8, 147.6, 144.2, 136.4, 135.3, 134.8, 131.0, 129.7, 129.0, 128.3, 128.0, 127.3, 124.4, 122.0; HRMS (ESI) m/z calcd for $C_{15}H_8ClN_3O$ $[M+H]^+$ 282.0429, found 282.0418.

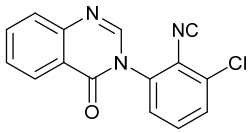


3-(5-Bromo-2-isocyanophenyl)quinazolin-4(3*H*)-one (**1r**, 587.1 mg, 45% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.36-8.34 (m, 1H), 7.97 (s, 1H), 7.86-7.82 (m, 1H), 7.80-7.77 (m, 1H), 7.72-7.66 (m, 2H), 7.60-7.56 (m, 1H), 7.48 (d, J = 8.5 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 171.9, 159.8, 147.6, 144.2, 135.3, 134.8, 133.9, 132.5, 129.1, 128.3, 128.0, 127.3, 124.0, 123.9, 121.9; HRMS (ESI) m/z calcd for $C_{15}H_8BrN_3O$ $[M+H]^+$ 325.9924, found 325.9917.

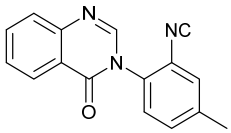


3-(3-Fluoro-2-isocyanophenyl)quinazolin-4(3*H*)-one (**1s**, 318.3 mg, 30% yield), flash

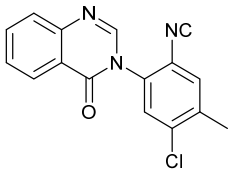
column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ =8.36 (d, J = 8.0 Hz, 1H), 7.99 (s, 1H), 7.86-7.78 (m, 2H), 7.61-7.56 (m, 2H), 7.41 (t, J = 8.5 Hz, 1H), 7.30 (d, J = 8.1 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 176.3, 159.7, 158.2 (d, $J_{C\text{-}F}$ = 261.2 Hz), 147.6, 144.3, 135.3, 135.2, 131.0 (d, $J_{C\text{-}F}$ = 8.9 Hz), 128.3, 128.0, 127.4, 124.5 (d, $J_{C\text{-}F}$ = 3.6 Hz), 121.9, 117.9 (d, $J_{C\text{-}F}$ = 18.9 Hz); HRMS (ESI) m/z calcd for $C_{15}H_8FN_3O$ $[M+H]^+$ 266.0724, found 266.0717.



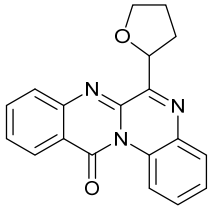
3-(3-Chloro-2-isocyanophenyl)quinazolin-4(3*H*)-one (**1t**, 428.2 mg, 38% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.38-7.36 (m, 1H), 7.99 (s, 1H), 7.88-7.79 (m, 2H), 7.70-7.67 (m, 1H), 7.61-7.53 (m, 2H), 7.42-7.40 (m 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 175.3, 159.8, 147.7, 144.3, 135.3, 135.2, 132.8, 131.3, 130.5, 128.3, 128.0, 127.5, 127.4, 125.5, 122.0; HRMS (ESI) m/z calcd for $C_{15}H_8ClN_3O$ $[M+H]^+$ 282.0429, found 282.0422.



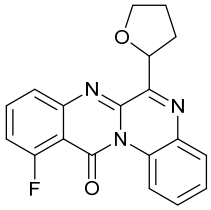
3-(2-Isocyano-4-methylphenyl)quinazolin-4(3*H*)-one (**1u**, 480.8 mg, 46% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.37-8.34 (m, 1H), 7.98 (s, 1H), 7.84-7.76 (m, 2H), 7.58-7.54 (m, 1H), 7.41-7.33 (m, 3H), 2.45 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 169.7, 160.1, 147.8, 145.1, 141.5, 135.0, 131.4, 131.2, 128.8, 128.5, 128.0, 127.9, 127.3, 124.5, 122.2, 21.1; HRMS (ESI) m/z calcd for $C_{16}H_{11}N_3O$ $[M+H]^+$ 262.0975, found 262.0983.



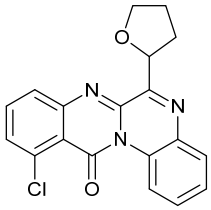
3-(5-Chloro-2-isocyano-4-methylphenyl)quinazolin-4(3*H*)-one (**1v**, 508.7 mg, 43% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.36-8.33 (m, 1H), 7.96 (s, 1H), 7.85-7.76 (m, 2H), 7.59-7.55 (m, 1H), 7.48 (d, J = 1.9 Hz, 2H), 2.45 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 171.0, 159.9, 147.7, 144.5, 139.8, 136.3, 135.2, 132.1, 129.7, 128.2, 128.0, 127.6, 127.3, 123.1, 122.0, 20.0; HRMS (ESI) m/z calcd for $C_{16}H_{10}ClN_3O$ $[M+H]^+$ 296.0585, found 296.0595.



6-(Tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3aa**, 45.7 mg, 72% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.59-9.56 (m, 1H), 8.46-8.44 (m, 1H), 8.01-7.99 (m, 1H), 7.87-7.81 (m, 2H), 7.61-7.51 (m, 3H), 5.95-5.91 (m, 1H), 4.33-4.28 (m, 1H), 4.12-4.07 (m, 1H), 2.70-2.62 (m, 1H), 2.20-2.06 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.9, 161.5, 145.4, 138.5, 135.0, 134.8, 130.2, 129.3, 128.1, 128.0, 127.9, 127.3, 127.2, 121.3, 120.4, 77.3, 69.4, 31.5, 25.7; HRMS (ESI) m/z calcd for $C_{19}H_{15}N_3O_2$ $[M+H]^+$ 318.1237, found 318.1224.

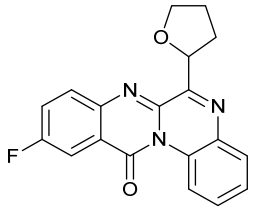


11-Fluoro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ba**, 44.9 mg, 67% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.41-9.39 (m, 1H), 7.99-7.97 (m, 1H), 7.78-7.73 (m, 1H), 7.65-7.62 (m, 1H), 7.57-7.50 (m, 2H), 7.24-7.19 (m, 1H), 5.89-5.85 (m, 1H), 4.30-4.24 (m, 1H), 4.10-4.05 (m, 1H), 2.65-2.58 (m, 1H), 2.20-2.05 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.3 (d, $J_{C\text{-}F}$ = 268.4 Hz), 161.1, 158.9 (d, $J_{C\text{-}F}$ = 4.8 Hz), 147.4, 139.1, 135.1 (d, $J_{C\text{-}F}$ = 10.5 Hz), 135.0, 130.2, 129.5, 127.5, 127.4, 123.9 (d, $J_{C\text{-}F}$ = 4.4 Hz), 120.1, 114.2 (d, $J_{C\text{-}F}$ = 20.9 Hz), 110.8 (d, $J_{C\text{-}F}$ = 5.1 Hz), 77.2, 69.4, 31.4, 25.7; HRMS (ESI) m/z calcd for $C_{19}H_{14}FN_3O_2$ $[M+H]^+$ 336.1143, found 336.1143.

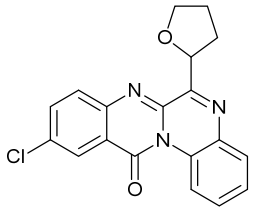


11-Chloro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ca**, 52.1 mg, 74% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.30-9.28 (m, 1H), 7.99-7.97 (m, 1H), 7.75-7.72 (m, 1H), 7.66 (t, J = 7.9 Hz, 1H), 7.56-7.51 (m, 3H), 5.88-5.85 (m, 1H), 4.31-4.25 (m, 1H), 4.10-4.05 (m, 1H), 2.65-2.57 (m, 1H), 2.20-2.05 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.1, 159.8, 147.8, 138.9, 135.1, 134.3, 134.0, 130.4, 130.2, 129.4, 127.4, 127.3, 127.2, 120.0, 118.2, 77.1, 69.4, 31.4, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}ClN_3O_2$ $[M+H]^+$

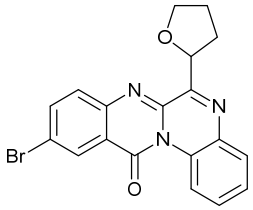
352.0847, found 352.0842.



10-Fluoro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3da**, 41.6 mg, 62% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.58-9.55 (m, 1H), 8.09-8.06 (m, 1H), 8.01-7.99 (m, 1H), 7.90-7.87 (m, 1H), 7.61-7.56 (m, 3H), 5.93-5.90 (m, 1H), 4.32-4.26 (m, 1H), 4.12-4.07 (m, 1H), 2.67-2.59 (m, 1H), 2.22-2.06 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.6 (d, $J_{C\text{-}F}$ = 251.8 Hz), 161.3, 161.2 (d, $J_{C\text{-}F}$ = 3.8 Hz), 142.1 (d, $J_{C\text{-}F}$ = 2.0 Hz), 137.9 (d, $J_{C\text{-}F}$ = 2.2 Hz), 135.1, 130.6 (d, $J_{C\text{-}F}$ = 8.2 Hz), 130.2, 129.4, 127.9, 127.5, 123.8 (d, $J_{C\text{-}F}$ = 24.4 Hz), 122.5 (d, $J_{C\text{-}F}$ = 8.8 Hz), 120.4, 112.1 (d, $J_{C\text{-}F}$ = 24.2 Hz), 77.3, 69.4, 31.4, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}FN_3O_2$ $[M+H]^+$ 336.1143, found 336.1140.

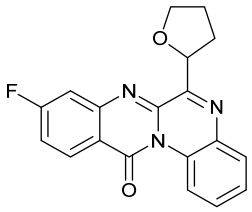


10-Chloro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ea**, 47.8 mg, 68% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.54-9.51 (m, 1H), 8.38-8.38 (m, 1H), 8.01-7.98 (m, 1H), 7.81-7.74 (m, 2H), 7.59-7.52 (m, 2H), 5.92-5.88 (m, 1H), 4.31-4.26 (m, 1H), 4.11-4.06 (m, 1H), 2.66-2.58 (m, 1H), 2.21-2.06 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.3, 160.8, 143.9, 138.5, 135.3, 135.0, 133.9, 130.2, 129.7, 129.5, 127.9, 127.6, 126.6, 122.1, 120.3, 77.3, 69.4, 31.4, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}ClN_3O_2$ $[M+Na]^+$ 374.0667, found 374.0665.

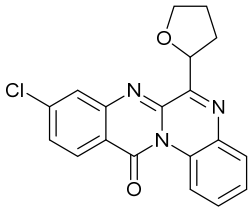


10-Bromo-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3fa**, 58.6 mg, 74% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.51-9.49 (m, 1H), 8.53 (d, J = 2.3 Hz, 1H), 7.99-7.97 (m, 1H), 7.89-7.87 (m, 1H), 7.70 (d, J = 8.7 Hz, 1H), 7.58-7.50 (m, 2H), 5.91-5.87 (m, 1H), 4.30-4.25 (m, 1H), 4.11-4.05 (m, 1H), 2.65-2.57 (m, 1H), 2.20-2.03 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.3, 160.7, 144.2, 138.6, 138.0, 135.0, 130.2, 129.8,

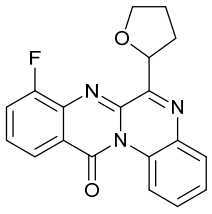
129.7, 129.5, 127.9, 127.5, 122.4, 121.7, 120.3, 77.3, 69.4, 31.4, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}BrN_3O_2$ $[M+H]^+$ 396.0342, found 396.0328.



9-Fluoro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ga**, 42.9 mg, 64% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.55-9.53 (m, 1H), 8.47-8.43 (m, 1H), 8.02-7.99 (m, 1H), 7.59-7.52 (m, 2H), 7.50-7.47 (m, 1H), 7.33-7.28 (m, 1H), 5.91-5.88 (m, 1H), 4.32-4.26 (m, 1H), 4.12-4.06 (m, 1H), 2.67-2.59 (m, 1H), 2.20-2.06 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 166.7 (d, $J_{C\text{-}F}$ = 257.0 Hz), 161.2, 161.1, 147.5 (d, $J_{C\text{-}F}$ = 13.4 Hz), 139.4, 135.0, 130.25, 130.23 (d, $J_{C\text{-}F}$ = 10.8 Hz), 129.5, 127.9, 127.4, 120.3, 117.97 (d, $J_{C\text{-}F}$ = 1.8 Hz), 117.0 (d, $J_{C\text{-}F}$ = 23.9 Hz), 112.9 (d, $J_{C\text{-}F}$ = 21.8 Hz), 77.3, 69.4, 31.5, 25.7; HRMS (ESI) m/z calcd for $C_{19}H_{14}FN_3O_2$ $[M+H]^+$ 336.1143, found 336.1142.

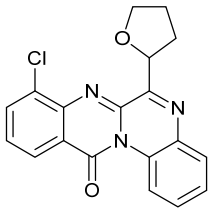


9-Chloro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ha**, 49.3 mg, 70% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.55-9.53 (m, 1H), 8.36 (d, J = 8.6 Hz, 1H), 8.02-8.00 (m, 1H), 7.86 (d, J = 2.0 Hz, 1H), 7.60-7.51 (m, 3H), 5.90-5.87 (m, 1H), 4.32-4.27 (m, 1H), 4.12-4.07 (m, 1H), 2.68-2.60 (m, 1H), 2.18-2.06 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.4, 161.3, 146.3, 141.2, 139.3, 135.0, 130.3, 129.6, 128.9, 128.6, 127.9, 127.5, 127.3, 120.3, 119.6, 77.3, 69.4, 31.5, 25.7; HRMS (ESI) m/z calcd for $C_{19}H_{14}ClN_3O_2$ $[M+H]^+$ 352.0847, found 352.0852.

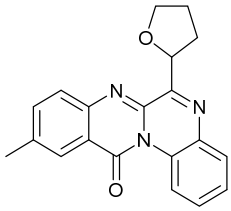


8-Fluoro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ia**, 53.7 mg, 80% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.54-9.51 (m, 1H), 8.22-8.19 (m, 1H), 8.03-8.00 (m, 1H), 7.59-7.49 (m, 4H), 5.91-5.88 (m, 1H), 4.33-4.27 (m, 1H), 4.11-4.06 (m, 1H), 2.76-2.69 (m, 1H), 2.17-2.07 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.6, 161.0 (d,

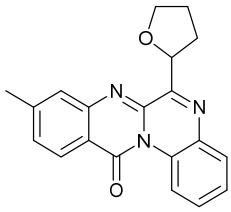
J_{C-F} = 3.2 Hz), 157.3 (d, J_{C-F} = 259.9 Hz), 138.5, 135.3, 135.1, 130.3, 129.5, 128.0 (d, J_{C-F} = 7.6 Hz), 127.8, 127.6, 123.0, 122.8 (d, J_{C-F} = 4.6 Hz), 120.3, 120.0 (d, J_{C-F} = 18.4 Hz), 77.7, 69.4, 31.7, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}FN_3O_2$ $[M+H]^+$ 336.1143, found 336.1138.



8-Chloro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ja**, 51.4 mg, 73% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.52-9.48 (m, 1H), 8.29-8.27 (m, 1H), 8.03-8.00 (m, 1H), 7.87-7.84 (m, 1H), 7.57-7.51 (m, 2H), 7.44 (t, J = 7.9 Hz, 1H), 5.90-5.87 (m, 1H), 4.33-4.27 (m, 1H), 4.12-4.07 (m, 1H), 2.86-2.80 (m, 1H), 2.14-2.05 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.8, 161.3, 142.1, 138.4, 135.1, 134.8, 132.6, 130.3, 129.5, 127.8, 127.7, 127.6, 126.0, 122.6, 120.2, 77.9, 69.4, 32.0, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}ClN_3O_2$ $[M+H]^+$ 352.0847, found 352.0854.

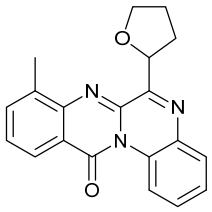


10-Methyl-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ka**, 45.1 mg, 68% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.59-9.56 (m, 1H), 8.24-8.22 (m, 1H), 8.00-7.98 (m, 1H), 7.76-7.74 (m, 1H), 7.67-7.63 (m, 1H), 7.58-7.50 (m, 2H), 5.94-5.90 (m, 1H), 4.33-4.27 (m, 1H), 4.12-4.06 (m, 1H), 2.67-2.62 (m, 1H), 2.54 (s, 3H), 2.20-2.04 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.9, 161.5, 143.4, 138.9, 137.9, 136.4, 135.0, 130.1, 129.2, 128.3, 127.9, 127.2, 126.6, 121.0, 120.4, 77.3, 69.4, 31.5, 25.7, 21.7; HRMS (ESI) m/z calcd for $C_{20}H_{17}N_3O_2$ $[M+H]^+$ 332.1394, found 332.1389.

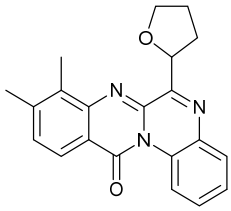


9-Methyl-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3la**, 48.3 mg, 73% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.59-9.56 (m, 1H), 8.31 (d, J = 8.2 Hz, 1H), 8.00-7.97 (m, 1H), 7.63 (s, 1H), 7.57-7.49 (m, 2H), 7.39-7.37 (m, 1H), 5.92-5.89 (m, 1H), 4.33-4.27 (m, 1H), 4.12-4.06 (m, 1H), 2.69-2.61 (m, 1H), 2.52 (s, 3H), 2.17-2.07 (m,

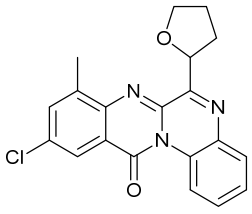
3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.9, 161.5, 146.0, 145.5, 138.6, 135.0, 130.1, 129.7, 129.3, 128.3, 127.6, 127.1, 120.4, 118.9, 77.4, 69.4, 31.6, 25.7, 22.0; HRMS (ESI) m/z calcd for $C_{20}H_{17}N_3O_2$ $[M+H]^+$ 332.1394, found 332.1384.



8-Methyl-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ma**, 45.1 mg, 68% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow soild; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.57-9.55 (m, 1H), 8.23-8.21 (m, 1H), 8.00-7.98 (m, 1H), 7.63-7.60 (m, 1H), 7.54-7.50 (m, 2H), 7.41 (t, J = 7.7 Hz, 1H), 5.92-5.89 (m, 1H), 4.34-4.29 (m, 1H), 4.11-4.06 (m, 1H), 2.73-2.67 (m, 1H), 2.65 (s, 3H), 2.14-2.03 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 162.1, 161.9, 143.8, 137.2, 136.5, 135.1, 135.0, 130.1, 129.2, 128.1, 127.7, 127.2, 124.9, 121.2, 120.4, 77.6, 69.4, 32.0, 25.6, 17.3; HRMS (ESI) m/z calcd for $C_{20}H_{17}N_3O_2$ $[M+H]^+$ 332.1394, found 332.1387.

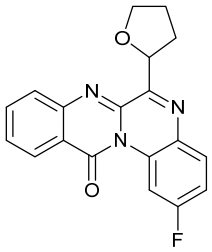


8,9-Dimethyl-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3na**, 51.1 mg, 74% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.61-9.58 (m, 1H), 8.16 (d, J = 8.2 Hz, 1H), 8.01-7.98 (m, 1H), 7.57-7.49 (m, 2H), 7.35 (d, J = 8.2 Hz, 1H), 5.96-5.93 (m, 1H), 4.36-4.30 (m, 1H), 4.14-4.08 (m, 1H), 2.74-2.69 (m, 1H), 2.60 (s, 3H), 2.43 (s, 3H), 2.15-2.04 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 162.2, 162.0, 143.9, 143.5, 137.2, 135.0, 134.4, 130.2, 130.1, 129.2, 128.2, 127.1, 124.1, 120.4, 119.2, 77.6, 69.4, 32.0, 25.6, 20.9, 13.1; HRMS (ESI) m/z calcd for $C_{21}H_{19}N_3O_2$ $[M+H]^+$ 346.1550, found 346.1558.

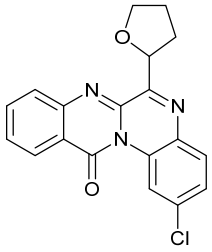


10-Chloro-8-methyl-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3oa**, 52.0 mg, 71% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.52-9.50 (m, 1H), 8.16 (d, J = 2.3 Hz, 1H), 8.00-7.97 (m, 1H), 7.58 (d, J = 2.4 Hz, 1H), 7.54-7.51 (m, 2H), 5.92-5.88 (m, 1H), 4.33-4.28 (m, 1H), 4.12-4.06 (m, 1H), 2.72-2.67 (m, 1H), 2.64 (s, 3H), 2.14-2.06 (m,

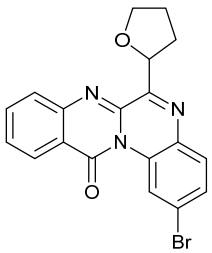
3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.7, 161.0, 142.5, 138.8, 137.4, 135.3, 135.1, 133.4, 130.2, 129.4, 127.8, 127.5, 124.1, 122.0, 120.3, 77.4, 69.4, 31.9, 25.7, 17.2; HRMS (ESI) m/z calcd for $C_{20}H_{16}ClN_3O_2$ $[M+H]^+$ 366.1004, found 366.1004.



2-Fluoro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3pa**, 49.0 mg, 73% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.44-9.40 (m, 1H), 8.43-8.40 (m, 1H), 7.99-7.95 (m, 1H), 7.84 (d, J = 3.9 Hz, 2H), 7.61-7.57 (m, 1H), 7.27-7.23 (m, 1H), 5.92-5.88 (m, 1H), 4.31-4.26 (m, 1H), 4.12-4.06 (m, 1H), 2.69-2.61 (m, 1H), 2.21-2.04 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.9 (d, $J_{C\text{-}F}$ = 248.9 Hz), 161.8, 160.6, 145.3, 138.0, 135.0, 131.7, 131.4 (d, $J_{C\text{-}F}$ = 9.9 Hz), 128.9 (d, $J_{C\text{-}F}$ = 12.5 Hz), 128.2, 128.1, 127.3, 120.9, 114.8 (d, $J_{C\text{-}F}$ = 23.2 Hz), 108.1 (d, $J_{C\text{-}F}$ = 32.0 Hz), 77.3, 69.4, 31.5, 25.7; HRMS (ESI) m/z calcd for $C_{19}H_{14}FN_3O_2$ $[M+H]^+$ 336.1143, found 336.1138.

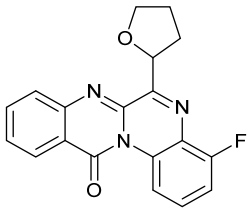


2-Chloro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3qa**, 49.3 mg, 78% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.68 (d, J = 2.2 Hz, 1H), 8.44-8.42 (m, 1H), 7.91 (d, J = 8.5 Hz, 1H), 7.87-7.85 (m, 2H), 7.63-7.59 (m, 1H), 7.51-7.48 (m, 1H), 5.92-5.89 (m, 1H), 4.31-4.26 (m, 1H), 4.12-4.06 (m, 1H), 2.70-2.62 (m, 1H), 2.16-2.6 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.78, 161.77, 145.2, 138.0, 135.09, 135.06, 133.6, 130.9, 128.6, 128.3, 128.1, 127.6, 127.4, 121.1, 120.5, 77.3, 69.4, 31.6, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}ClN_3O_2$ $[M+H]^+$ 352.0847, found 352.0841.

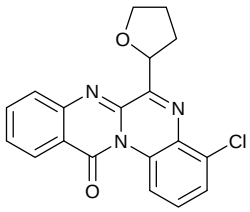


2-Bromo-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ra**, 60.2

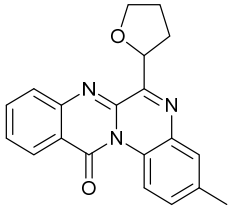
mg, 76% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.85 (t, J = 1.9 Hz, 1H), 8.47-8.44 (m, 1H), 7.88-7.84 (m, 3H), 7.67-7.61 (m, 2H), 5.93-7.89 (m, 1H), 4.31-4.26 (m, 1H), 4.12-4.07 (m, 1H), 2.70-2.63 (m, 1H), 2.20-2.06 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 162.0, 161.8, 145.3, 138.0, 135.1, 134.0, 131.1, 130.6, 128.8, 128.4, 128.2, 127.4, 123.4, 123.3, 121.1, 77.3, 69.5, 31.6, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}BrN_3O_2$ $[M+Na]^+$ 418.0162, found 418.0168.



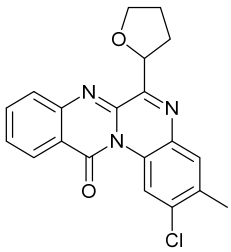
4-Fluoro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3sa**, 40.2 mg, 60% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.37-9.34 (m, 1H), 8.45-8.42 (m, 1H), 7.89-7.84 (m, 2H), 7.63-7.59 (m, 1H), 7.54-7.48 (m, 1H), 7.31-7.28 (m, 1H), 6.00-5.96 (m, 1H), 4.33-4.27 (m, 1H), 4.13-4.08 (m, 1H), 2.62-2.53 (m, 1H), 2.32-2.24 (m, 1H), 2.19-2.06 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 161.88 (d, $J_{C\text{-}F}$ = 2.1 Hz), 161.81, 157.8 (d, $J_{C\text{-}F}$ = 256.9 Hz), 145.3, 138.2, 135.0, 129.4 (d, $J_{C\text{-}F}$ = 8.9 Hz), 129.3, 128.3, 128.2, 127.4, 125.1 (d, $J_{C\text{-}F}$ = 12.8 Hz), 121.3, 116.0 (d, $J_{C\text{-}F}$ = 4.3 Hz), 113.8 (d, $J_{C\text{-}F}$ = 19.3 Hz), 77.3, 69.4, 31.1, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}FN_3O_2$ $[M+H]^+$ 336.1143, found 336.1140.



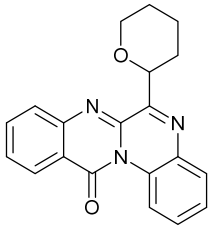
4-Chloro-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ta**, 50.0 mg, 71% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.48-9.45 (m, 1H), 8.43-8.40 (m, 1H), 7.89-7.83 (m, 2H), 7.62-7.57 (m, 2H), 7.47-7.43 (m, 1H), 6.08-6.05 (m, 1H), 4.37-4.31 (m, 1H), 4.15-4.09 (m, 1H), 2.54-2.45 (m, 1H), 2.40-2,32 (m, 1H), 2.27-2.17 (m, 1H), 2.14-2.06 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 162.2, 161.9, 145.4, 138.1, 135.0, 134.5, 131.9, 129.6, 129.1, 128.3, 128.2, 128.1, 127.4, 121.2, 119.0, 76.8, 69.4, 30.7, 25.5; HRMS (ESI) m/z calcd for $C_{19}H_{14}ClN_3O_2$ $[M+H]^+$ 352.0847, found 352.0845.



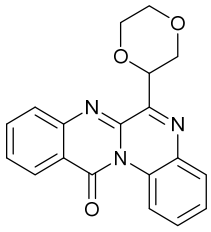
3-Methyl-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ua**, 47.1 mg, 71% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.46-9.43 (m, 1H), 8.43-8.40 (m, 1H), 7.84-7.78 (m, 3H), 7.58-7.53 (m, 1H), 7.36-7.33 (m, 1H), 5.94-5.90 (m, 1H), 4.31-4.26 (m, 1H), 4.11-4.06 (m, 1H), 2.68-2.59 (m, 1H), 2.46 (s, 3H), 2.19-2.05 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.8, 161.3, 145.4, 138.5, 137.3, 134.9, 134.6, 130.3, 130.1, 128.0, 127.8, 127.2, 125.8, 121.2, 120.1, 77.3, 69.4, 31.5, 25.8, 20.8; HRMS (ESI) m/z calcd for $C_{20}H_{17}N_3O_2$ $[M+H]^+$ 332.1394, found 332.1391.



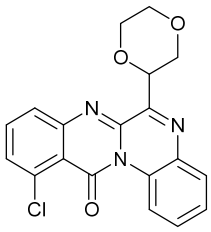
2-Chloro-3-methyl-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3va**, 57.8 mg, 79% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.65 (s, 1H), 8.41-8.35 (m, 1H), 7.83-7.81 (m, 3H), 7.60-7.54 (m, 1H), 5.91-5.87 (m, 1H), 4.30-4.25 (m, 1H), 4.11-4.05 (m, 1H), 2.69-2.60 (m, 1H), 2.45 (s, 3H), 2.17-2.06 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.6, 145.3, 138.0, 135.5, 135.4, 134.9, 133.6, 131.3, 128.1, 128.0, 127.3, 126.4, 121.0, 120.7, 77.3, 69.4, 31.5, 25.8, 19.8; HRMS (ESI) m/z calcd for $C_{20}H_{16}ClN_3O_2$ $[M+H]^+$ 366.1004, found 366.1010.



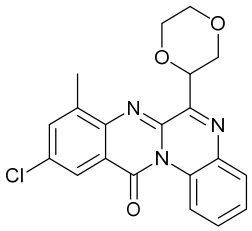
6-(Tetrahydro-2*H*-pyran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ab**, 42.4 mg, 64% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.57-9.55 (m, 1H), 8.46-8.44 (m, 1H), 8.11-8.09 (m, 1H), 7.87-7.82 (m, 2H), 7.62-7.51 (m, 3H), 5.58-5.55 (m, 1H), 4.37-4.32 (m, 1H), 3.84-3.77 (m, 1H), 2.29-2.25 (m, 1H), 2.06-1.99 (m, 1H), 1.94-1.86 (m, 2H), 1.80-1.62 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.9, 160.7, 145.3, 138.0, 135.1, 134.8, 130.2, 129.4, 127.98, 127.93, 127.90, 127.3, 127.2, 121.2, 120.3, 76.4, 69.6, 31.0, 25.7, 23.9; HRMS (ESI) m/z calcd for $C_{20}H_{17}N_3O_2$ $[M+H]^+$ 332.1394, found 332.1389.



6-(1,4-Dioxan-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ac**, 38.7 mg, 58% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.58-9.55 (m, 1H), 8.45-8.43 (m, 1H), 8.09-8.07 (m, 1H), 7.88-7.83 (m, 2H), 7.62-7.52 (m, 3H), 5.87-5.84 (m, 1H), 4.48-4.45 (m, 1H), 4.21-4.17 (m, 1H), 4.12-4.06 (m, 1H), 3.95-3.86 (m, 2H), 3.75-3.70 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 161.8, 157.1, 145.2, 138.1, 135.0, 134.9, 130.3, 130.0, 128.3, 128.0, 127.4, 127.3, 121.2, 120.4, 74.9, 70.4, 67.7, 66.5; HRMS (ESI) m/z calcd for $C_{19}H_{15}N_3O_3$ $[M+H]^+$ 334.1186, found 334.1192.

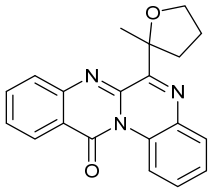


11-Chloro-6-(1,4-dioxan-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3cc**, 44.1 mg, 60% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.32-9.30 (m, 1H), 8.10-8.07 (m, 1H), 7.80-7.77 (m, 1H), 7.72 (t, J = 7.9 Hz, 1H), 7.61-7.53 (m, 3H), 5.82-5.79 (m, 1H), 4.44-4.41 (m, 1H), 4.20-4.16 (m, 1H), 4.11-4.05 (m, 1H), 3.95-3.86 (m, 2H), 3.75-3.70 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 159.6, 156.7, 147.7, 138.5, 135.0, 134.4, 134.3, 130.7, 130.5, 130.1, 127.6, 127.2, 120.0, 118.2, 74.7, 70.3, 67.7, 66.4; HRMS (ESI) m/z calcd for $C_{19}H_{14}ClN_3O_3$ $[M+H]^+$ 368.0796, found 368.0813.

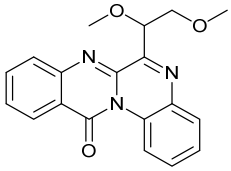


10-Chloro-6-(1,4-dioxan-2-yl)-8-methyl-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3oc**, 44.3 mg, 58% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.56-9.53 (m, 1H), 8.22 (d, J = 2.4 Hz, 1H), 8.09-8.07 (m, 1H), 7.64-7.54 (m, 3H), 5.80-5.77 (m, 1H), 4.47-4.44 (m, 1H), 4.21-4.17 (m, 1H), 4.11-4.05 (m, 1H), 3.95-3.87 (m, 2H), 3.80-3.75 (m, 1H), 2.70 (s, 3H); ^{13}C

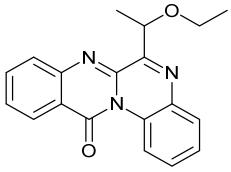
NMR (101 MHz, $CDCl_3$): δ = 161.0, 157.0, 142.3, 138.9, 137.1, 135.6, 135.0, 133.7, 130.4, 130.1, 127.8, 127.7, 124.2, 122.1, 120.4, 75.1, 70.4, 67.7, 66.5, 17.3; HRMS (ESI) m/z calcd for $C_{20}H_{16}ClN_3O_3$ $[M+H]^+$ 382.0953, found 382.0945.



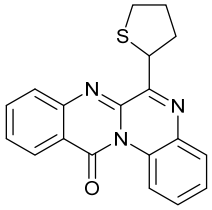
6-(2-Methyltetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ad**, 45.1 mg, 68% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.53-9.50 (m, 1H), 8.47-8.45 (m, 1H), 8.06-8.03 (m, 1H), 7.88-7.84 (m, 2H), 7.63-7.50 (m, 3H), 4.18-4.07 (m, 2H), 2.79-2.71 (m, 1H), 2.49-2.42 (m, 1H), 2.14-2.04 (m, 1H), 1.95 (s, 3H), 1.92-1.87 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 163.4, 162.1, 144.9, 137.7, 134.8, 134.7, 130.4, 129.3, 128.1, 128.0, 127.8, 127.3, 127.2, 121.1, 120.1, 86.1, 67.7, 37.9, 26.6, 25.6; HRMS (ESI) m/z calcd for $C_{20}H_{17}N_3O_2$ $[M+H]^+$ 332.1394, found 332.1386.



6-(1,2-Dimethoxyethyl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ae**, 23.5 mg, 35% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.62-9.60 (m, 1H), 8.50-8.47 (m, 1H), 8.09-8.06 (m, 1H), 7.91-7.86 (m, 2H), 7.66-7.55 (m, 3H), 5.76 (t, J = 5.0 Hz, 1H), 3.94 (d, J = 5.0 Hz, 2H), 3.58 (s, 3H), 3.47 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 162.0, 158.2, 145.4, 138.9, 135.1, 135.0, 130.4, 129.8, 128.2, 128.1, 128.0, 127.4, 121.3, 120.4, 78.4, 74.4, 59.5, 58.4; HRMS (ESI) m/z calcd for $C_{19}H_{17}N_3O_2$ $[M+H]^+$ 336.1343, found 336.1355.



6-(1-Ethoxyethyl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3af**, 19.2 mg, 30% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.58-9.56 (m, 1H), 8.46-8.44 (m, 1H), 8.05-8.03 (m, 1H), 7.87-7.82 (m, 2H), 7.61-7.52 (m, 3H), 5.73-5.68 (m, 1H), 3.75-3.59 (m, 2H), 1.66 (d, J = 6.5 Hz, 3H), 1.30 (t, J = 7.0 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 162.1, 162.0, 145.4, 138.7, 135.2, 134.8, 130.2, 129.4, 128.1, 128.0, 127.9, 127.4, 127.3, 121.2, 120.4, 73.2, 65.3, 20.3, 15.6; HRMS (ESI) m/z calcd for $C_{19}H_{15}N_3O_2$ $[M+Na]^+$ 320.1394, found 320.1386.

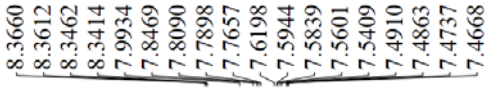


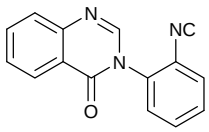
6-(Tetrahydrothiophen-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (**3ag**, 34.0 mg, 51% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.58-9.56 (m, 1H), 8.46-8.43 (m, 1H), 7.92-7.83 (m, 3H), 7.61-7.49 (m, 3H), 5.43-5.40 (m, 1H), 2.99-2.90 (m, 3H), 2.52-2.42 (m, 1H), 2.31-2.14 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 162.1, 161.6, 145.3, 139.2, 135.0, 134.8, 129.8, 129.1, 128.2, 128.1, 127.9, 127.3, 127.2, 121.2, 120.5, 47.8, 33.2, 32.1, 31.3; HRMS (ESI) m/z calcd for $C_{19}H_{15}N_3OS$ $[M+H]^+$ 334.1009, found 334.1019.

5. References

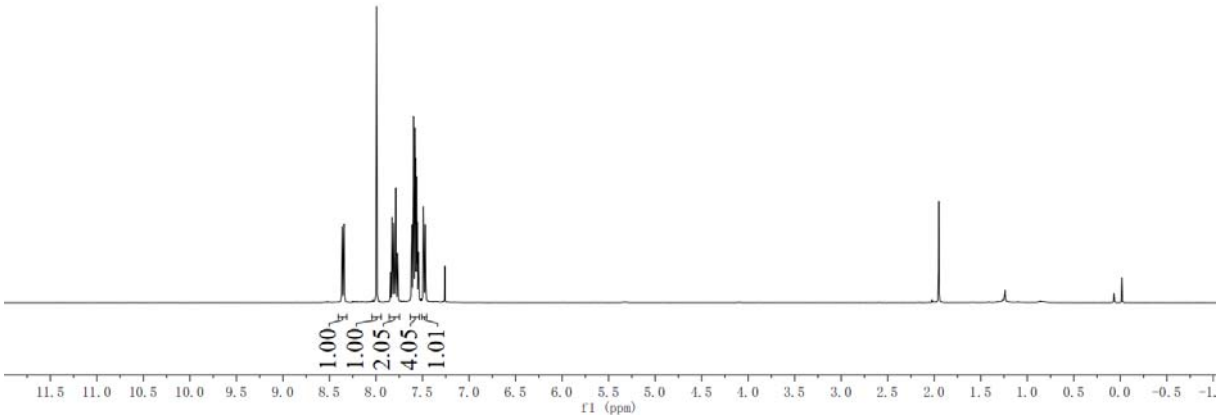
1. A. Banerjee, P. Subramanian and K. P. Kaliappan, *J. Org. Chem.,* 2016, **81**, 10424.
2. V. A. Mamedov, V. L. Mamedova, V. V. Syakaev, D. E. Korshin, G. Z. Khikmatova, E. V. Mironova, O. B. Bazanova, I. Kh. Rizvanov and S. K. Latypov, *Tetrahedron.,* 2017, **73**, 5082.
3. Y. Liu, X.-L. Chen, X.-Y. Li, S.-S. Zhu, S.-J. Li, Y. Song, L.-B. Qu and B. Yu, *J. Am. Chem. Soc.,* 2021, **143**, 964.

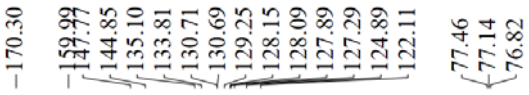
6. Copies of the ^{1}H NMR and ^{13}C NMR Spectra

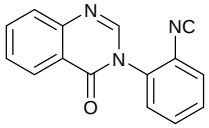




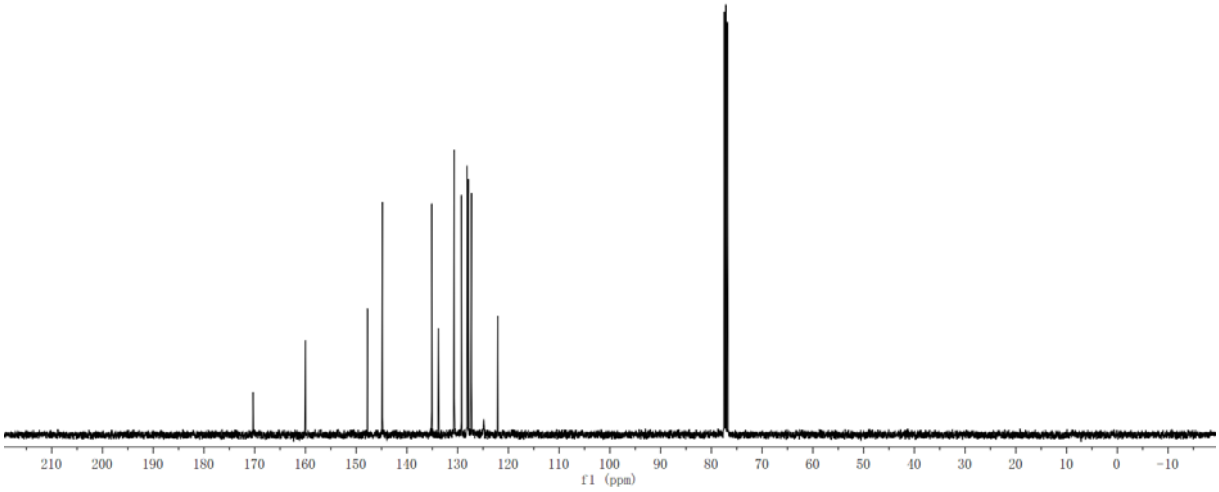
^{1}H NMR (400M, $CDCl_3$) of **1a**

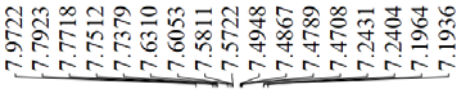


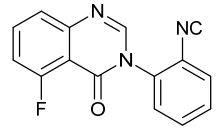




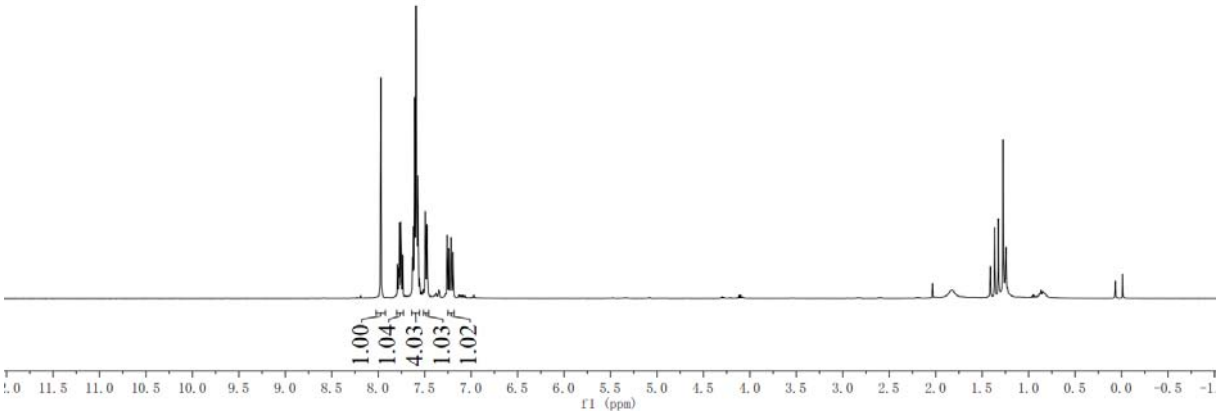
^{13}C NMR (101M, $CDCl_3$) of **1a**

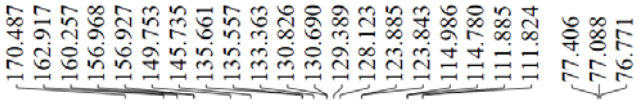


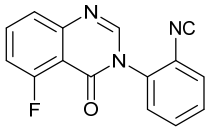




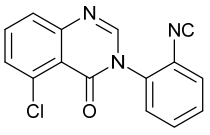
^{1}H NMR (400M, $CDCl_3$) of **1b**



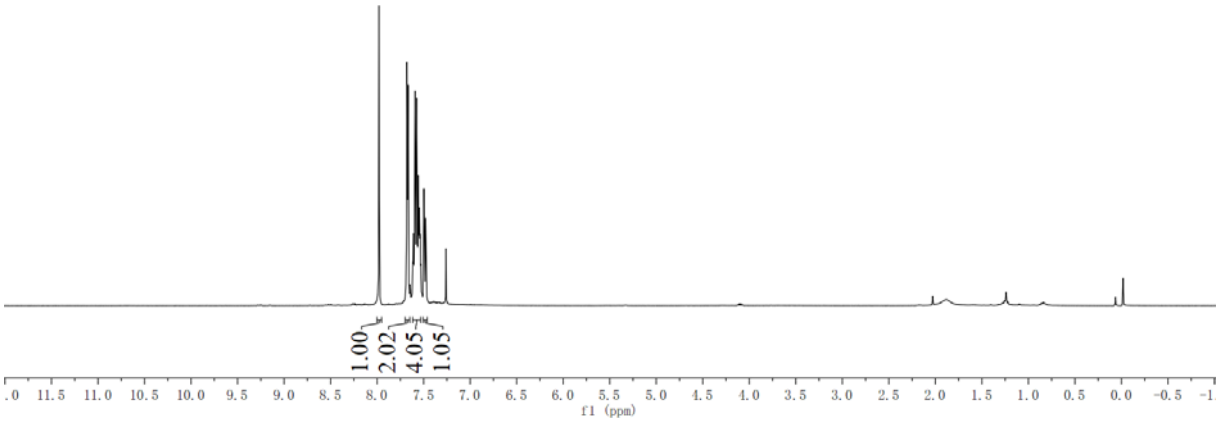


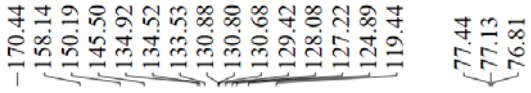


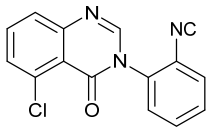
^{13}C NMR (101M, $CDCl_3$) of **1b**



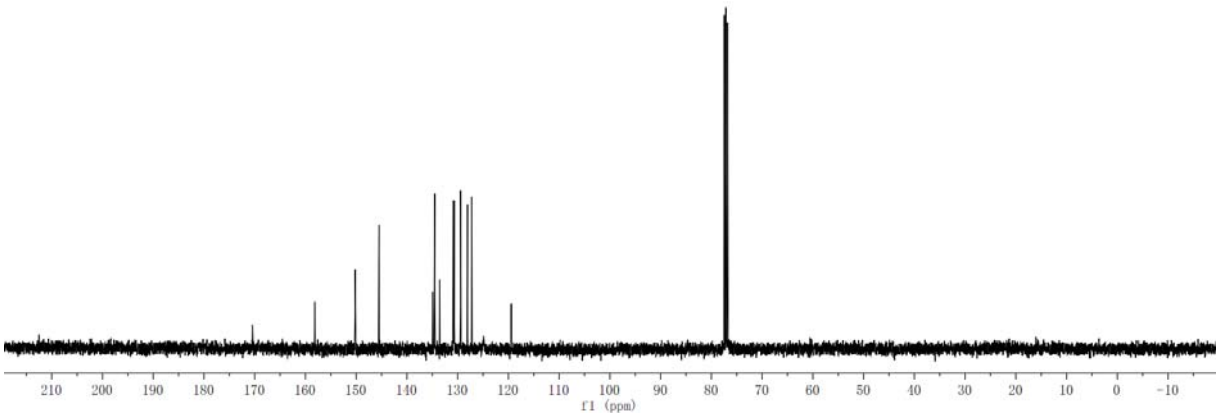
^{1}H NMR (400M, $CDCl_3$) of **1c**

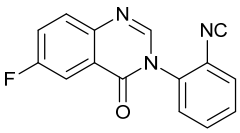




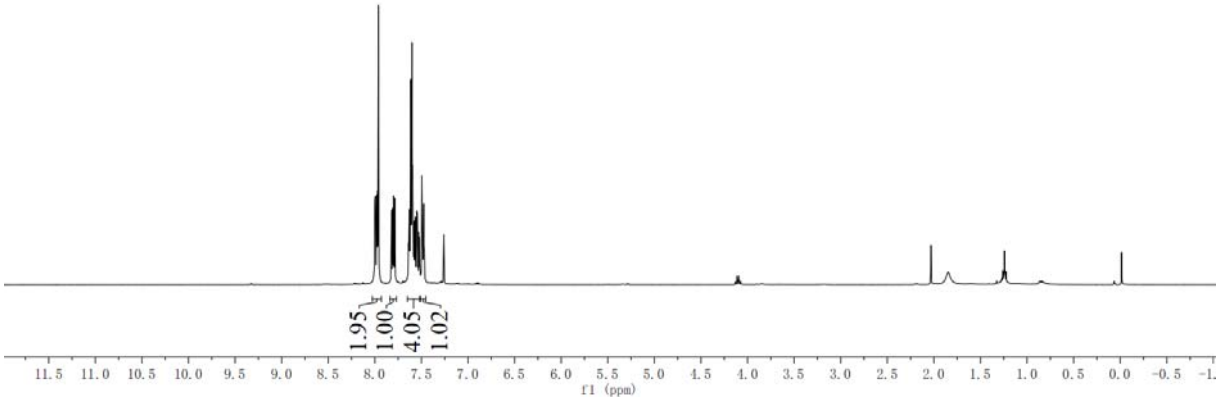


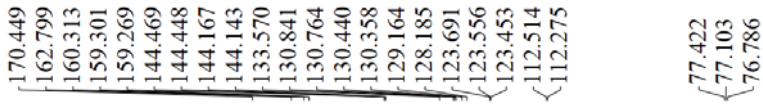
^{13}C NMR (101M, $CDCl_3$) of **1c**

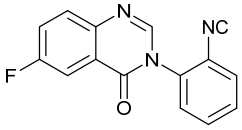




^{1}H NMR (400M, $CDCl_3$) of **1d**







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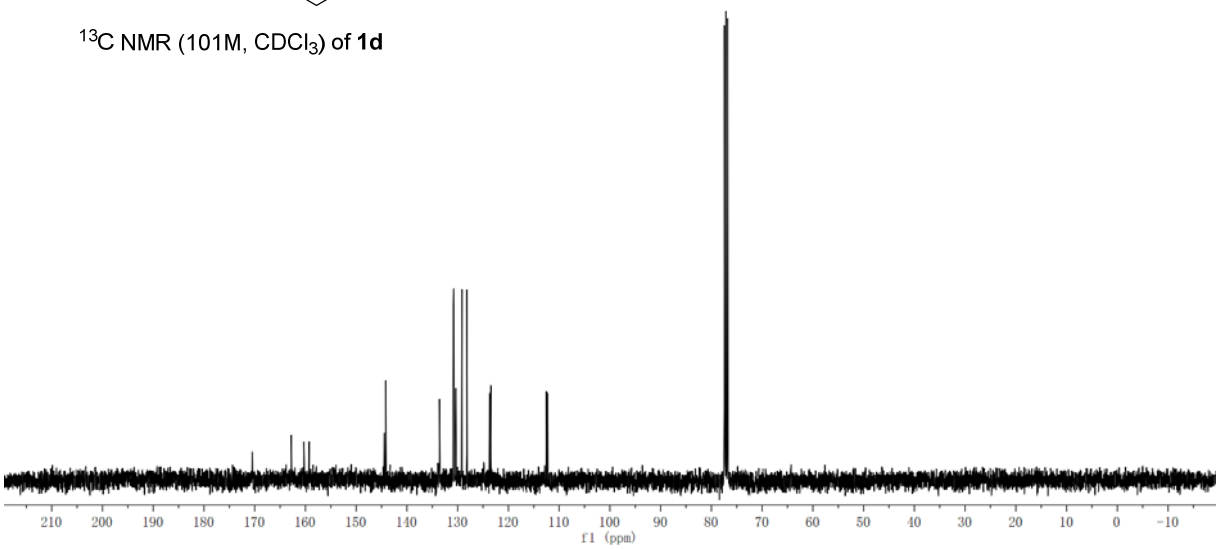
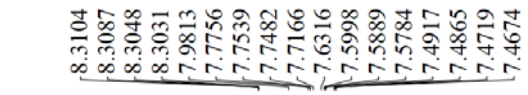
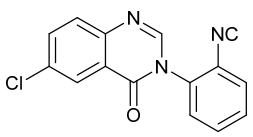
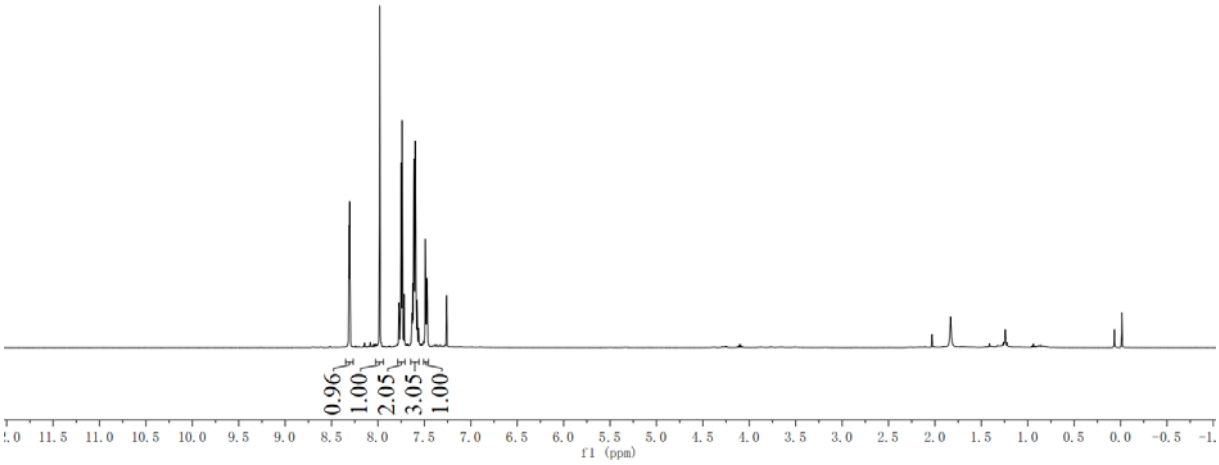
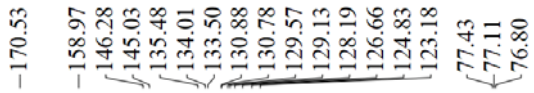


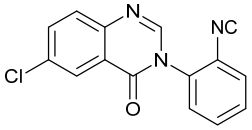




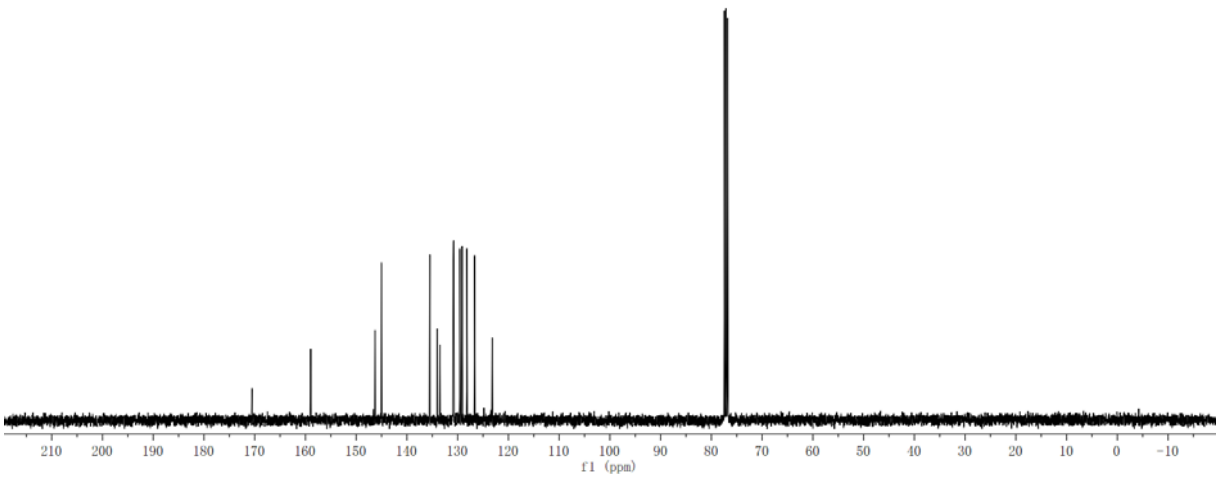
^{1}H NMR (400M, $CDCl_3$) of **1e**

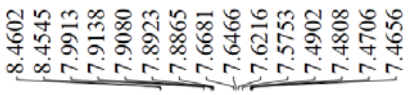


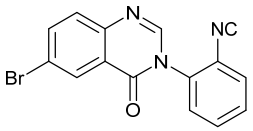




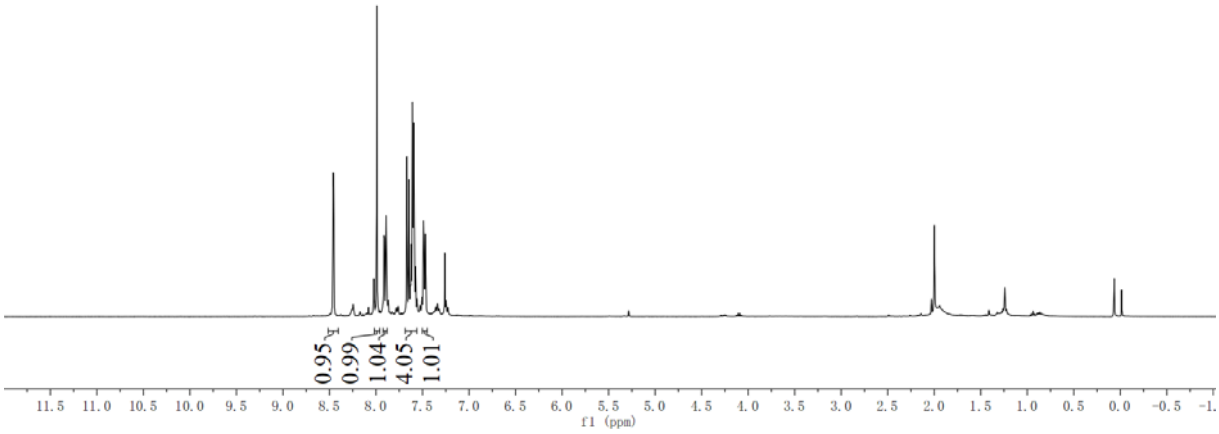
^{13}C NMR (101M, $CDCl_3$) of **1e**

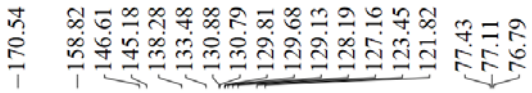


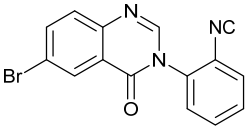




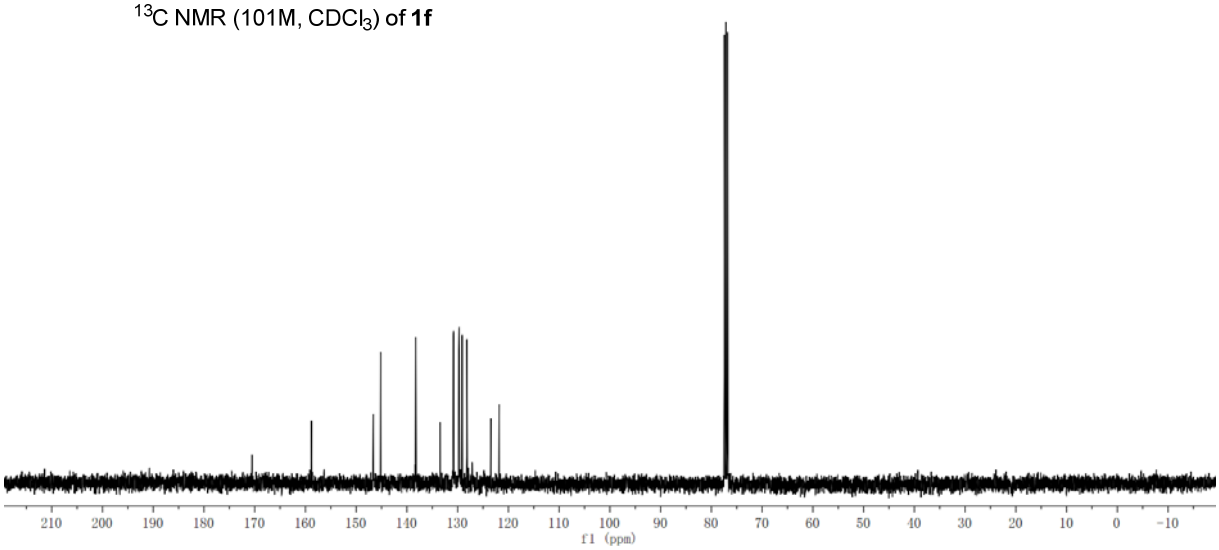
^{1}H NMR (400M, $CDCl_3$) of **1f**

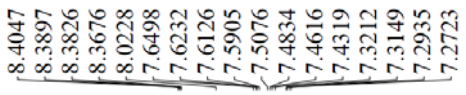


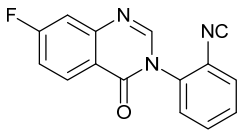




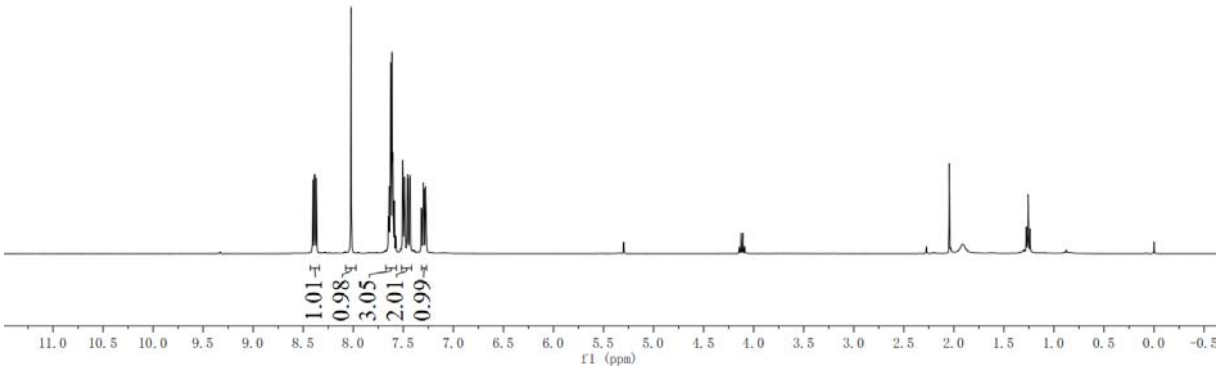
^{13}C NMR (101M, $CDCl_3$) of **1f**

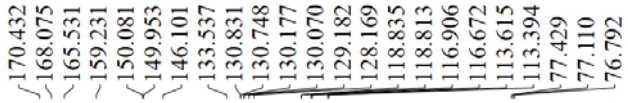


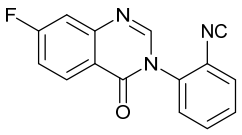




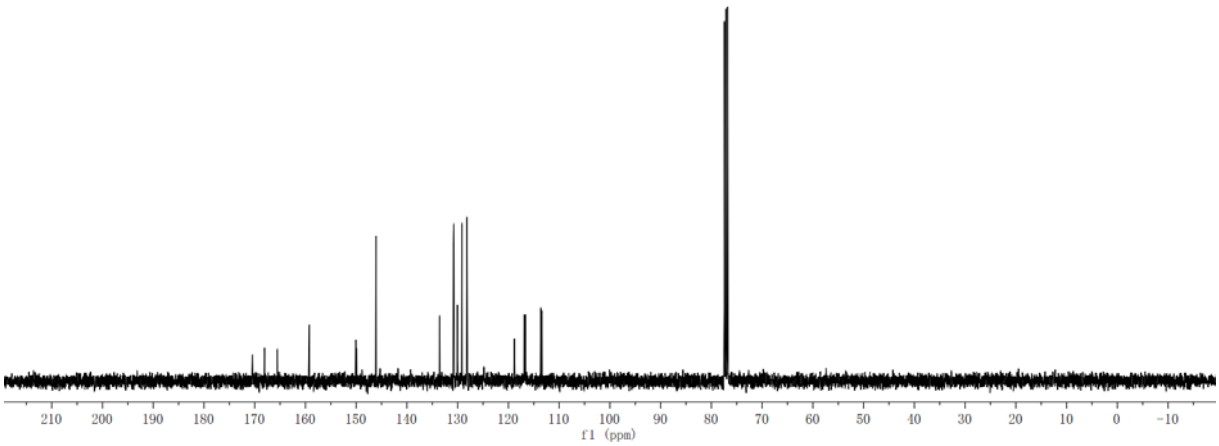
^{1}H NMR (400M, $CDCl_3$) of **1g**

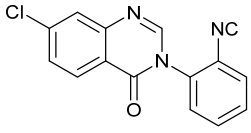




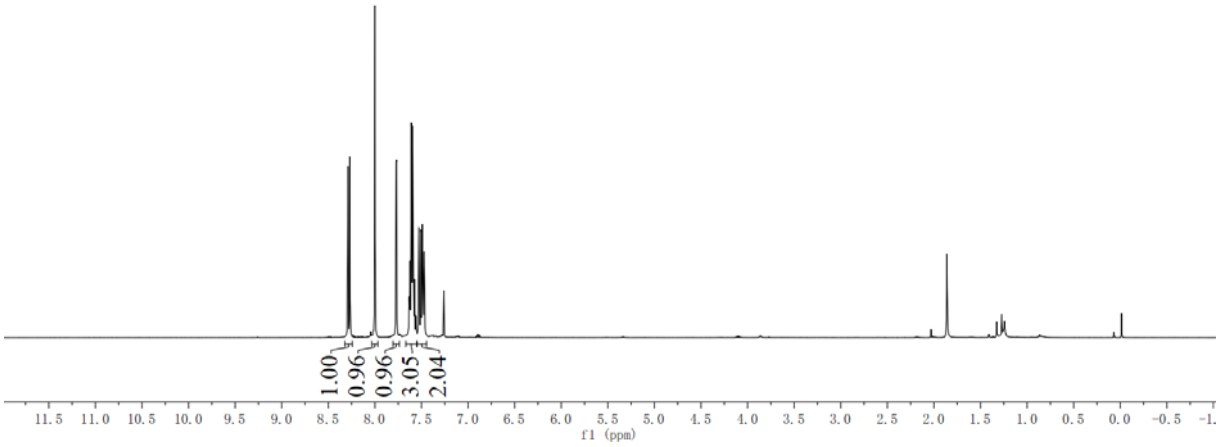


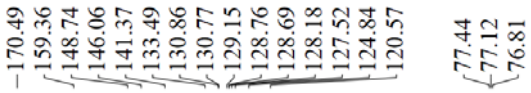
^{13}C NMR (101M, $CDCl_3$) of **1g**

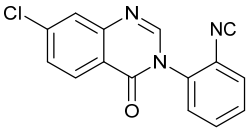




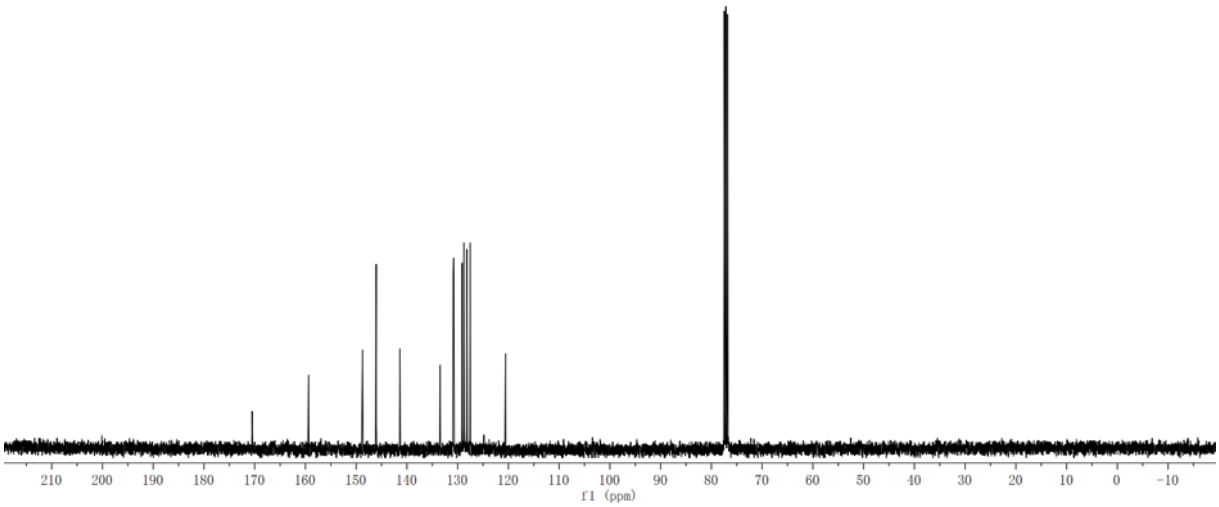
^{1}H NMR (400M, $CDCl_3$) of **1h**

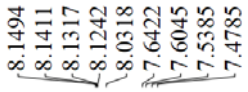


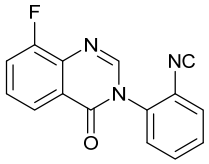




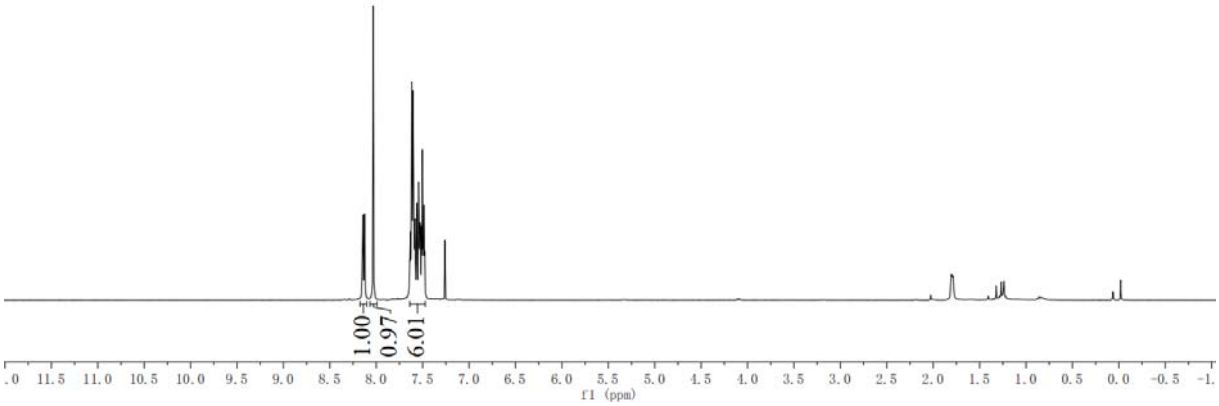
^{13}C NMR (101M, $CDCl_3$) of **1h**

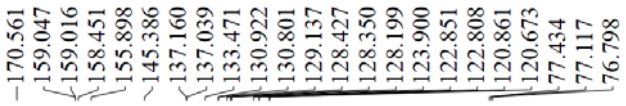


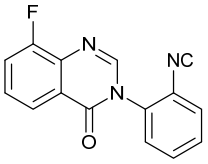




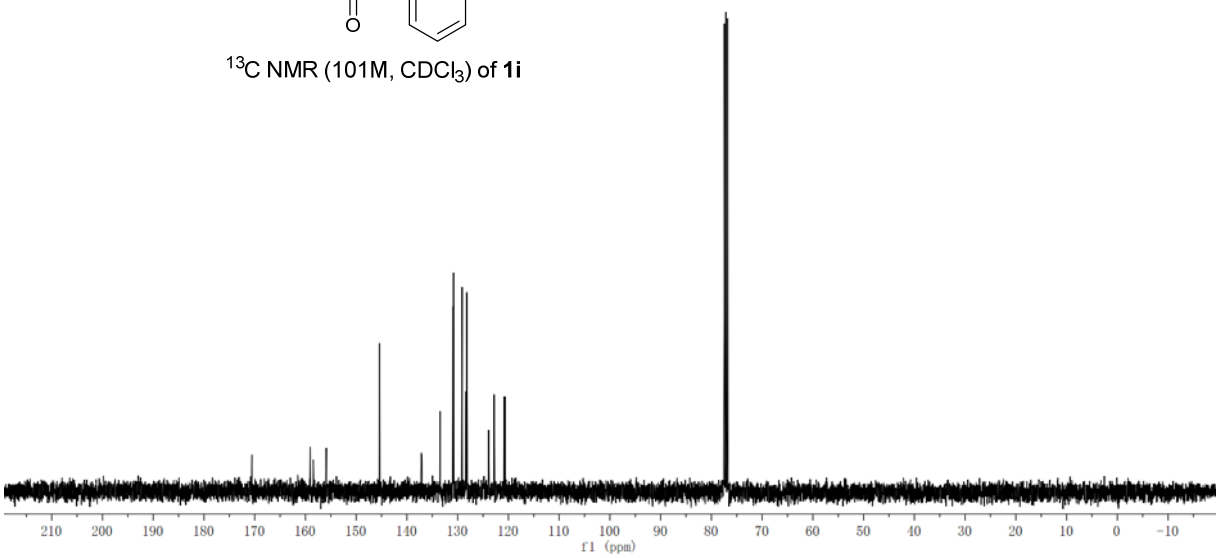
^{1}H NMR (400M, $CDCl_3$) of **1i**

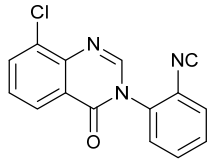






^{13}C NMR (101M, $CDCl_3$) of **1i**





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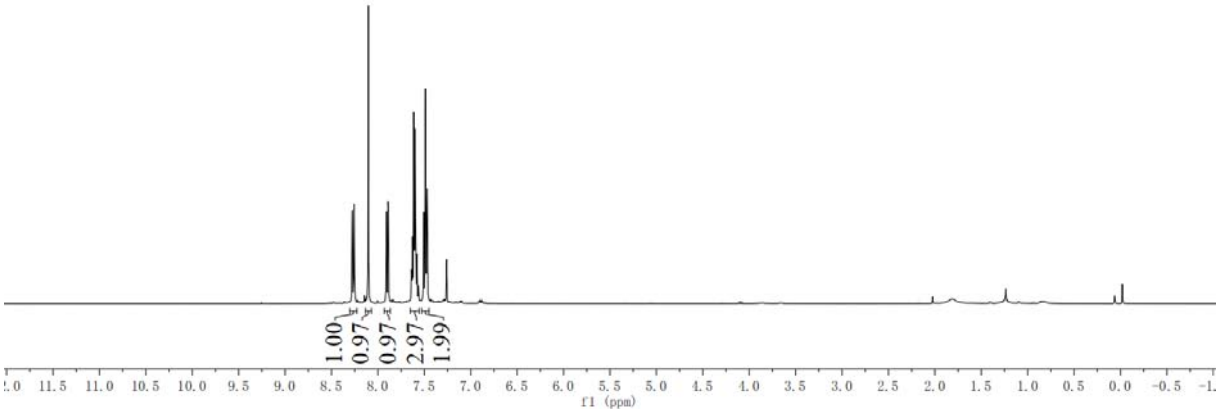

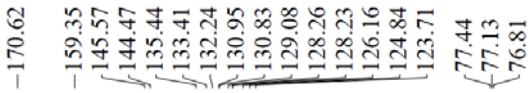

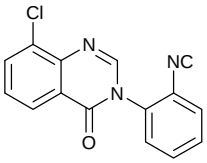

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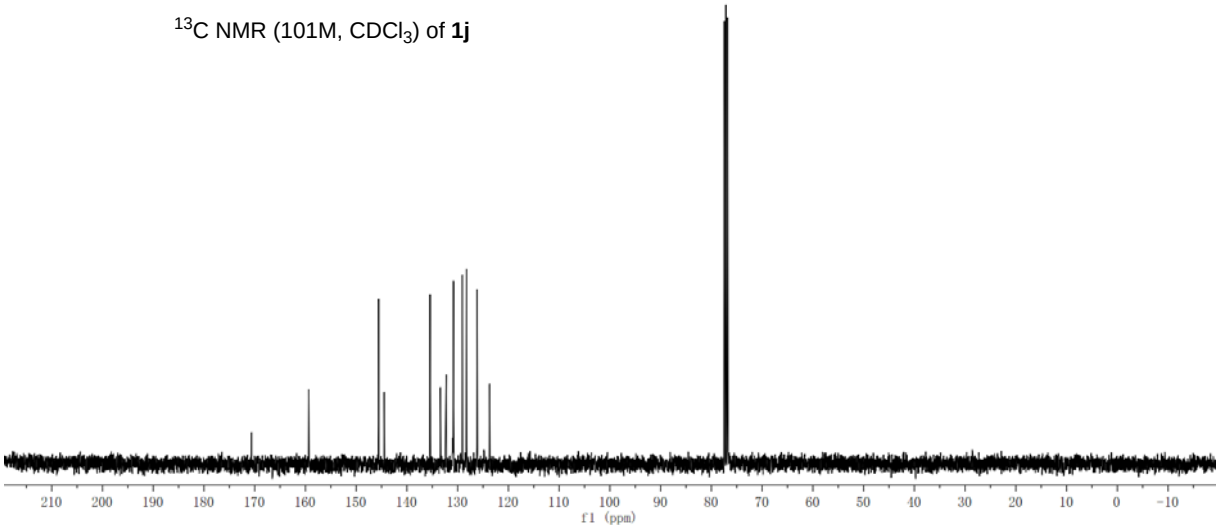
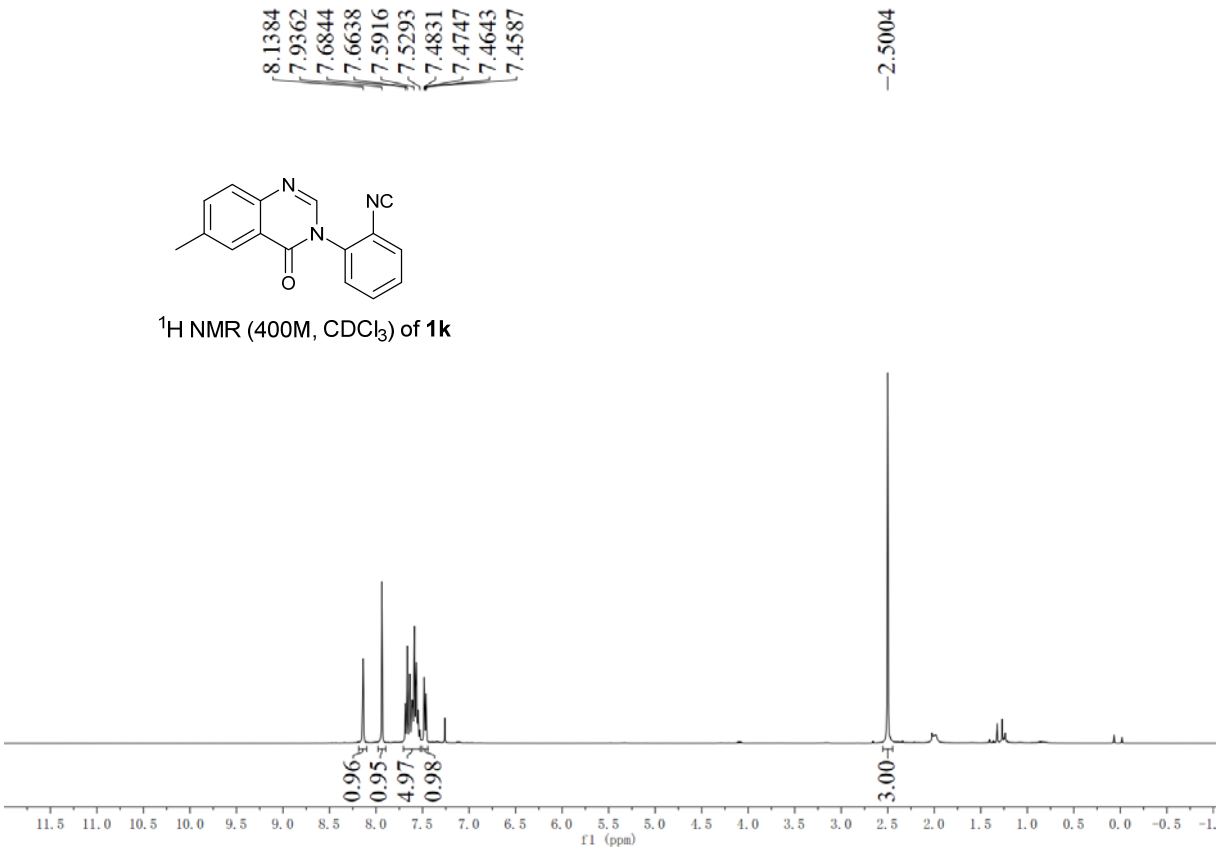
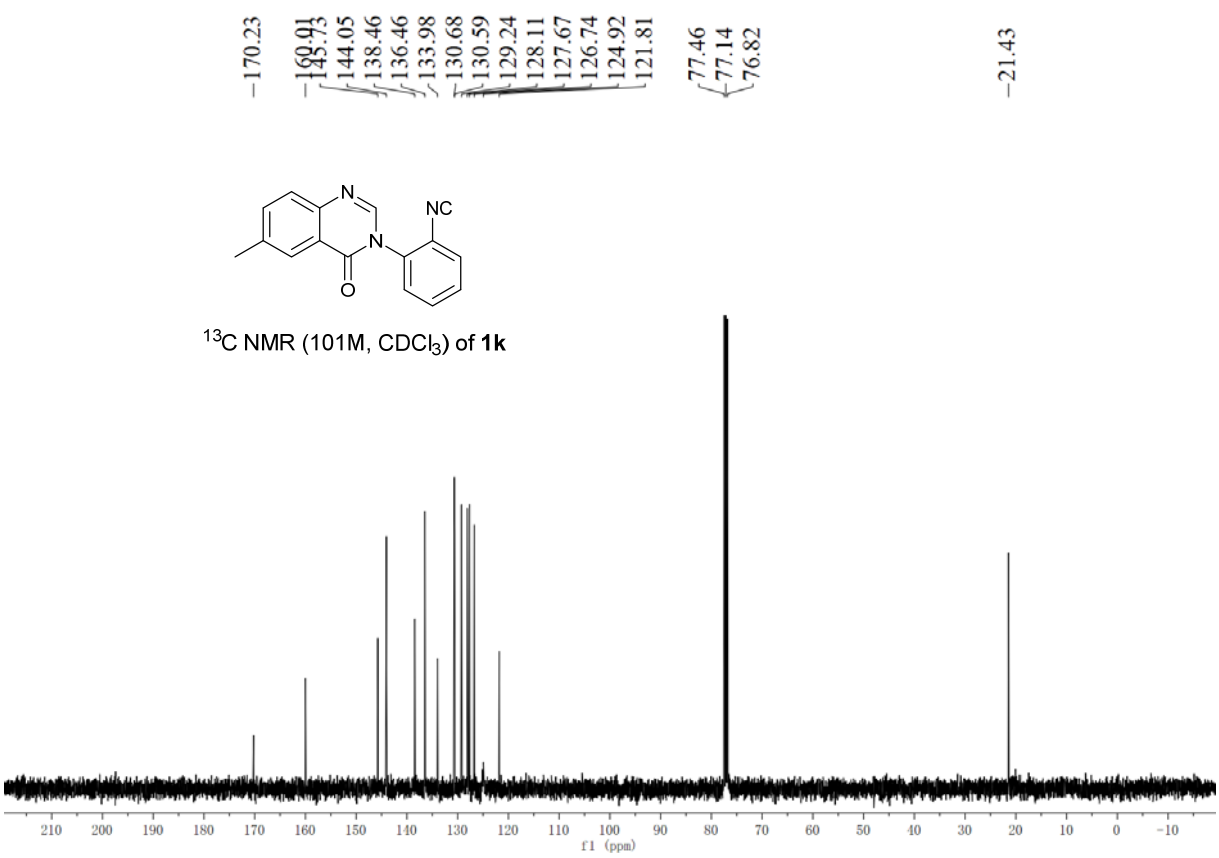
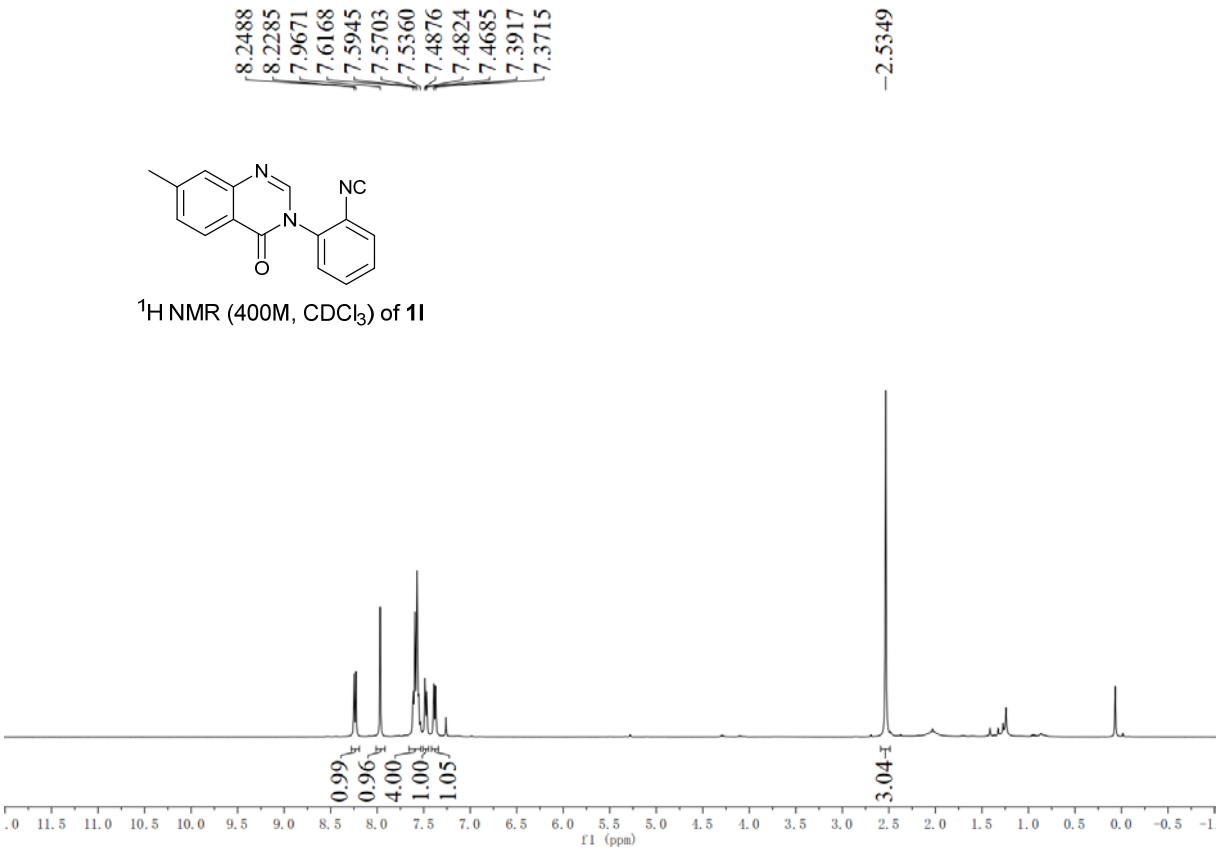




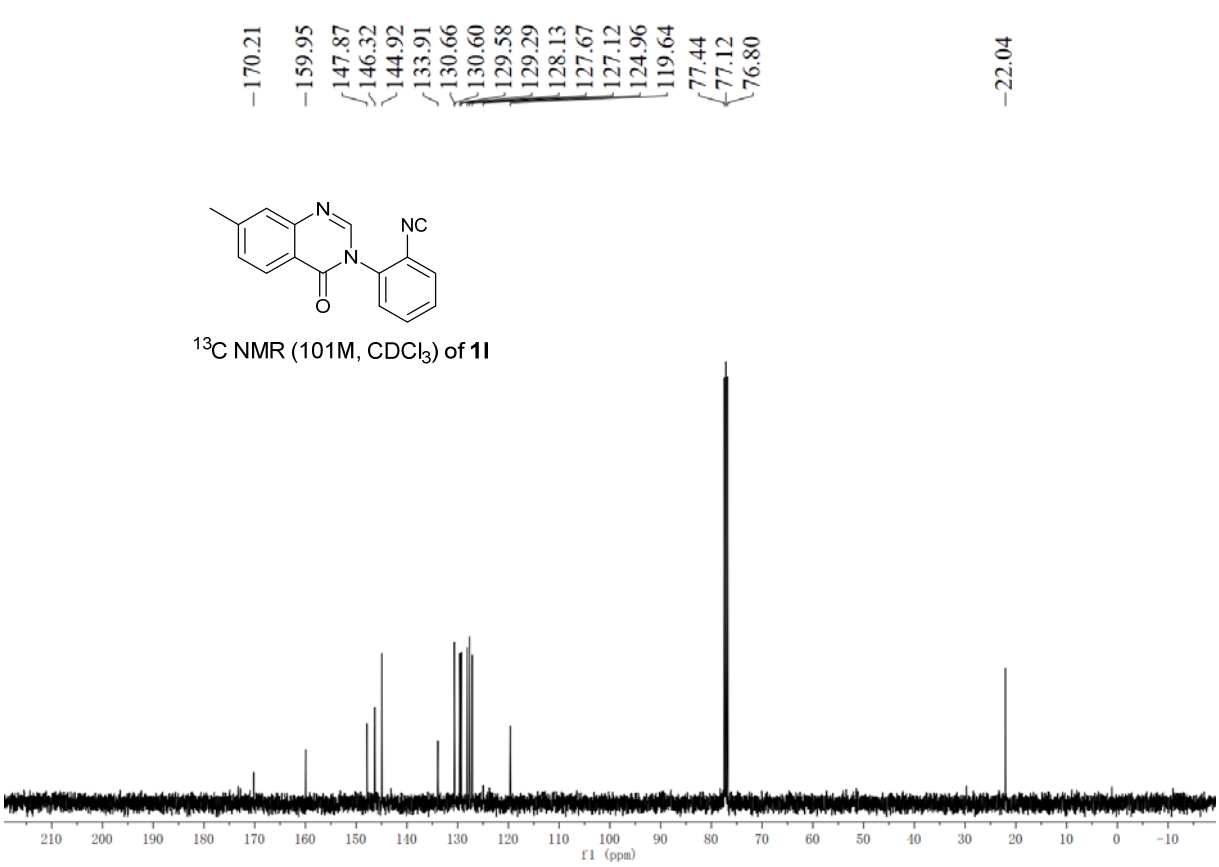
^{1}H NMR (400M, $CDCl_3$) of **1k**



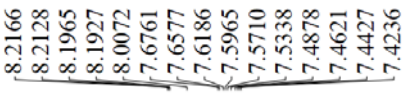
^{13}C NMR (101M, $CDCl_3$) of **1k**

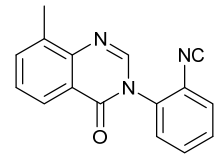


^{1}H NMR (400M, $CDCl_3$) of **1l**



^{13}C NMR (101M, $CDCl_3$) of **1l**





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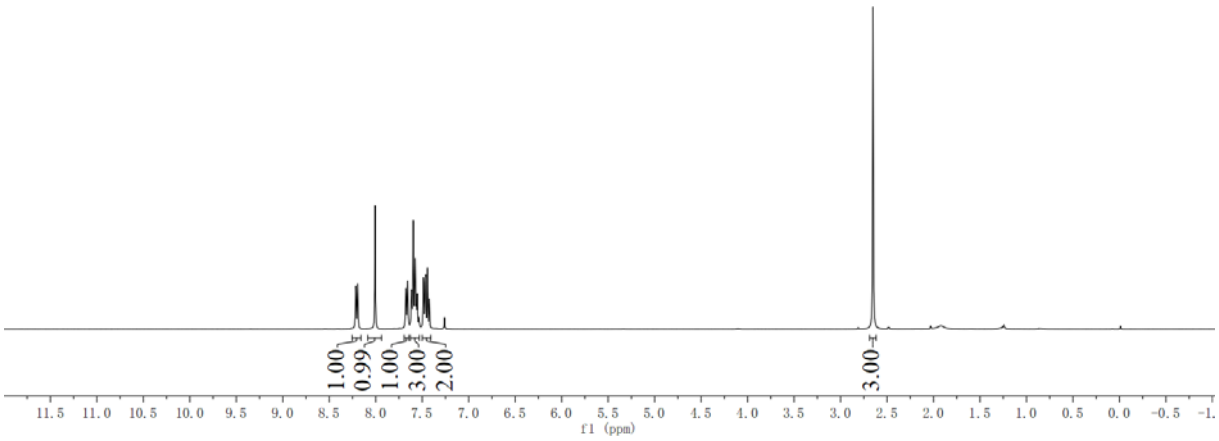
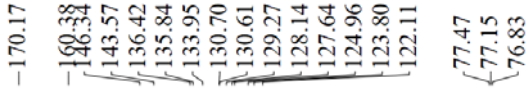
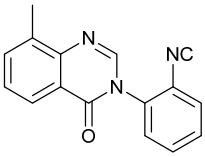
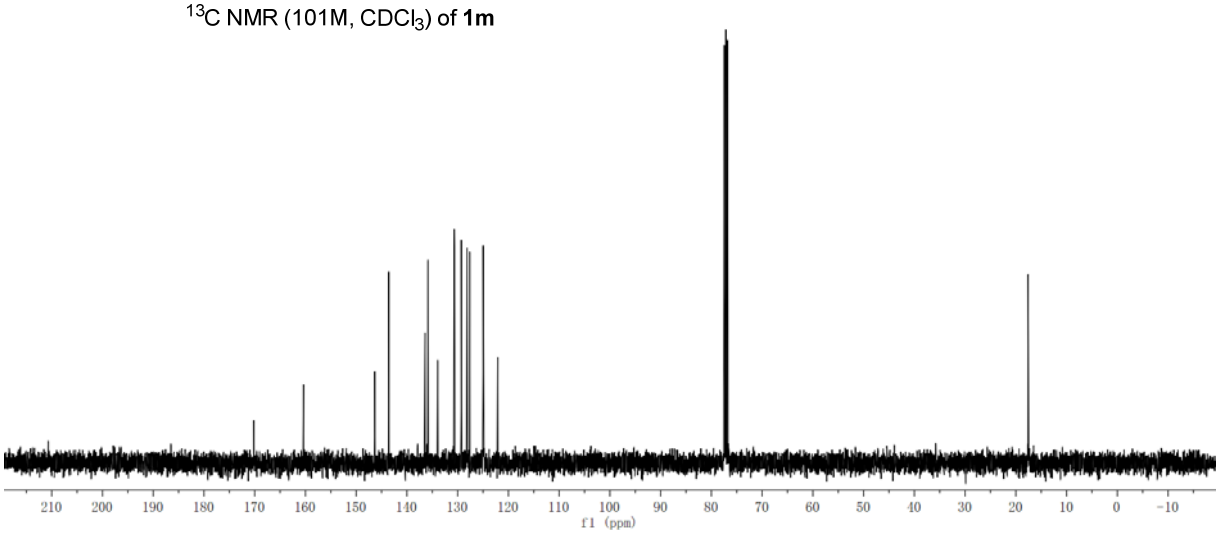
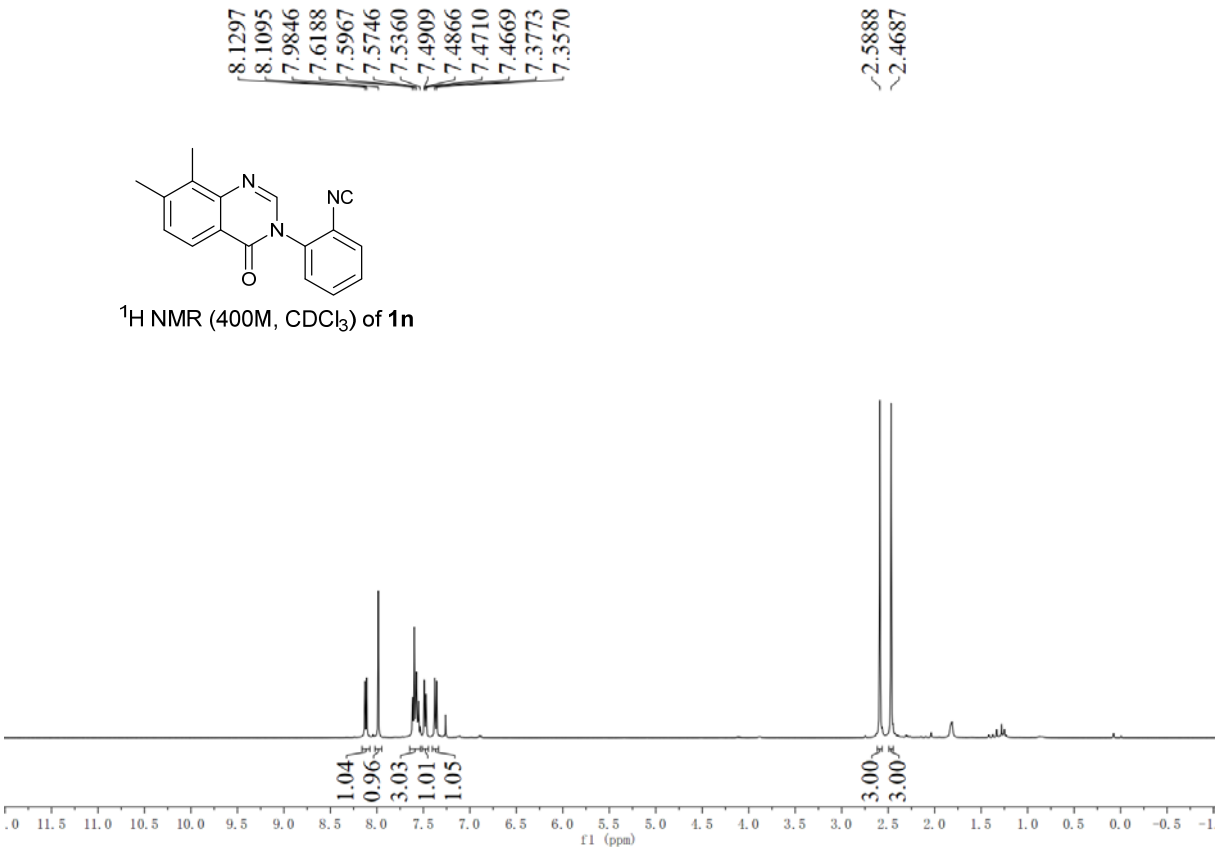




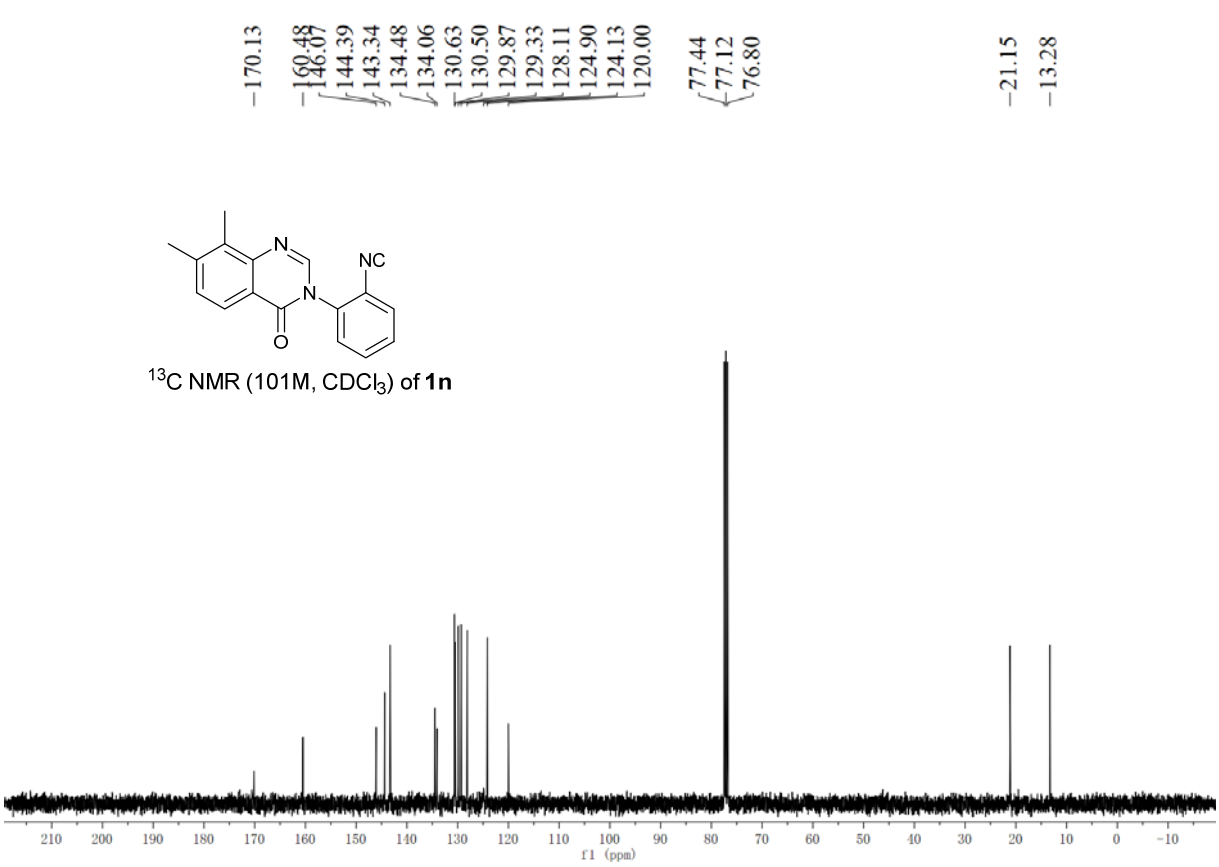


^{13}C NMR (101M, $CDCl_3$) of **1m**

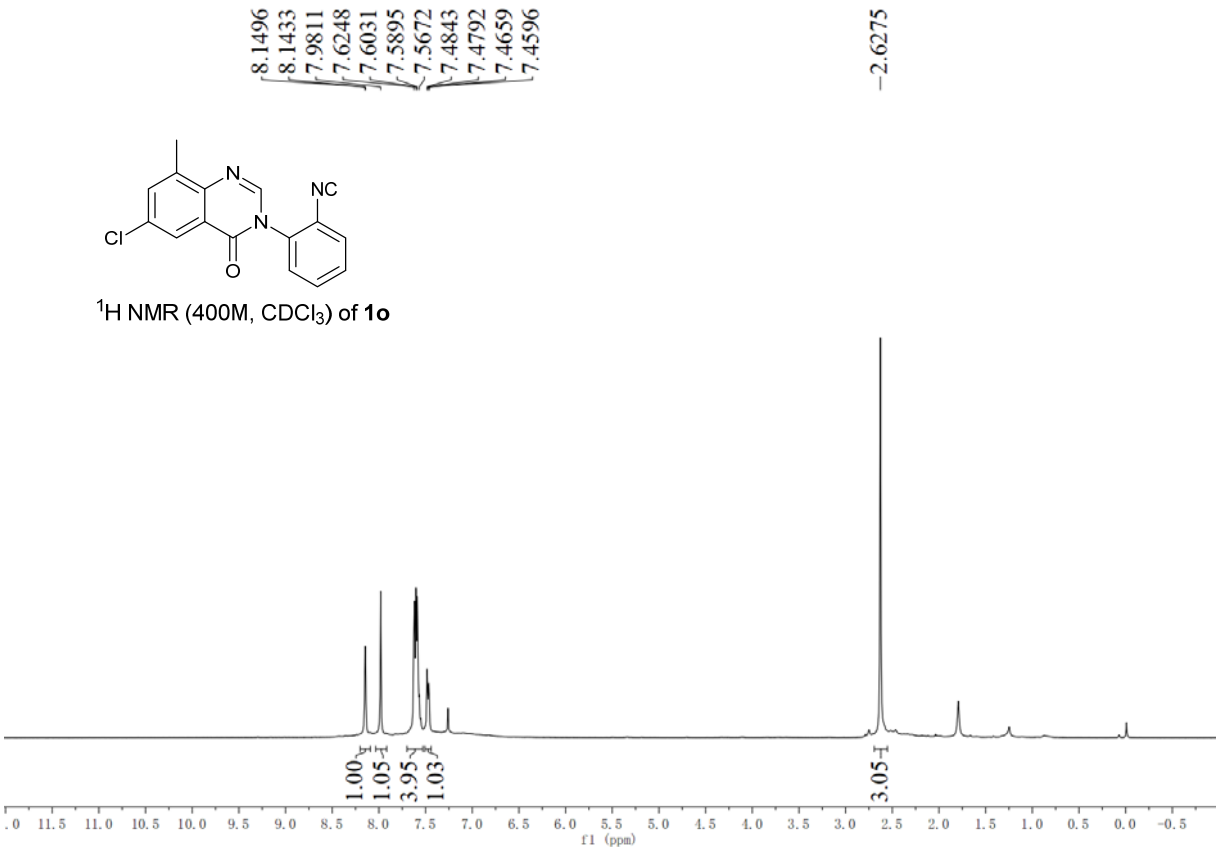




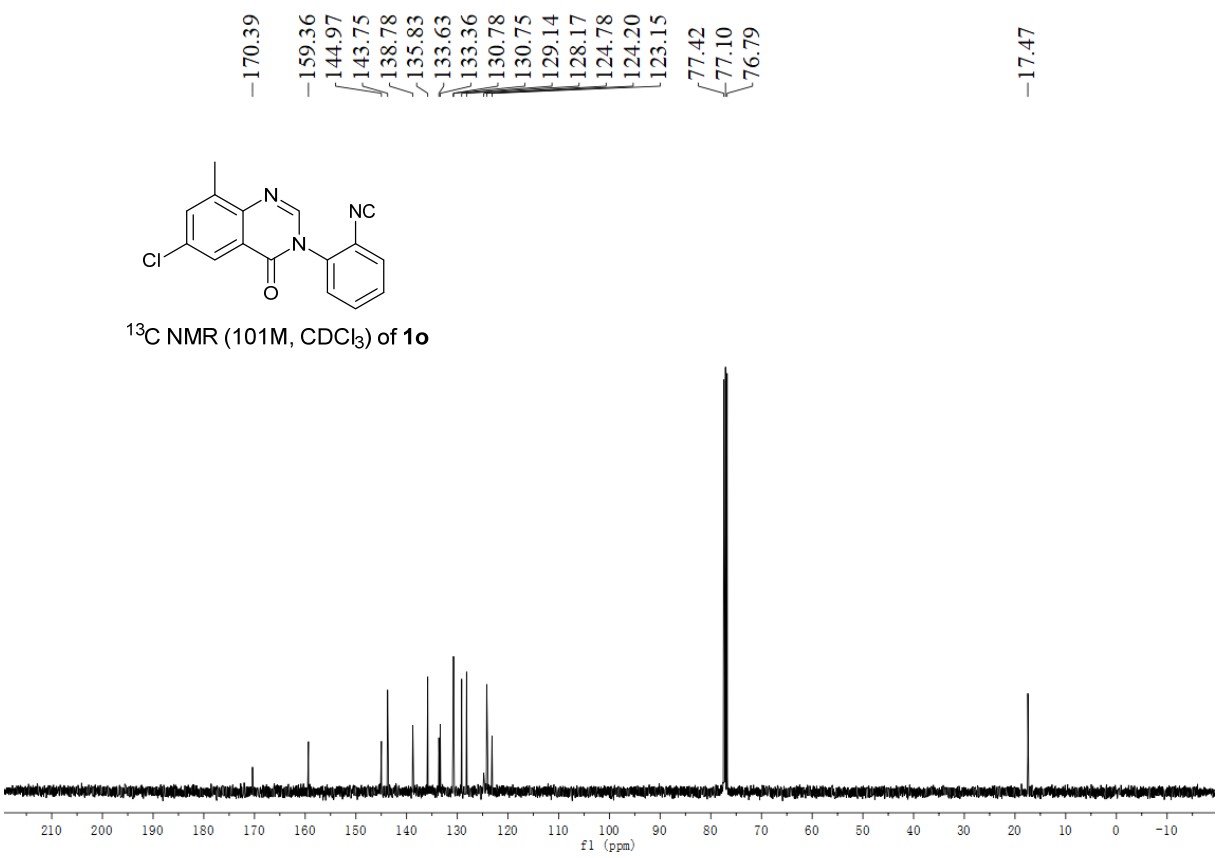
^{1}H NMR (400M, $CDCl_3$) of **1n**



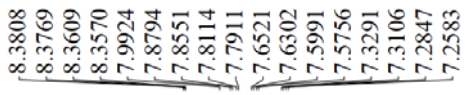
^{13}C NMR (101M, $CDCl_3$) of **1n**

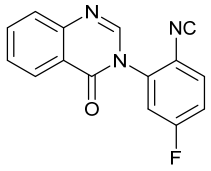


^{1}H NMR (400M, $CDCl_3$) of **1o**



^{13}C NMR (101M, $CDCl_3$) of **1o**





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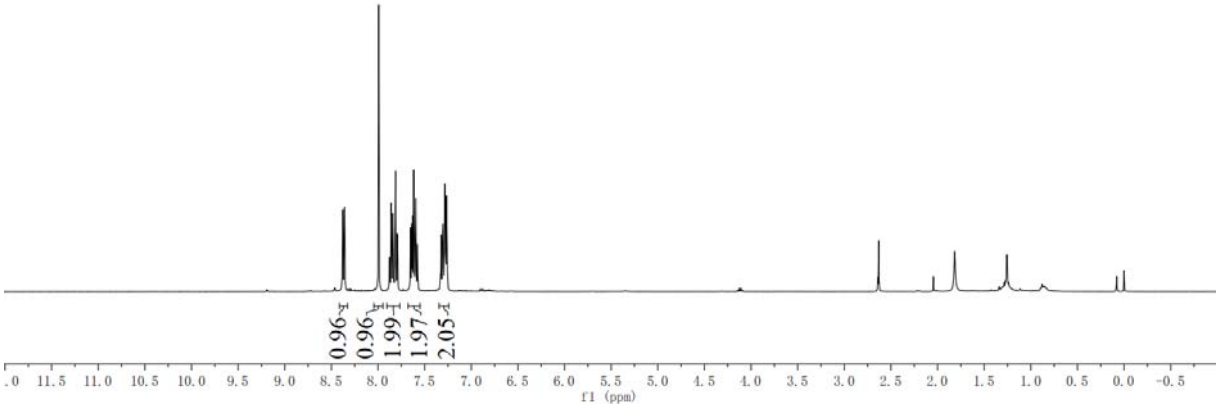
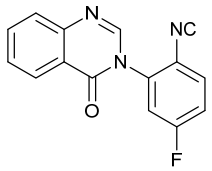
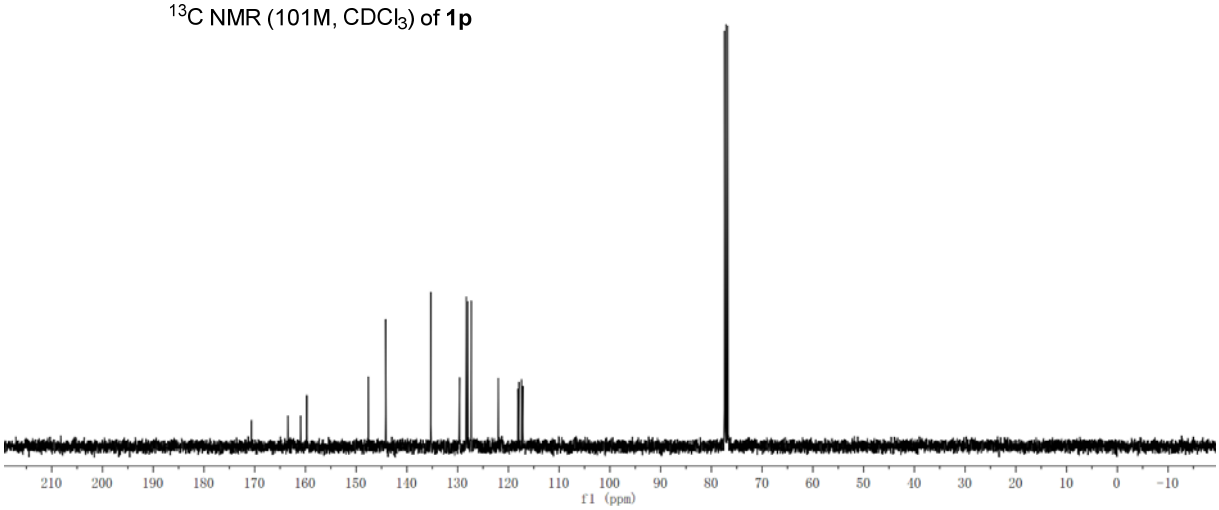
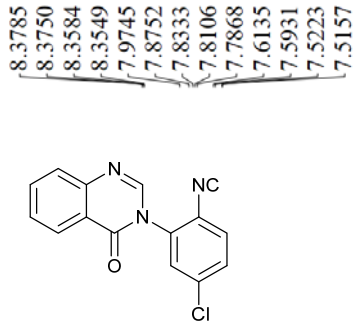


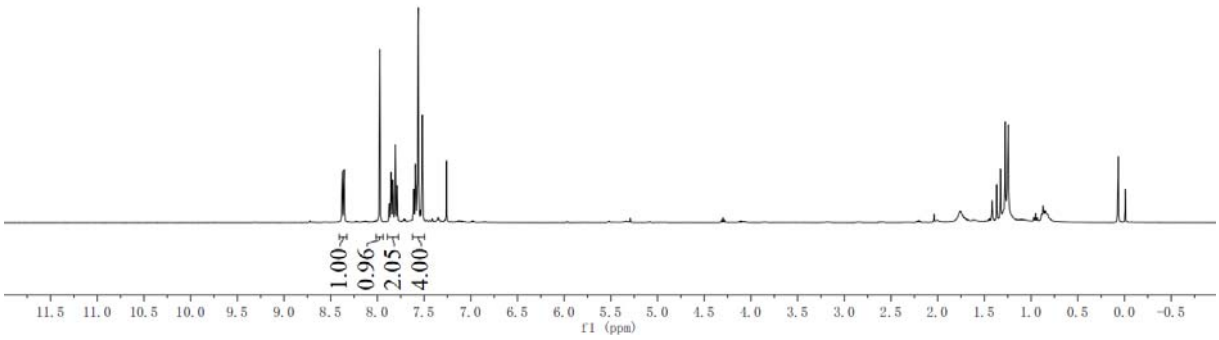


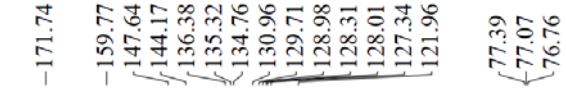
^{13}C NMR (101M, $CDCl_3$) of **1p**

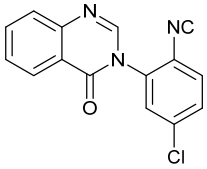




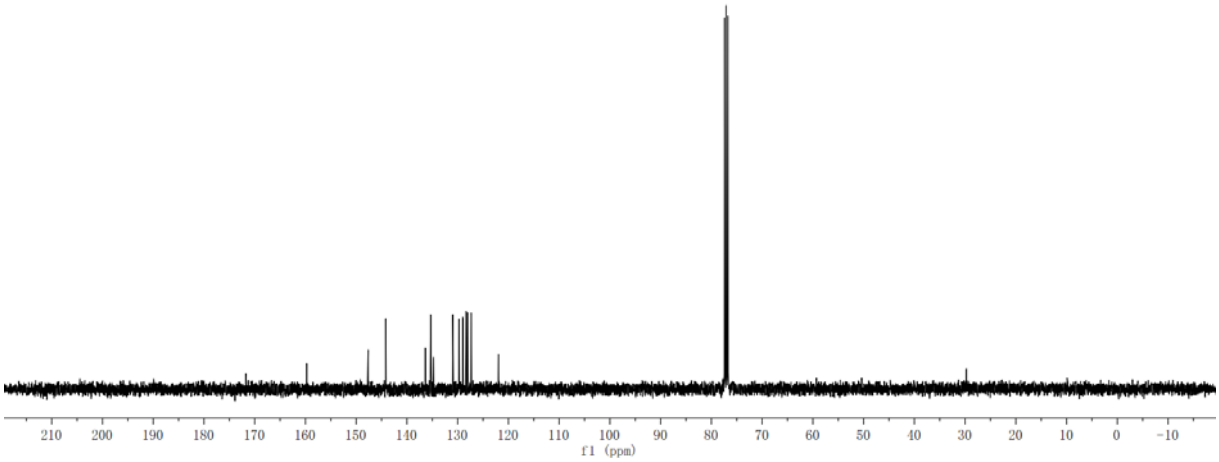
^{1}H NMR (400M, $CDCl_3$) of **1q**

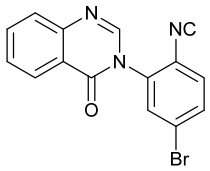




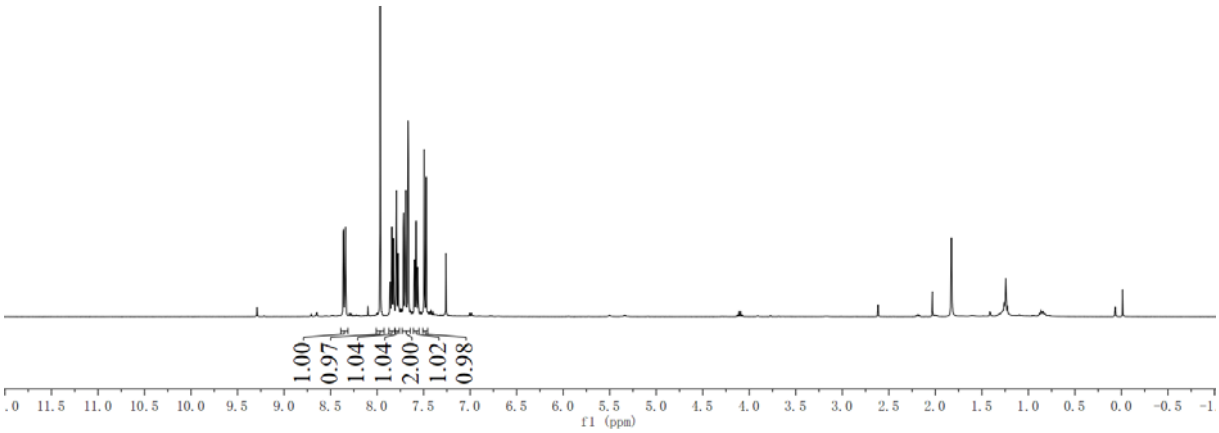


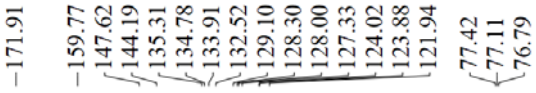
^{13}C NMR (101M, $CDCl_3$) of **1q**

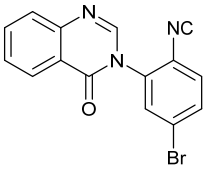




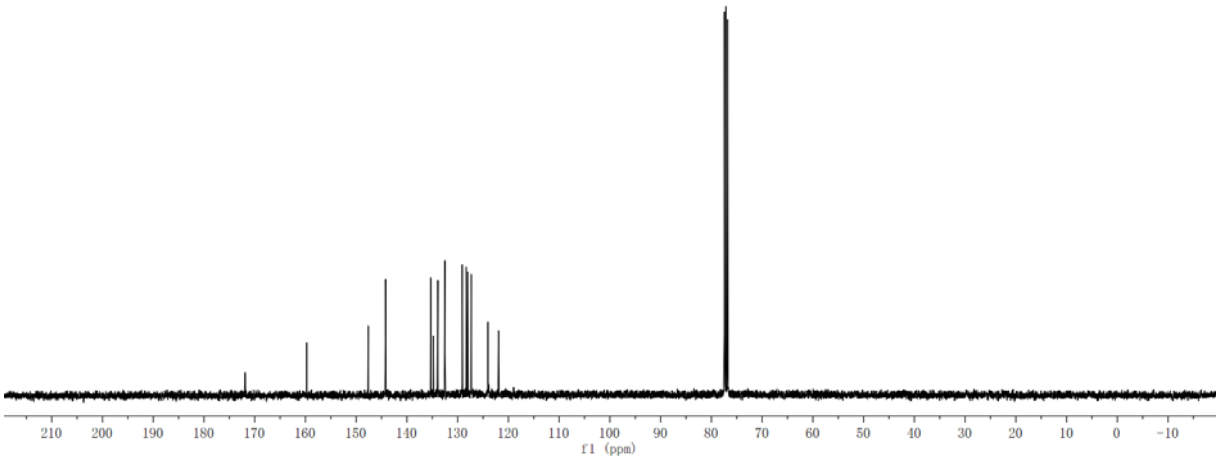
^{1}H NMR (400M, $CDCl_3$) of **1r**

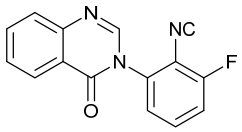




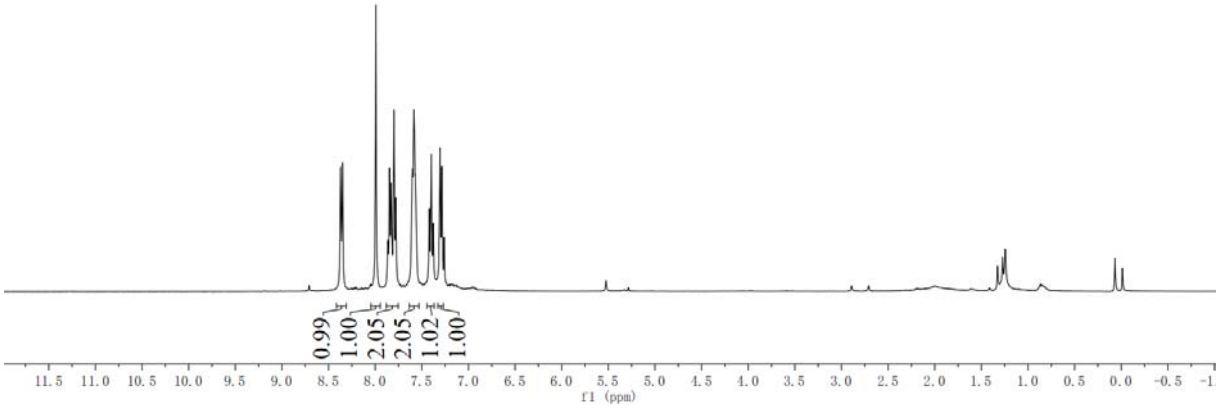


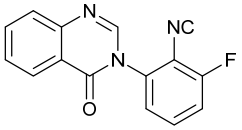
^{13}C NMR (101M, $CDCl_3$) of **1r**



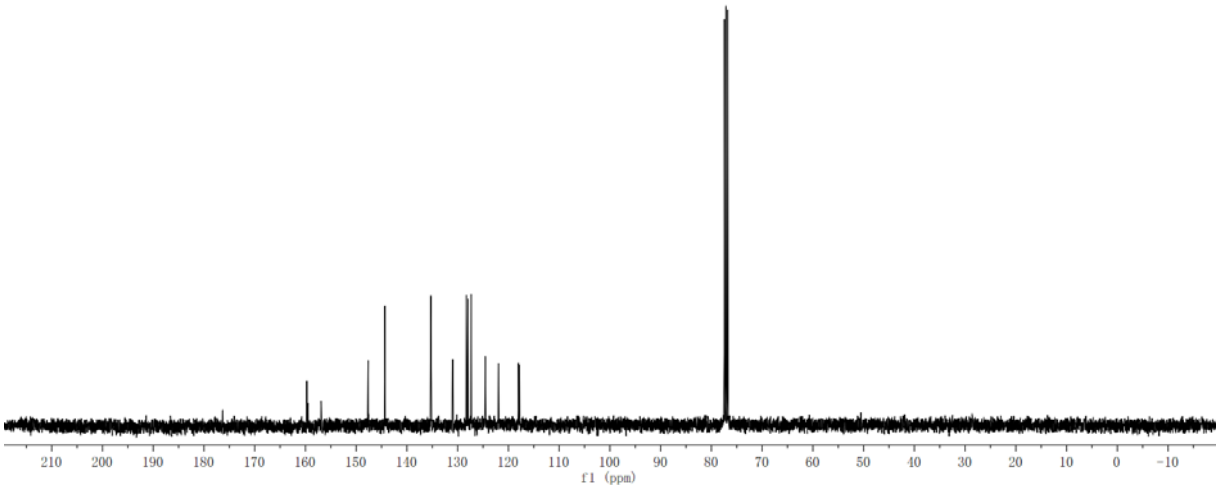


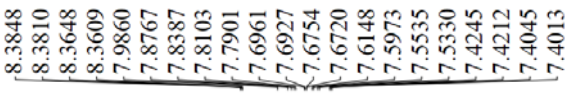
^{1}H NMR (400M, $CDCl_3$) of **1s**

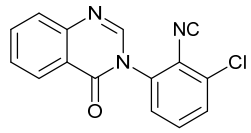




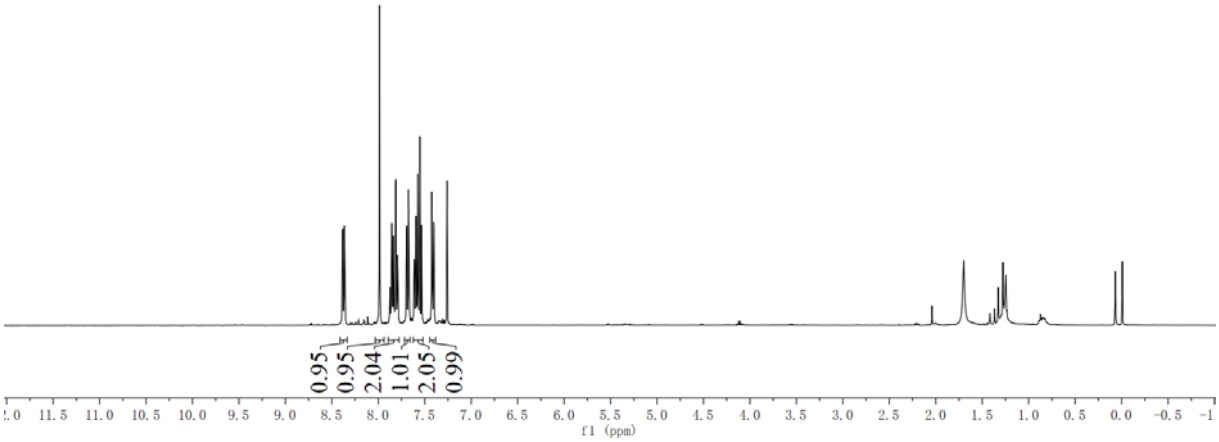
^{13}C NMR (101M, $CDCl_3$) of **1s**

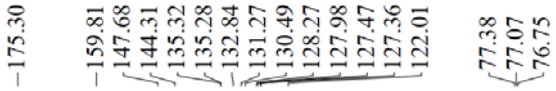


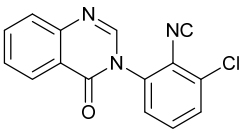




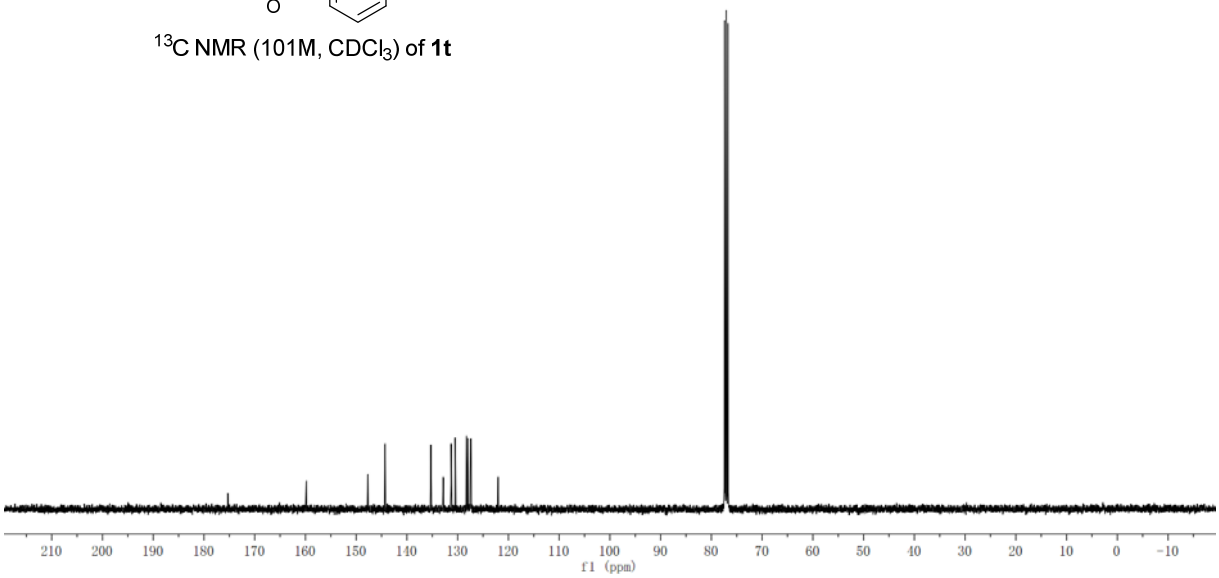
^{1}H NMR (400M, $CDCl_3$) of **1t**

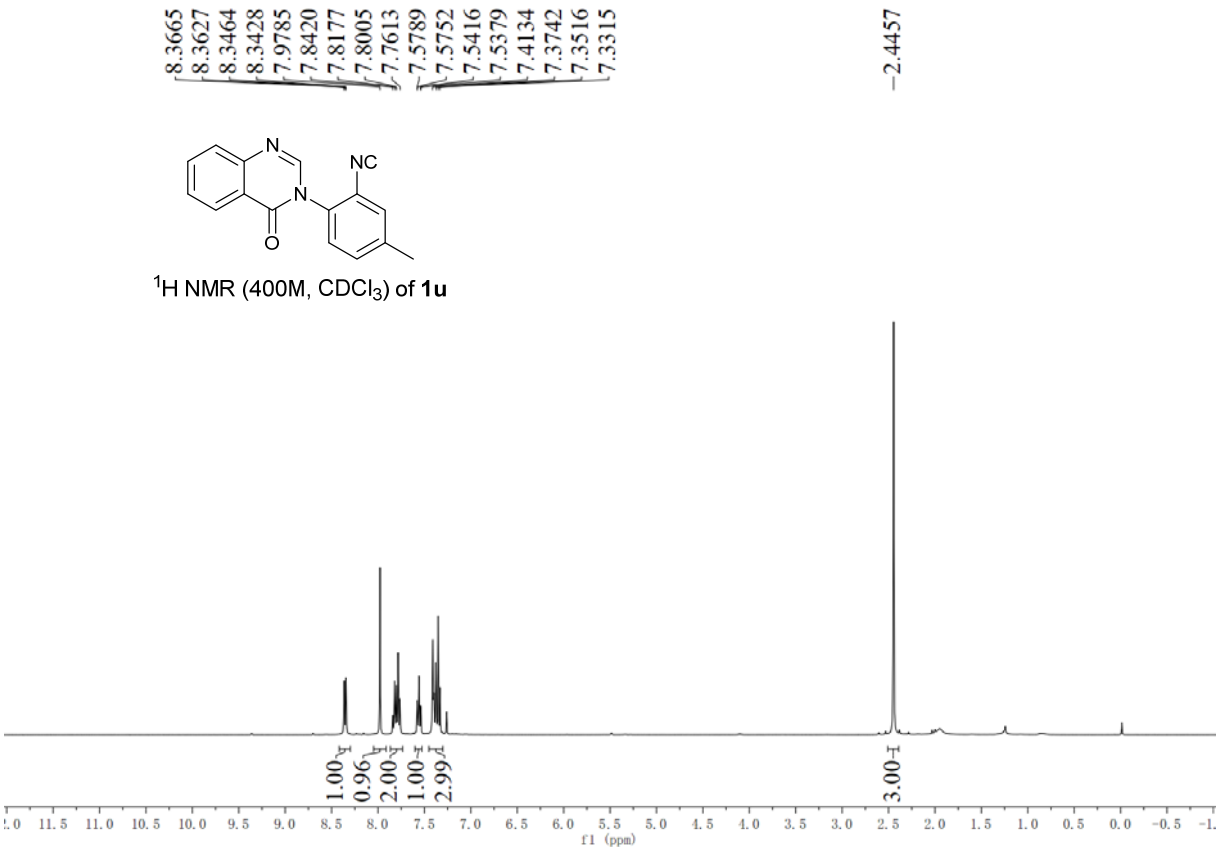




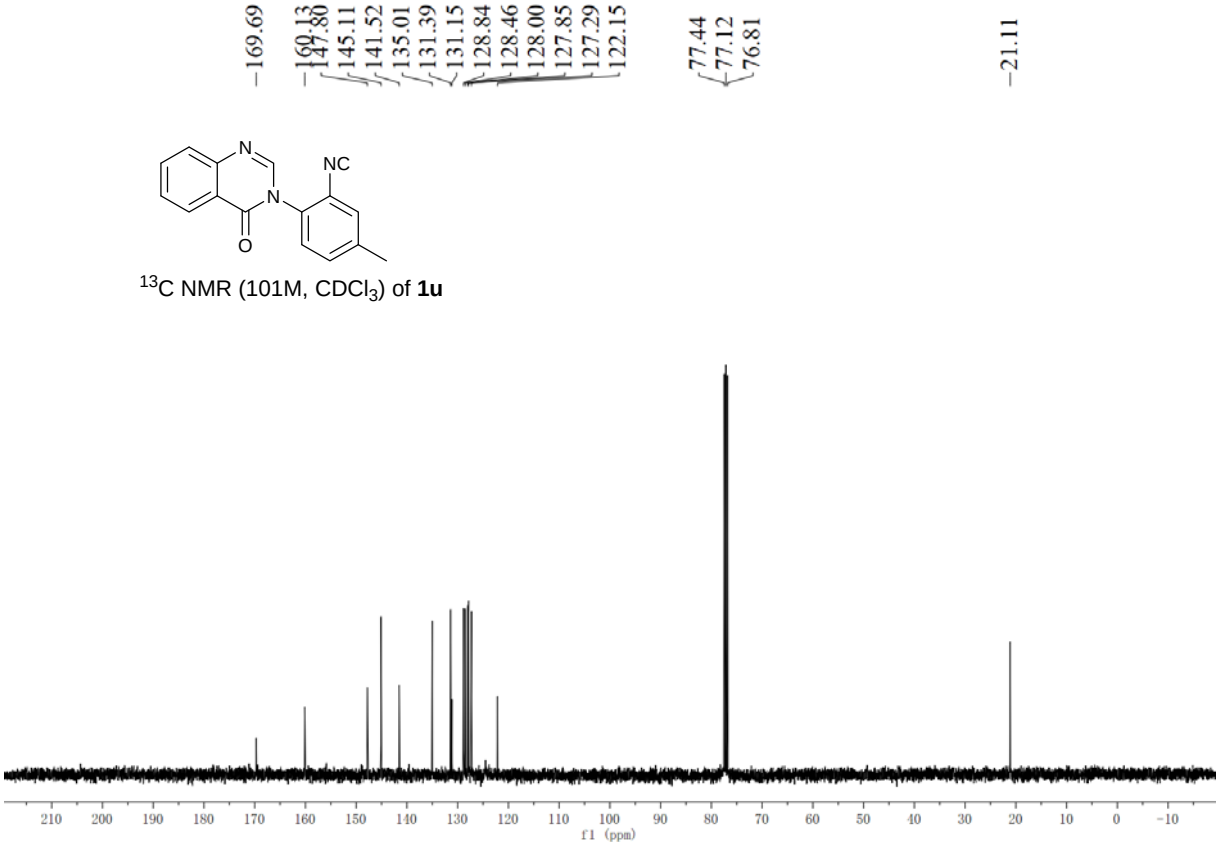


^{13}C NMR (101M, $CDCl_3$) of **1t**

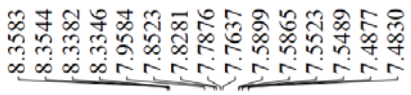


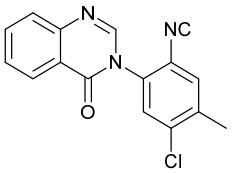


^{1}H NMR (400M, $CDCl_3$) of **1u**

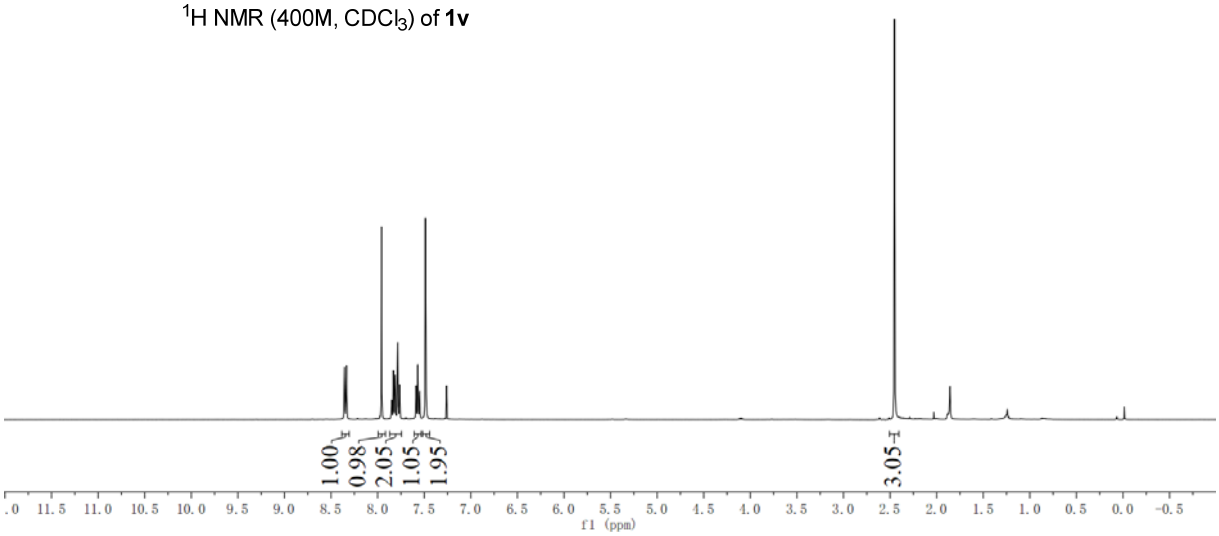


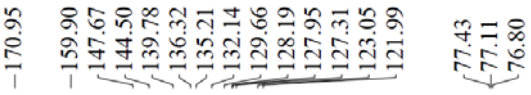
^{13}C NMR (101M, $CDCl_3$) of **1u**

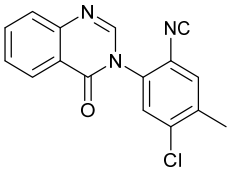




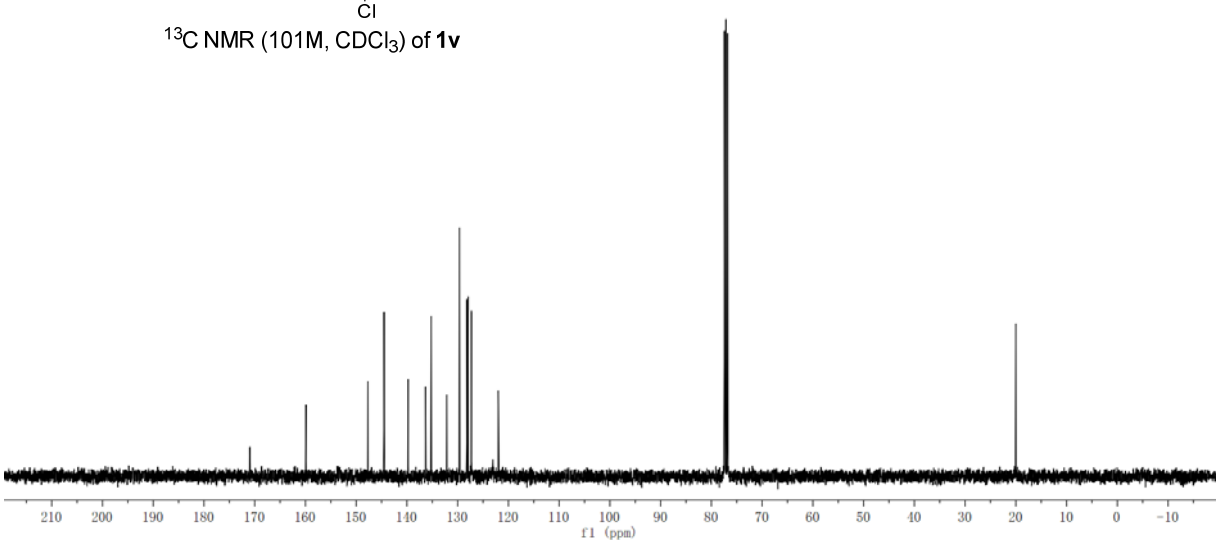
^{1}H NMR (400M, $CDCl_3$) of **1v**

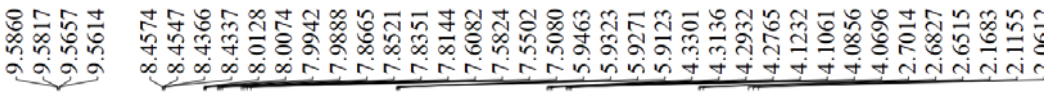


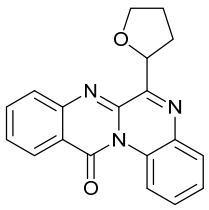




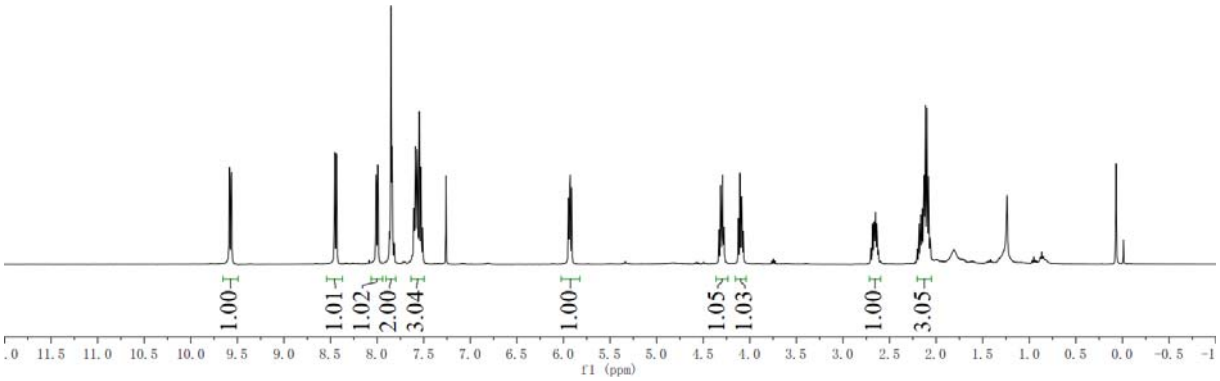
^{13}C NMR (101M, $CDCl_3$) of **1v**

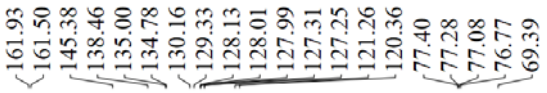


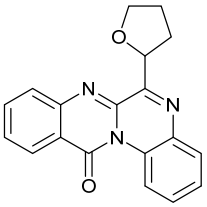




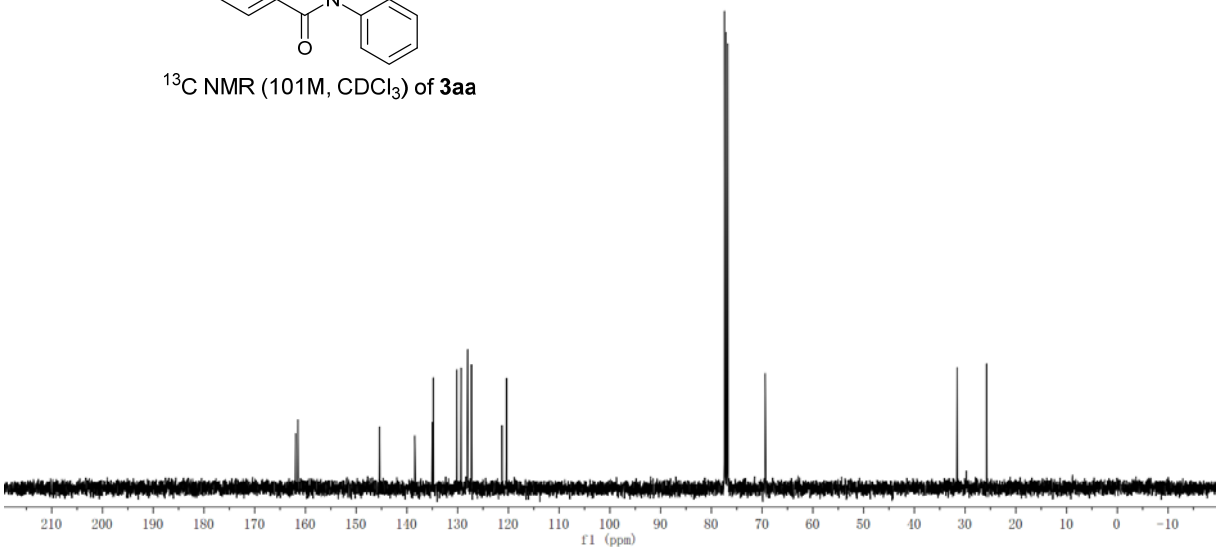
^{1}H NMR (400M, $CDCl_3$) of **3aa**

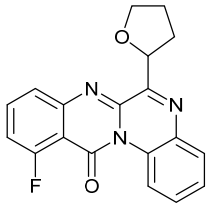




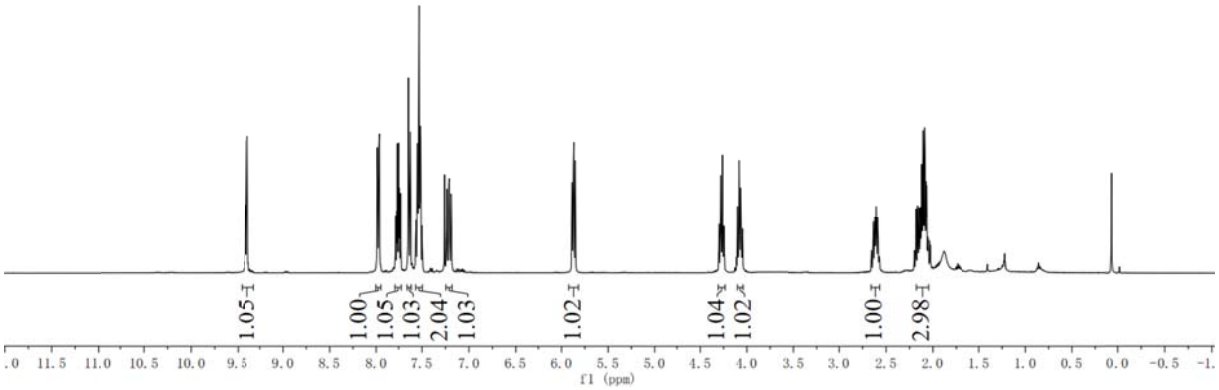


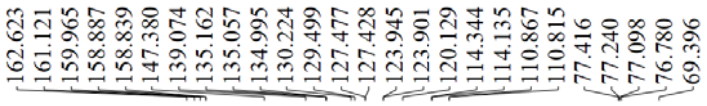
^{13}C NMR (101M, $CDCl_3$) of **3aa**

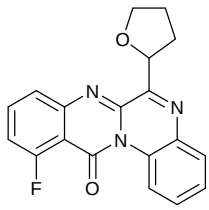




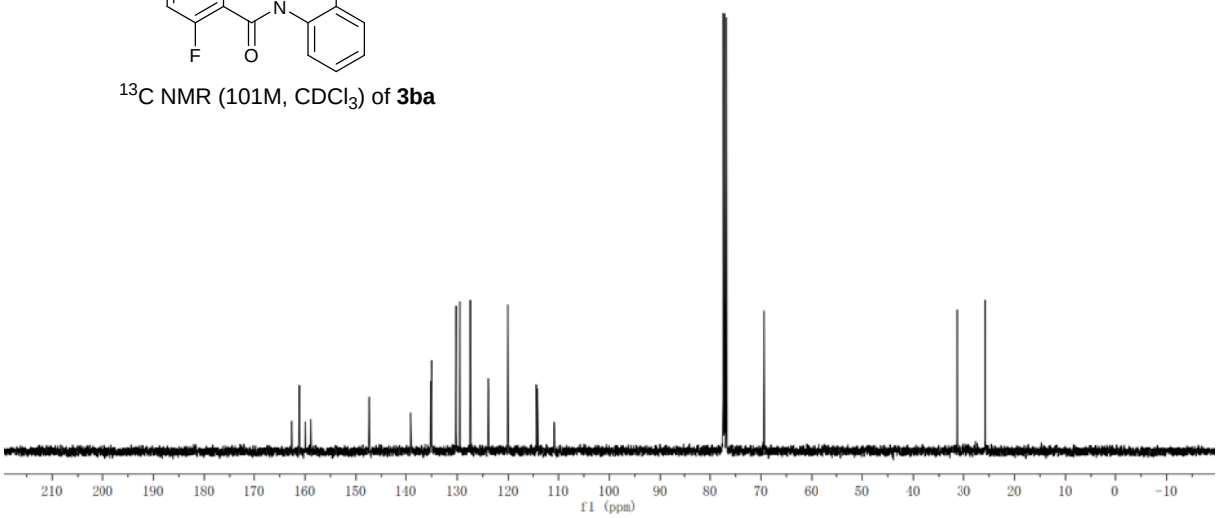
^{1}H NMR (400M, $CDCl_3$) of **3ba**

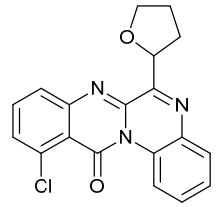




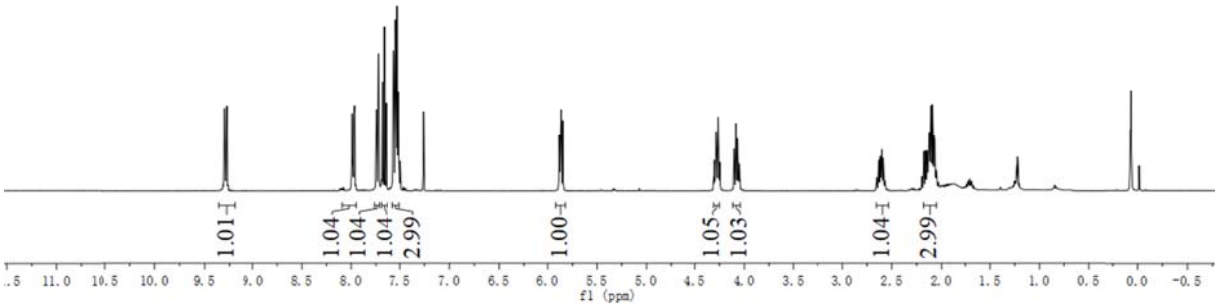


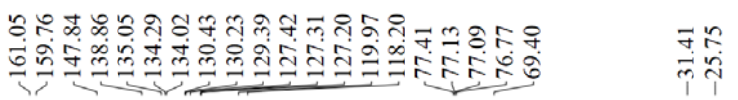
^{13}C NMR (101M, $CDCl_3$) of **3ba**

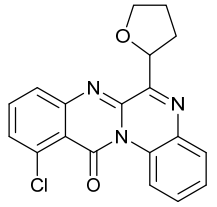




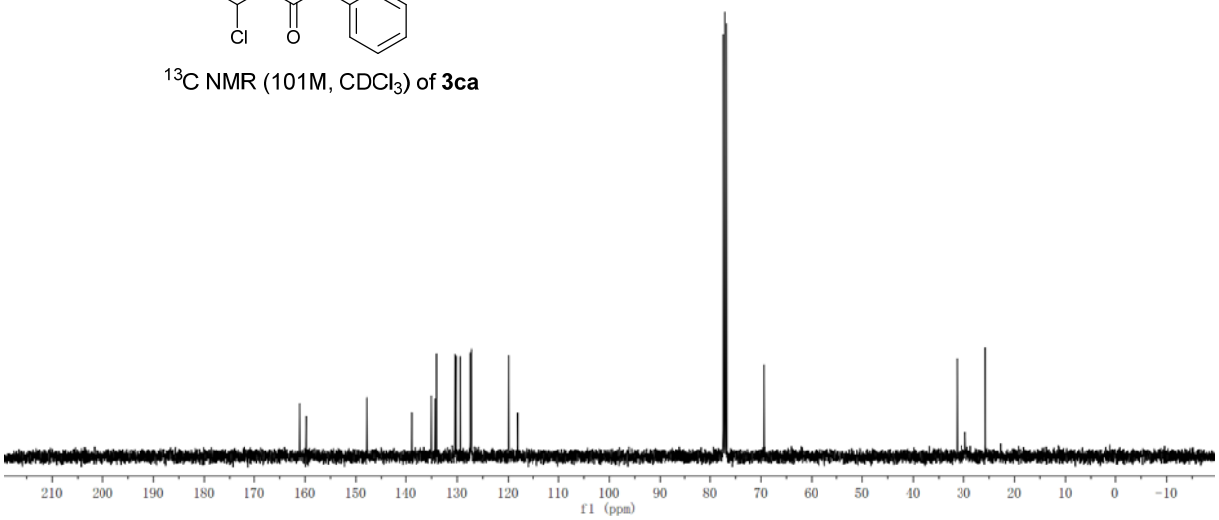
^{1}H NMR (400M, $CDCl_3$) of **3ca**

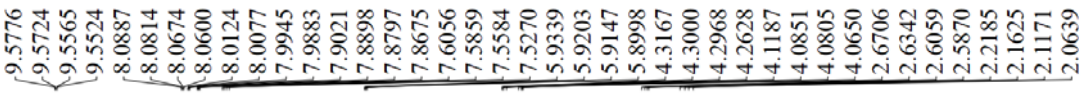


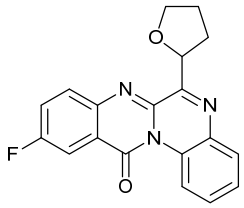




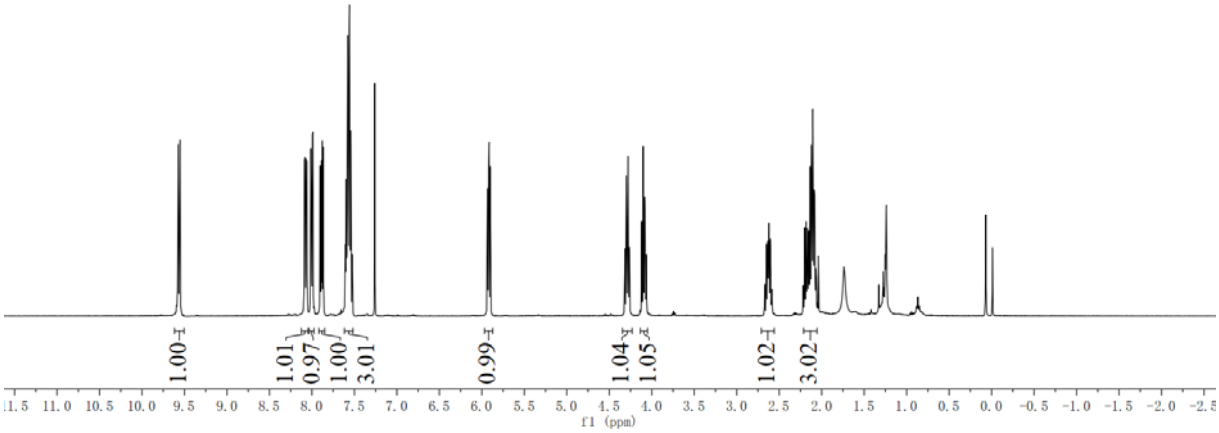
^{13}C NMR (101M, $CDCl_3$) of **3ca**

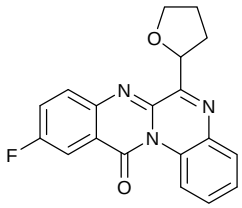




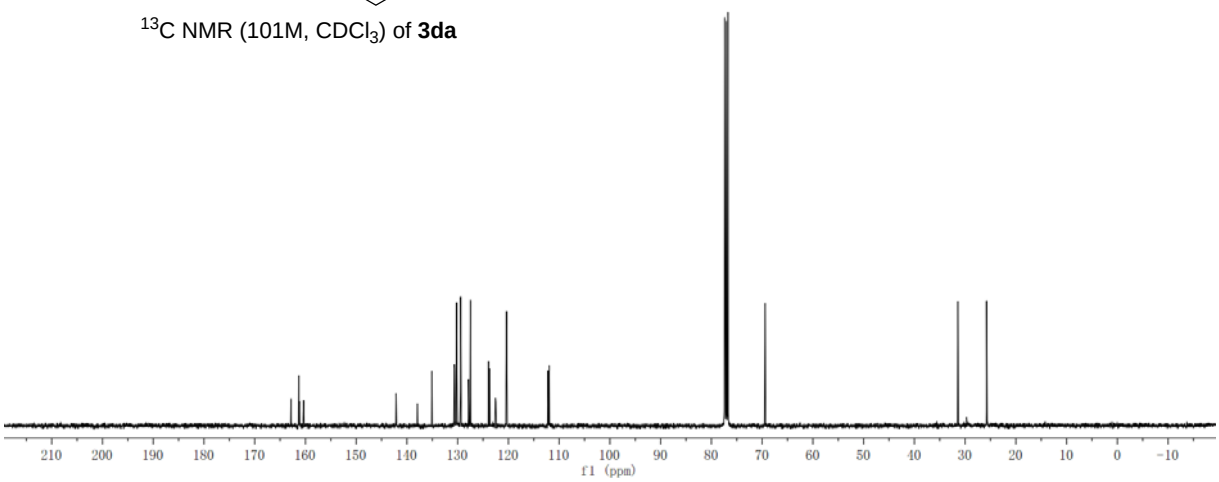


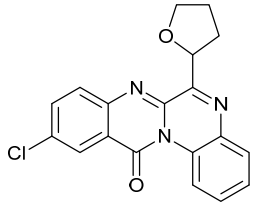
^{1}H NMR (400M, $CDCl_3$) of **3da**



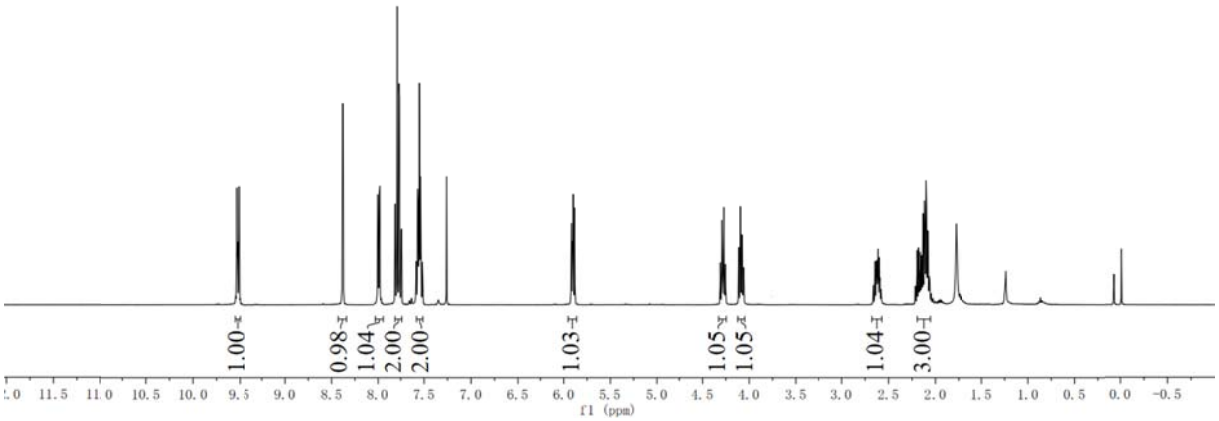


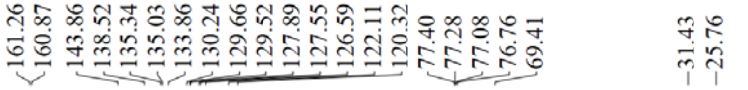
^{13}C NMR (101M, $CDCl_3$) of **3da**

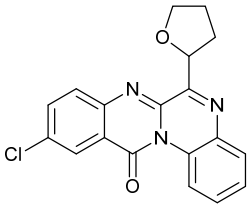




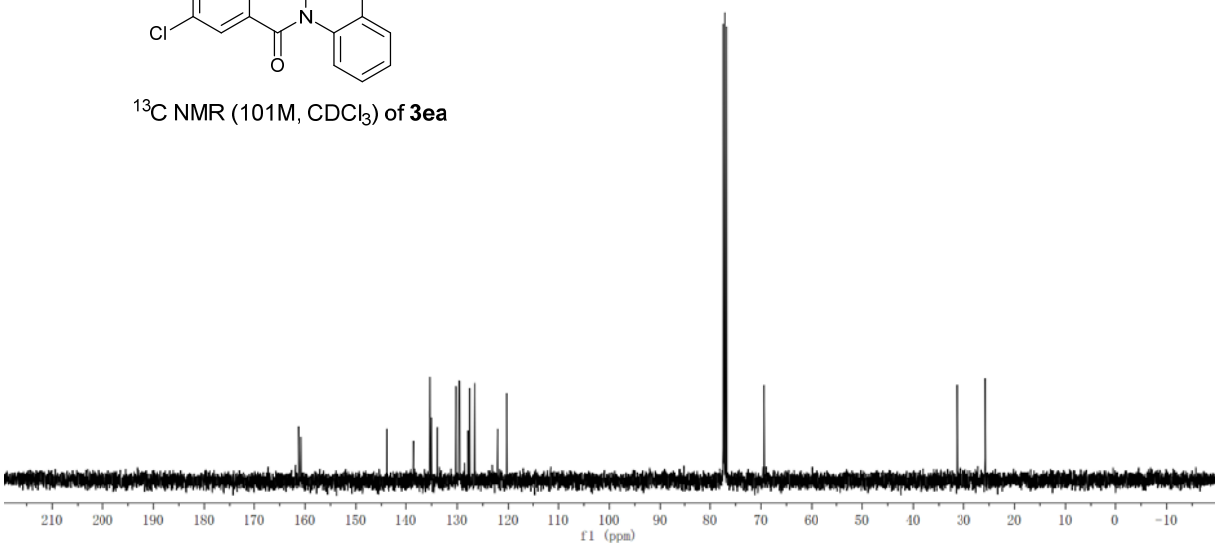
^{1}H NMR (400M, $CDCl_3$) of **3ea**

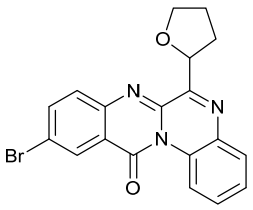




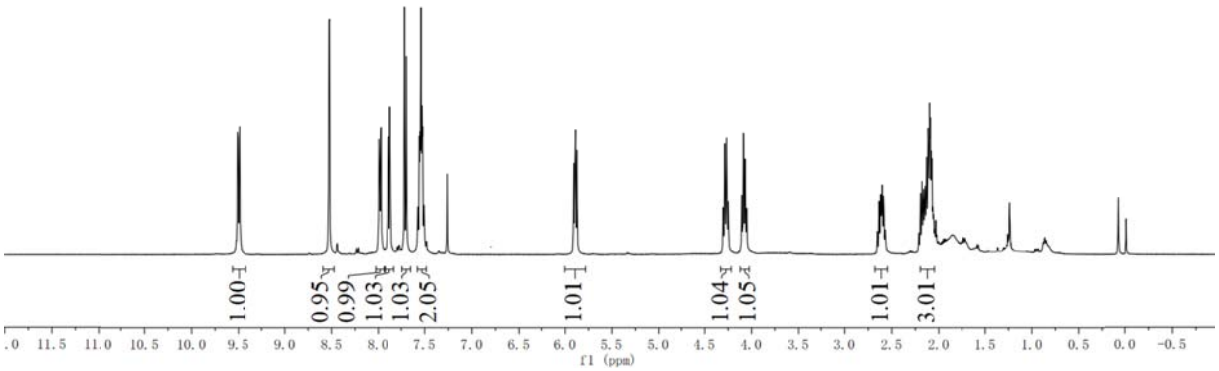


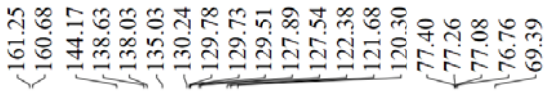
^{13}C NMR (101M, $CDCl_3$) of **3ea**

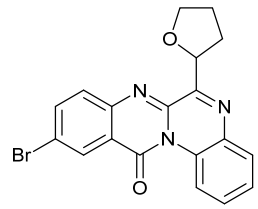




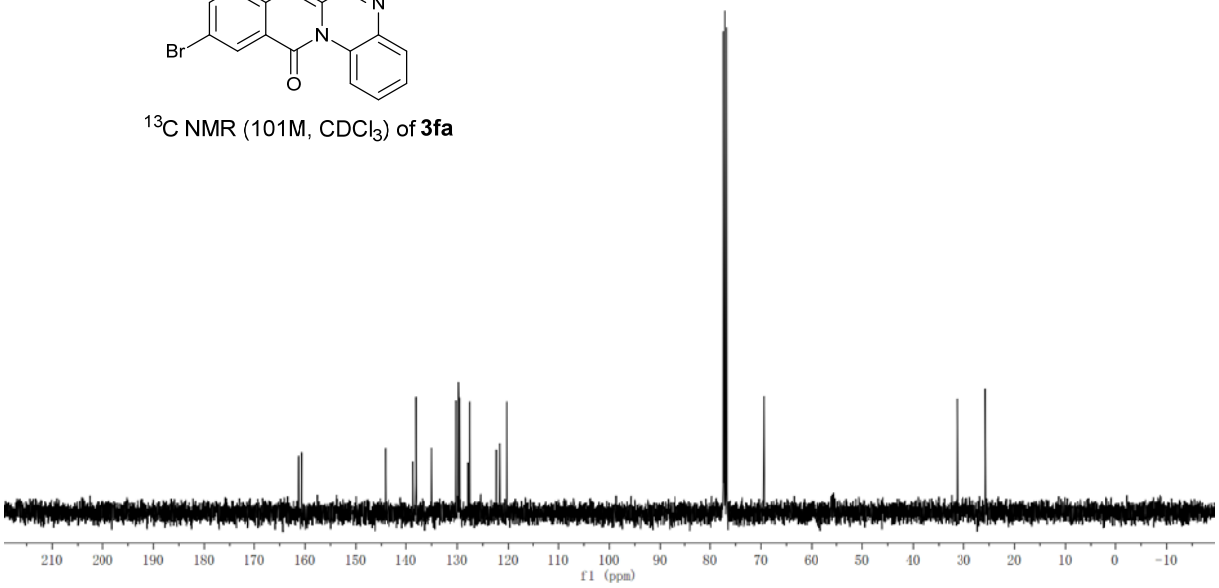
^{1}H NMR (400M, $CDCl_3$) of **3fa**

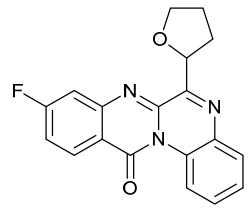




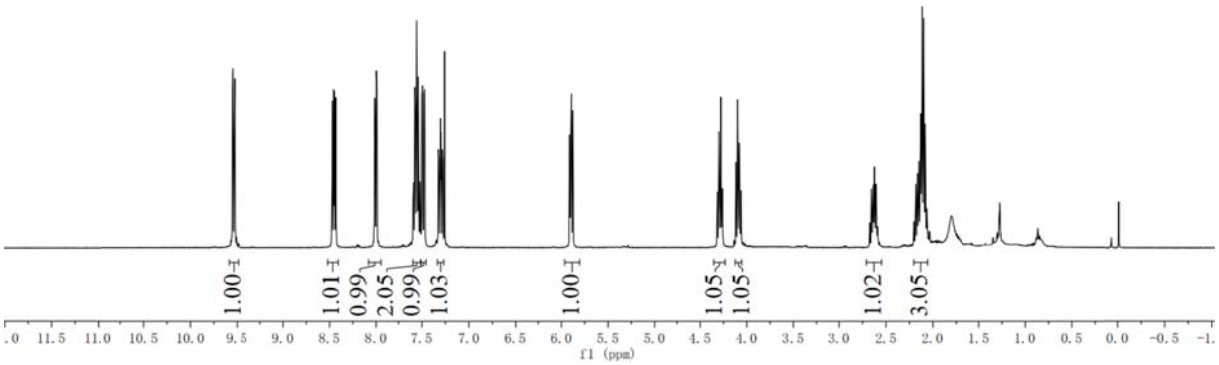


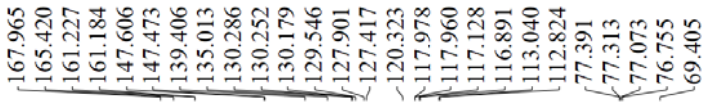
^{13}C NMR (101M, $CDCl_3$) of **3fa**

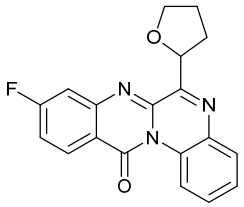




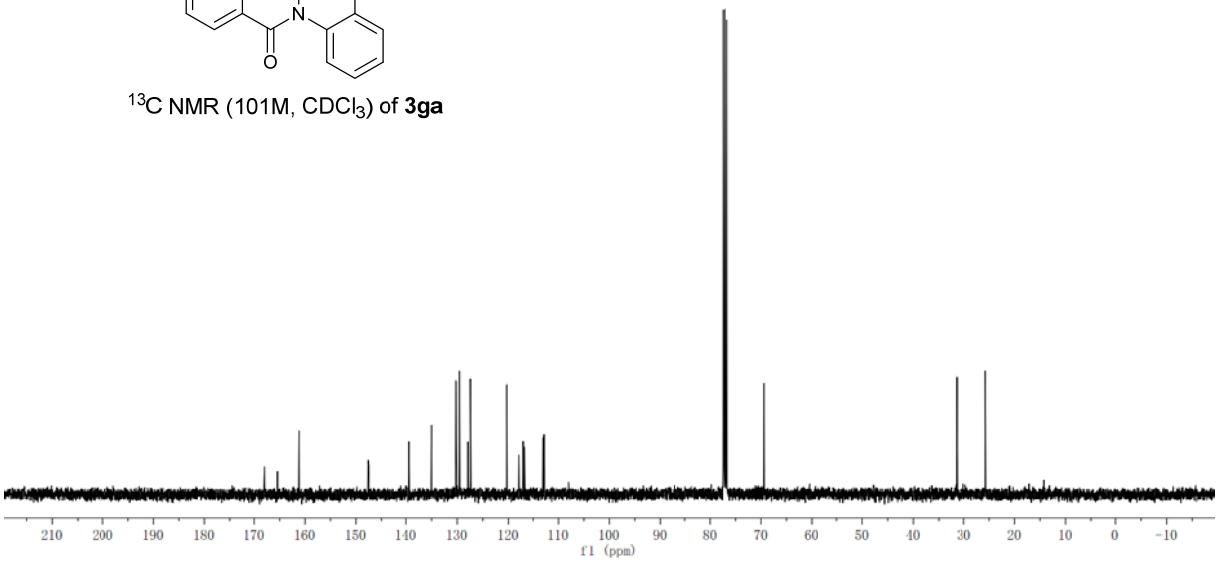
^{1}H NMR (400M, $CDCl_3$) of **3ga**

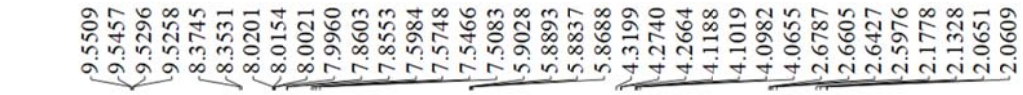


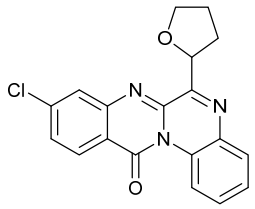




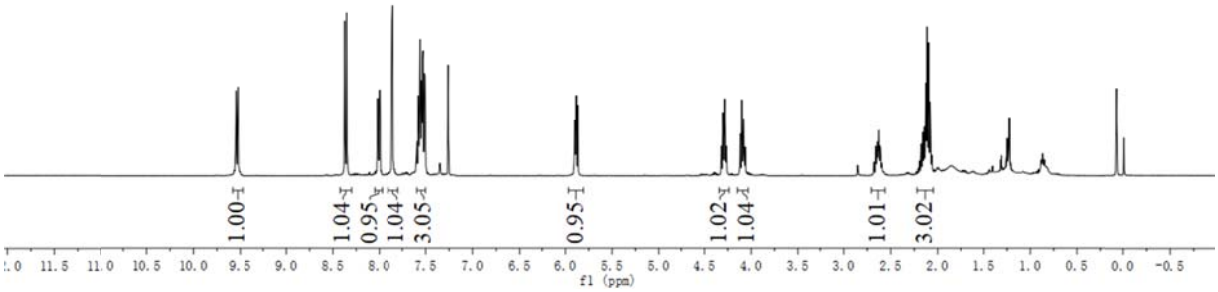
^{13}C NMR (101M, $CDCl_3$) of **3ga**

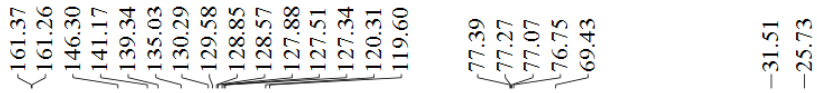


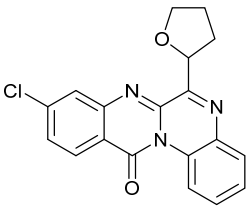




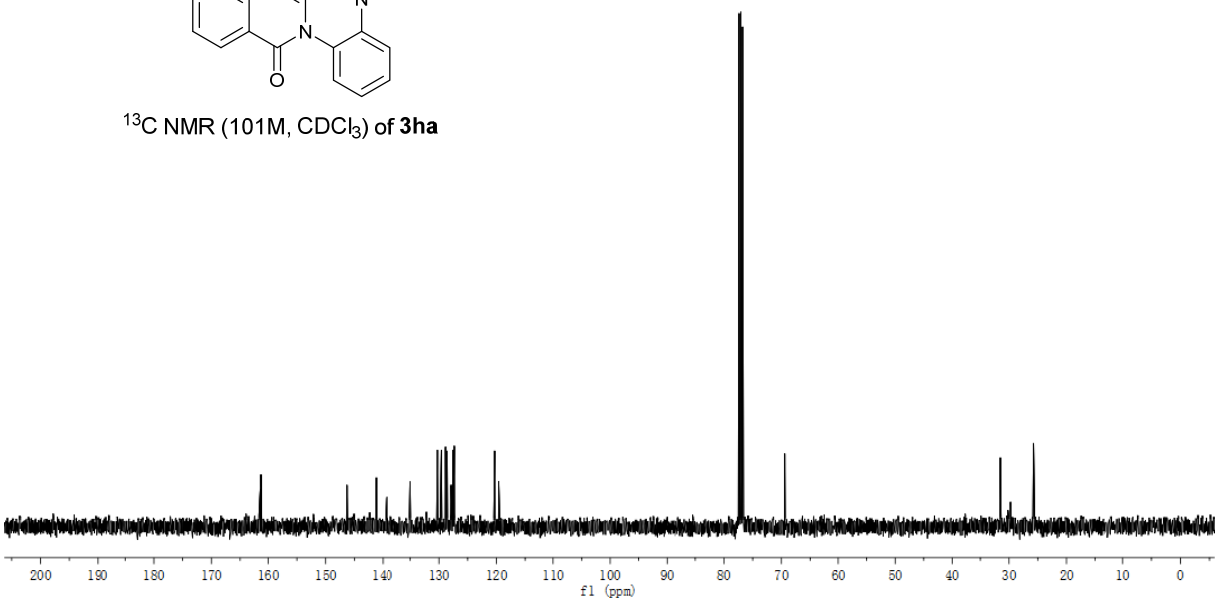
^{1}H NMR (400M, $CDCl_3$) of **3ha**

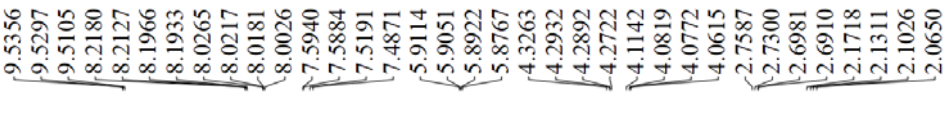


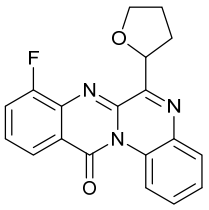




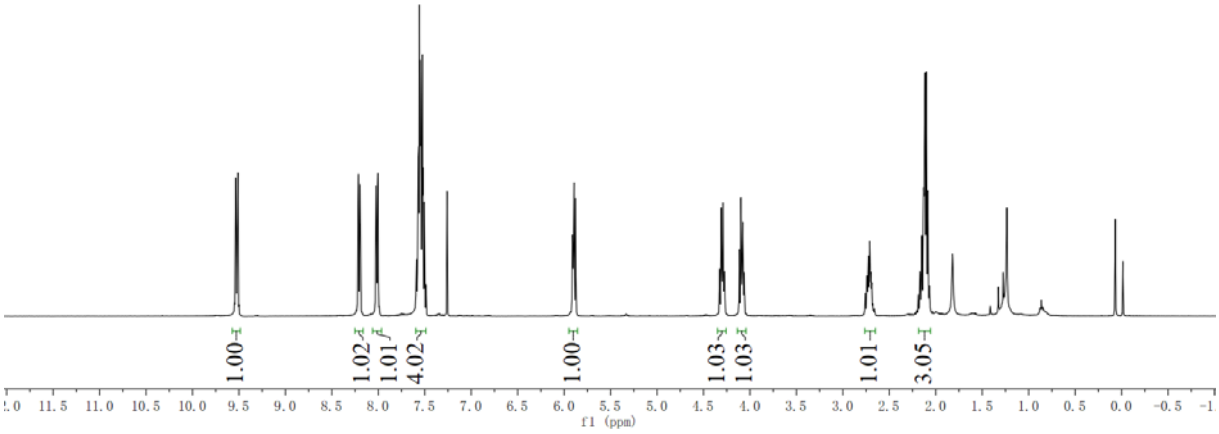
^{13}C NMR (101M, $CDCl_3$) of **3ha**

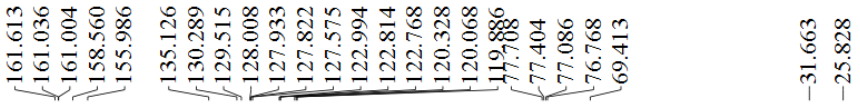


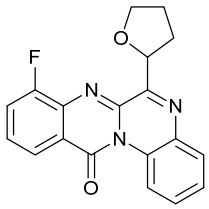




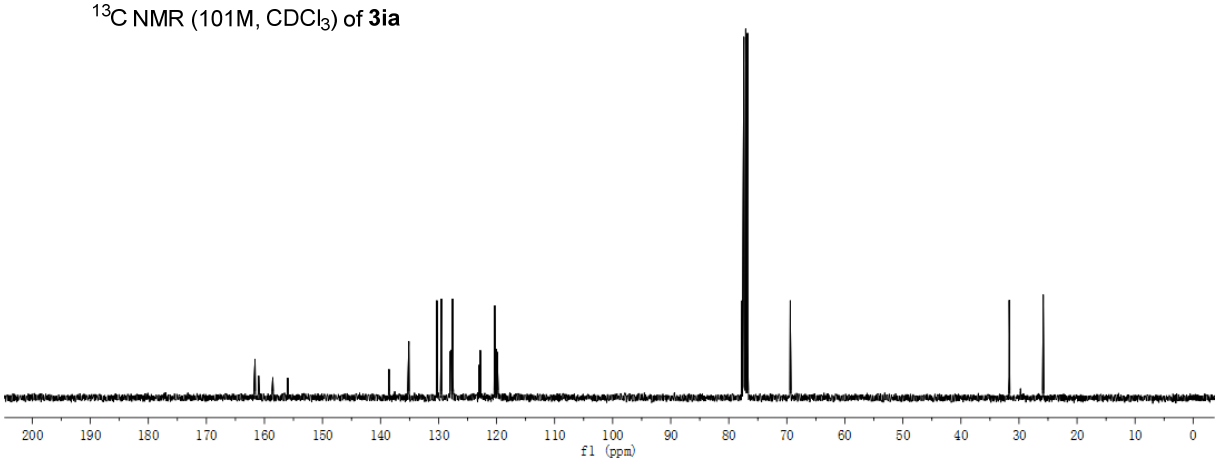
^{1}H NMR (400M, $CDCl_3$) of **3ia**

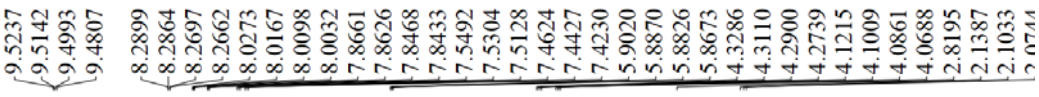


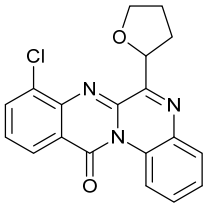




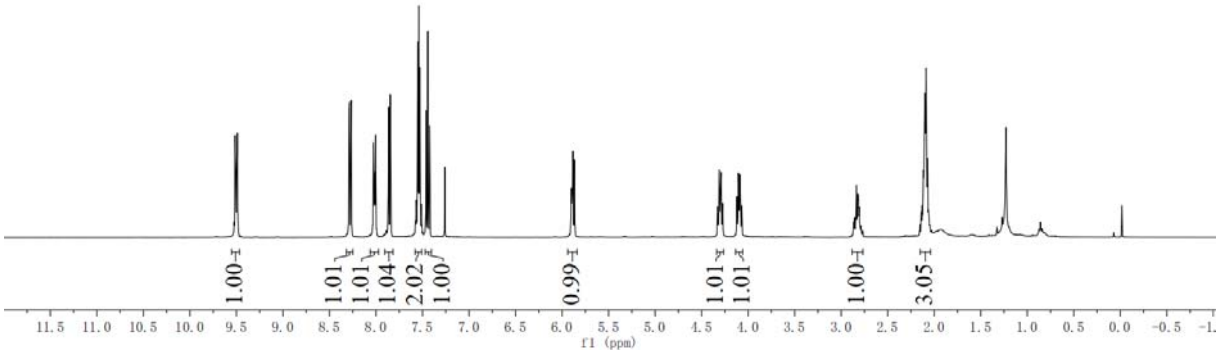
^{13}C NMR (101M, $CDCl_3$) of **3ia**

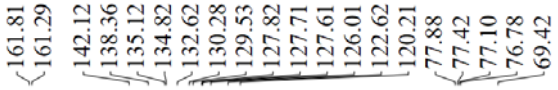


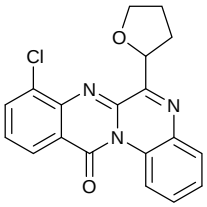




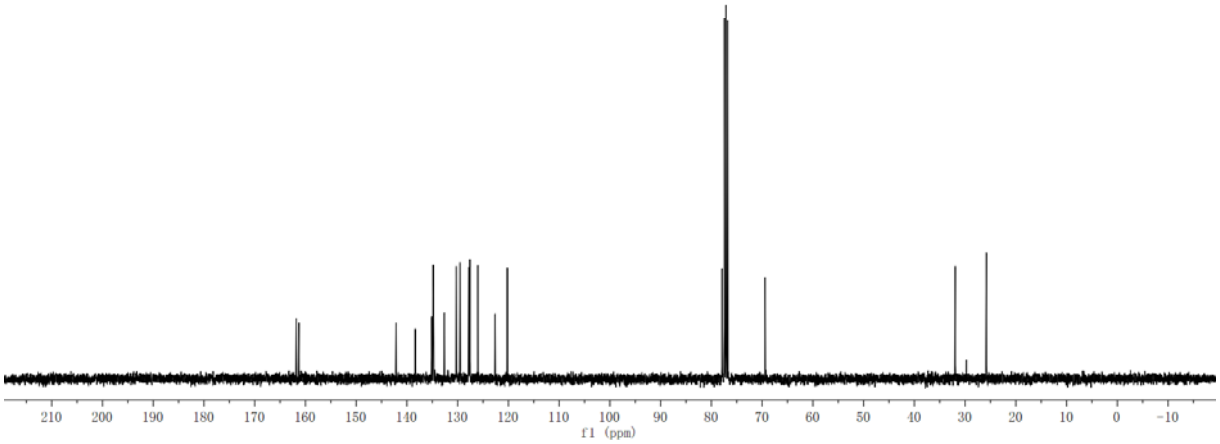
^{1}H NMR (400M, $CDCl_3$) of **3ja**

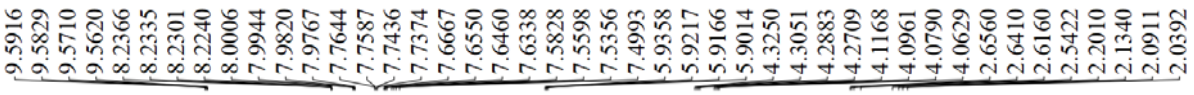


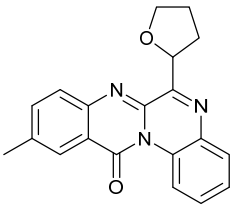




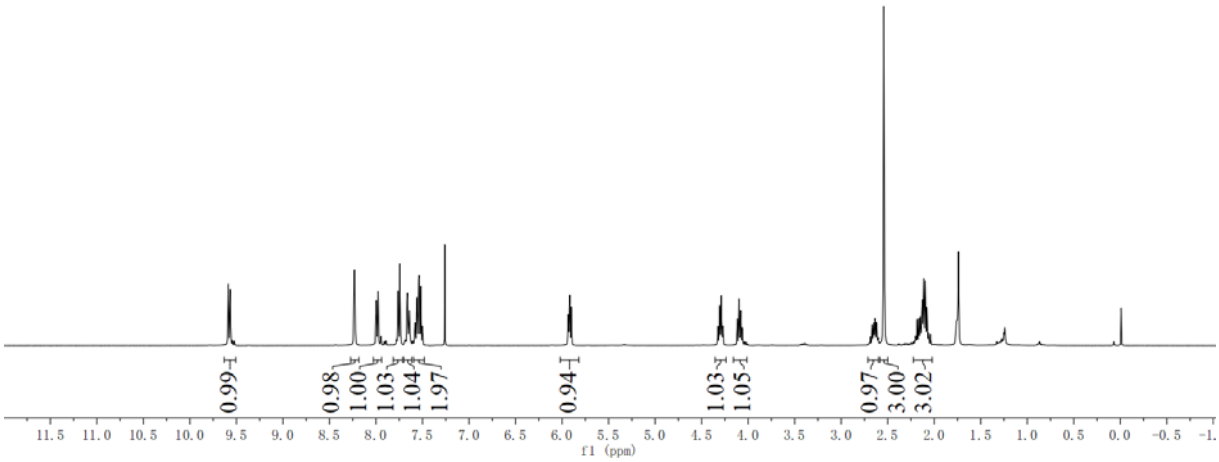
^{13}C NMR (101M, $CDCl_3$) of **3ja**

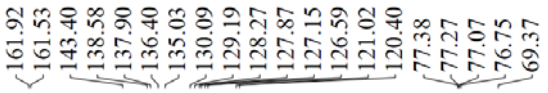


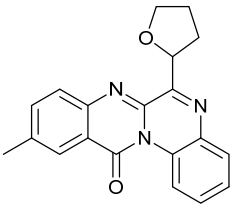




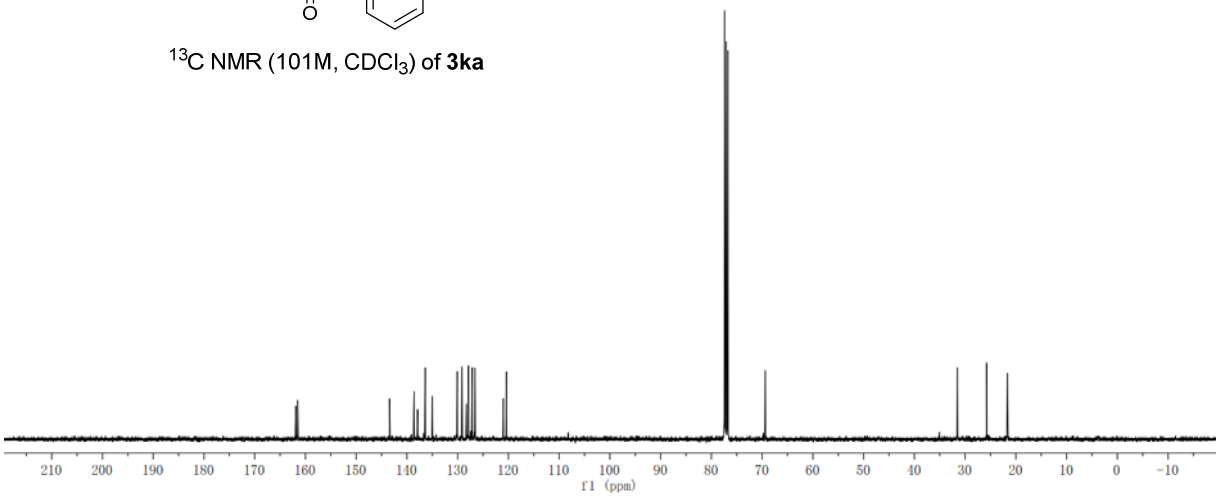
^{1}H NMR (400M, $CDCl_3$) of **3ka**

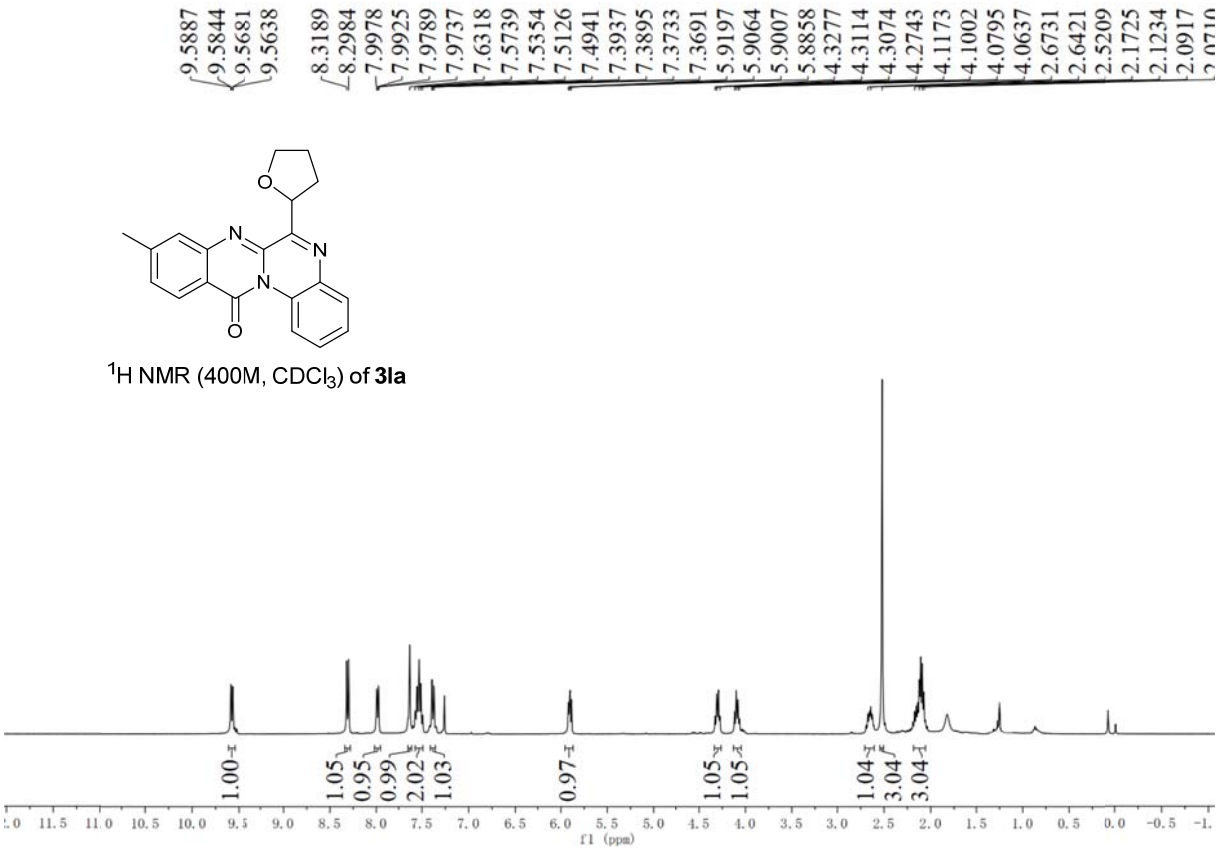




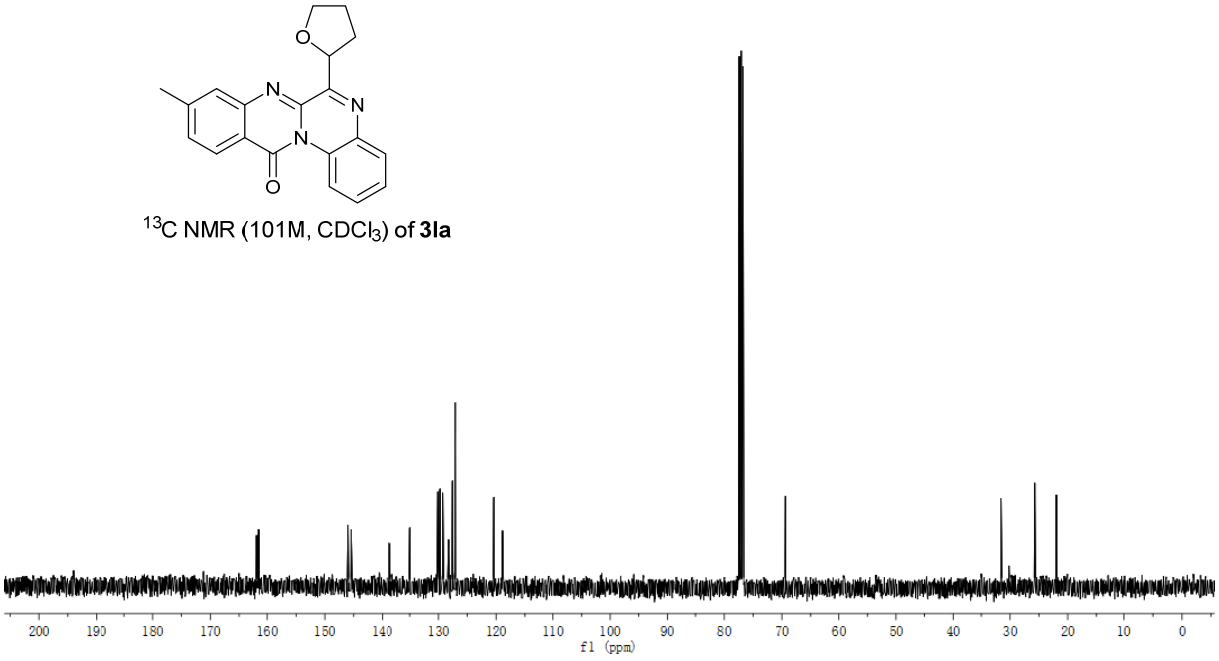


^{13}C NMR (101M, $CDCl_3$) of **3ka**

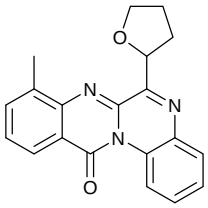




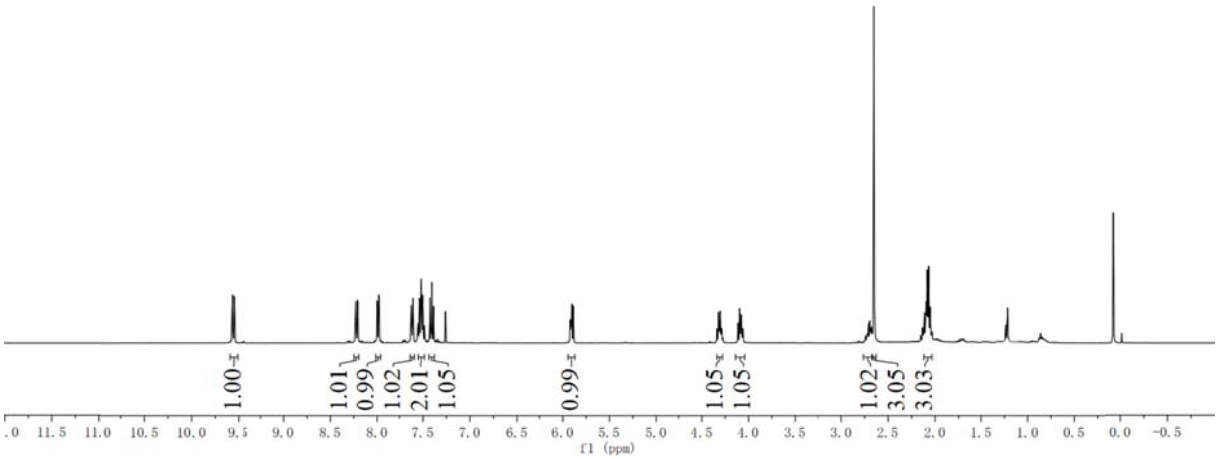
^{1}H NMR (400M, $CDCl_3$) of **3la**

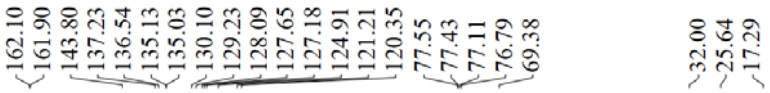


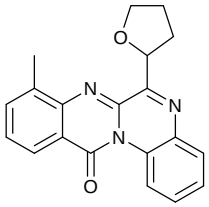
^{13}C NMR (101M, $CDCl_3$) of **3la**



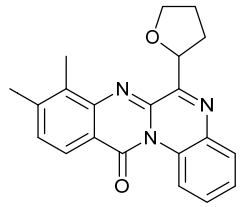
^{1}H NMR (400M, $CDCl_3$) of **3ma**



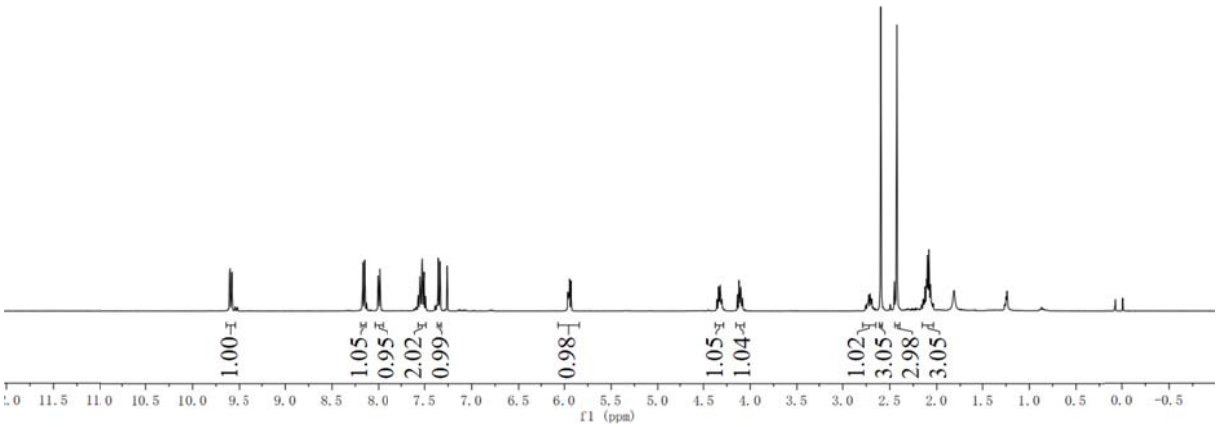


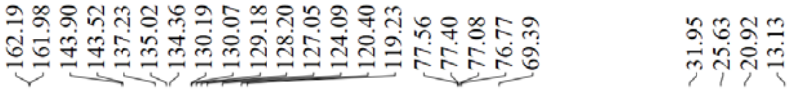


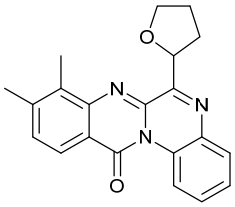
^{13}C NMR (101M, $CDCl_3$) of **3ma**



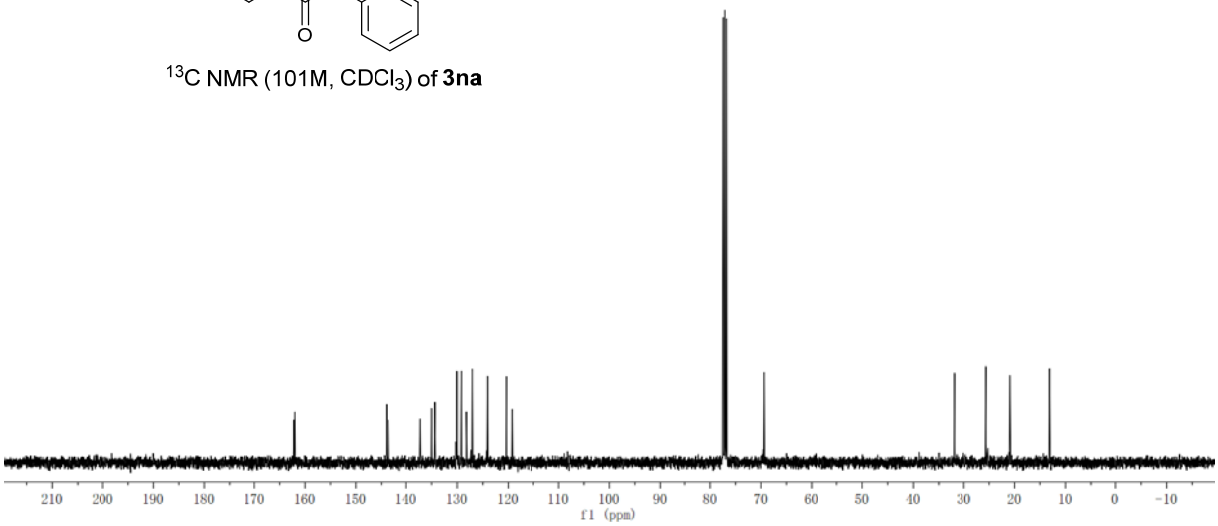
^{1}H NMR (400M, $CDCl_3$) of **3na**

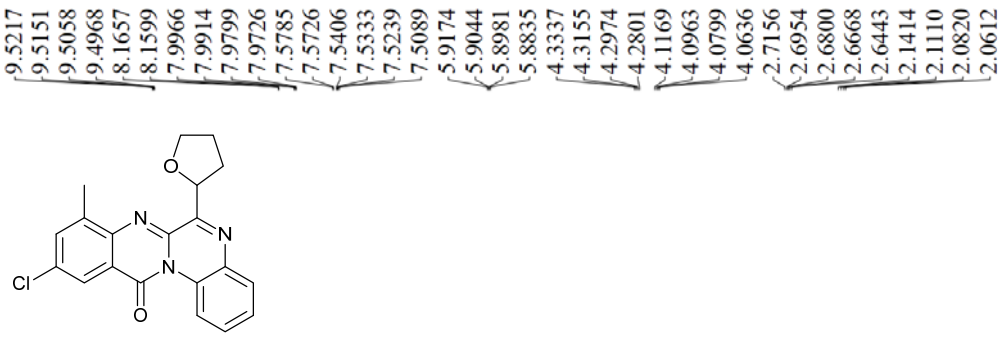




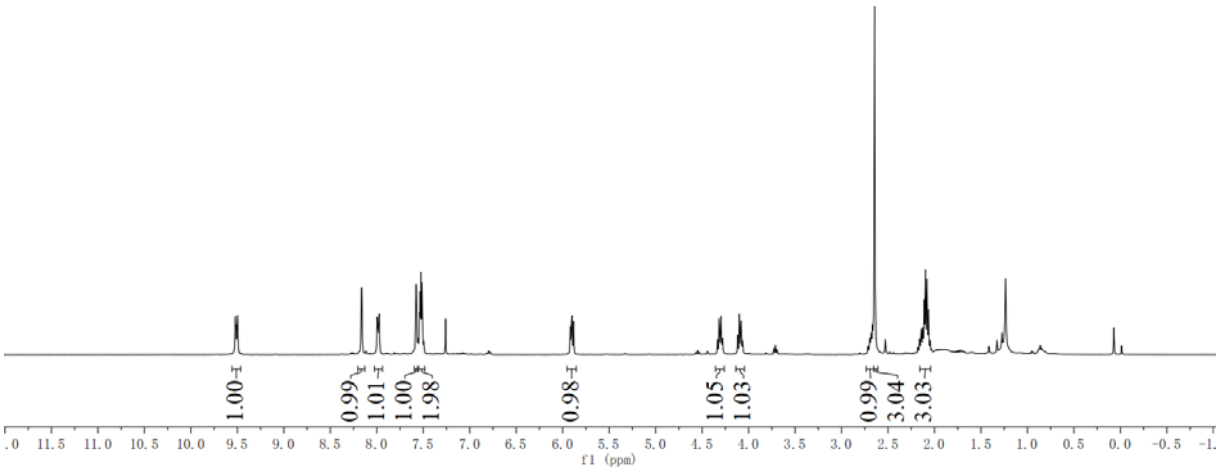


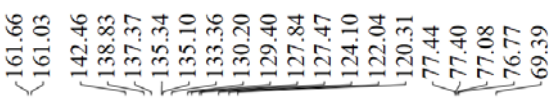
^{13}C NMR (101M, $CDCl_3$) of **3na**

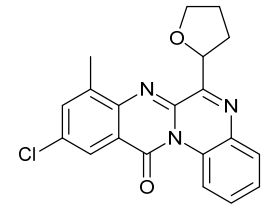




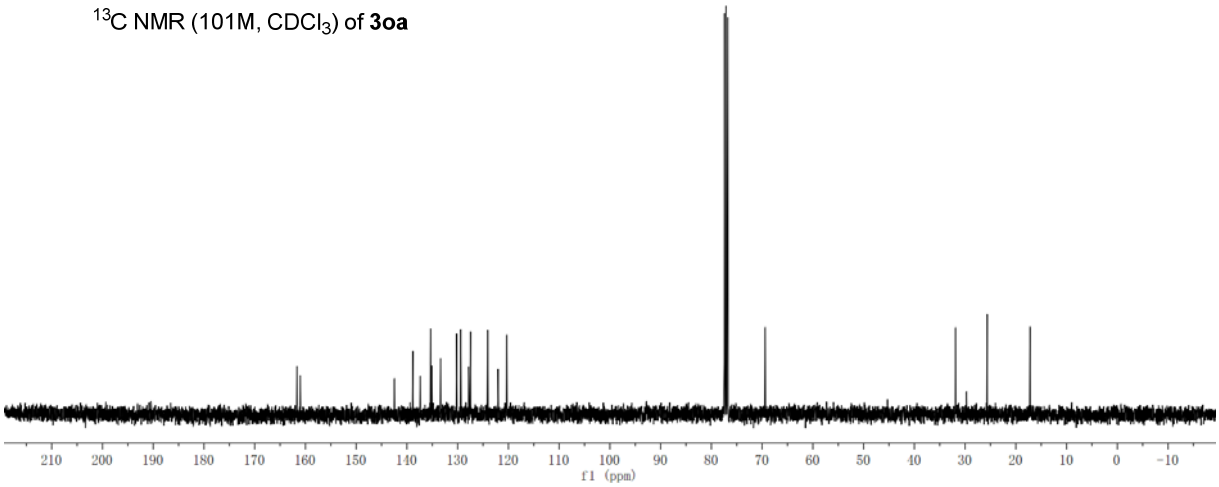
^{1}H NMR (400M, $CDCl_3$) of **3oa**

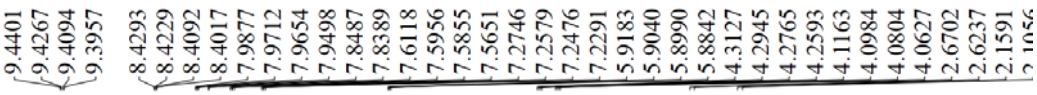


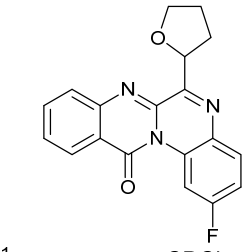




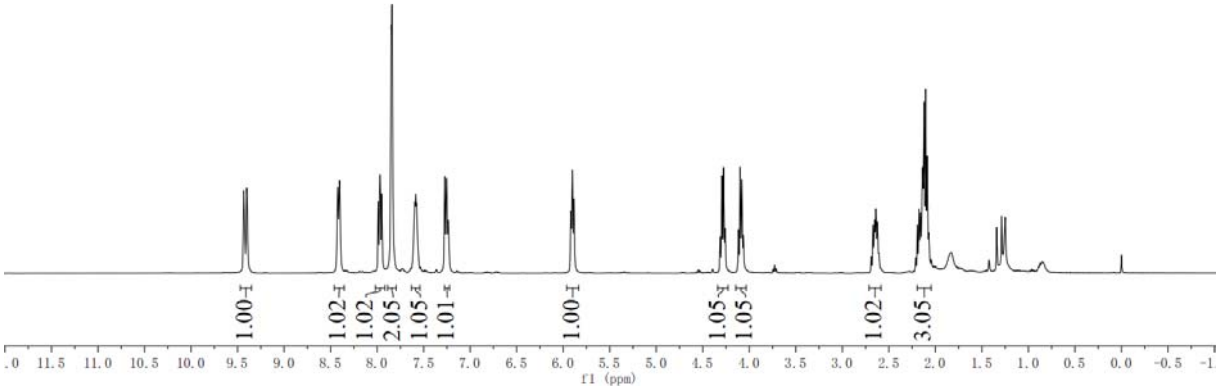
^{13}C NMR (101M, $CDCl_3$) of **3oa**

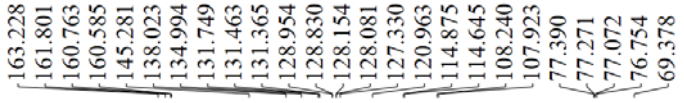


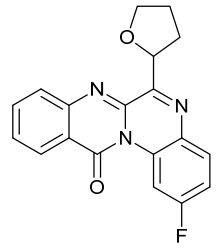




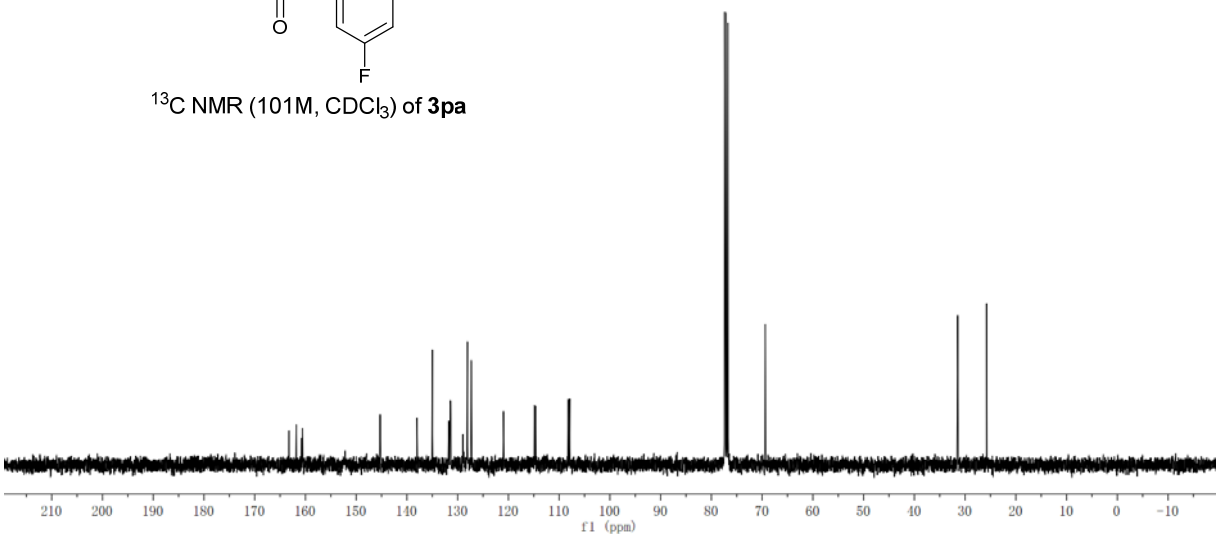
^{1}H NMR (400M, $CDCl_3$) of **3pa**

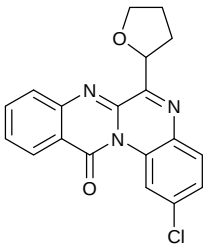




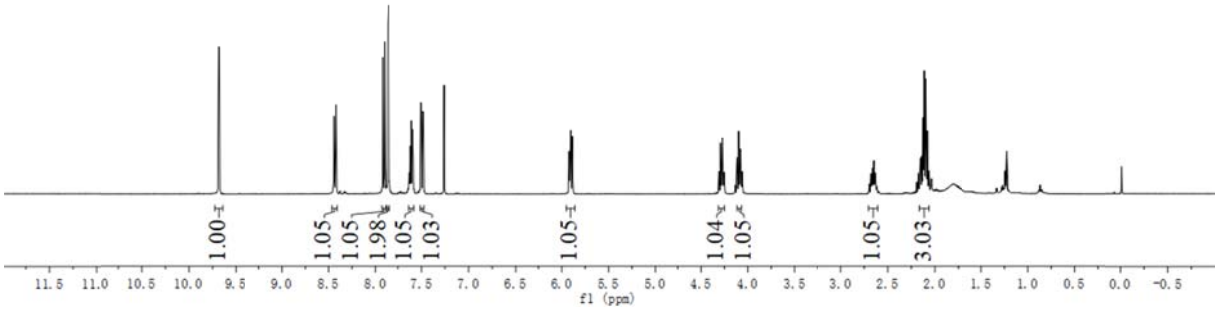


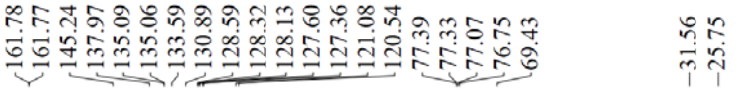
^{13}C NMR (101M, $CDCl_3$) of **3pa**

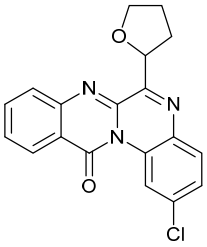




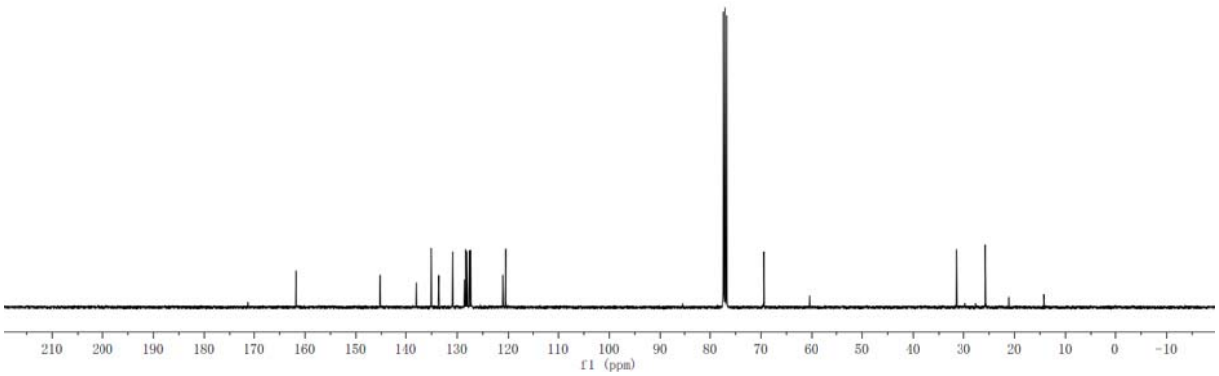
^{1}H NMR (400M, $CDCl_3$) of **3qa**

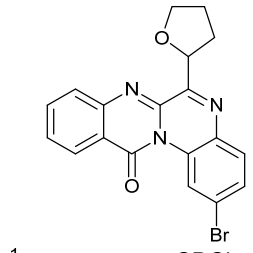




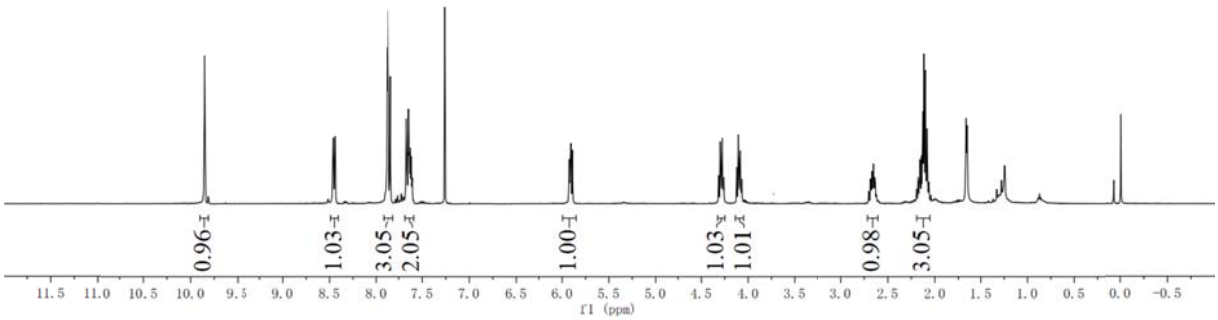


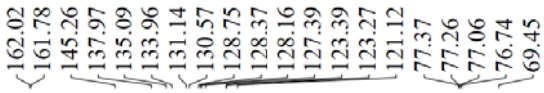
^{13}C NMR (101M, $CDCl_3$) of **3qa**

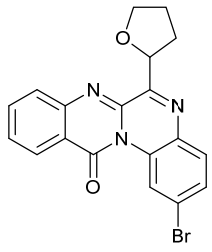




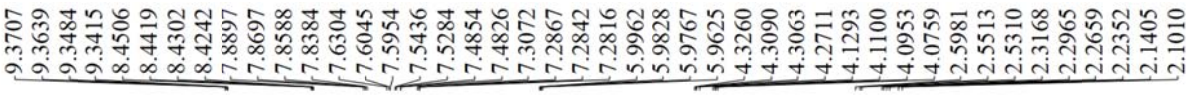
^{1}H NMR (400M, $CDCl_3$) of **3ra**

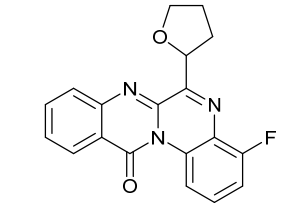




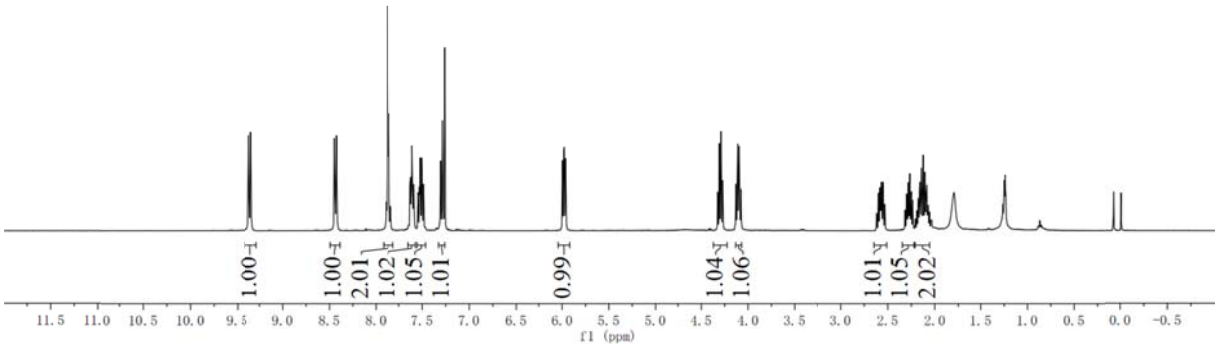


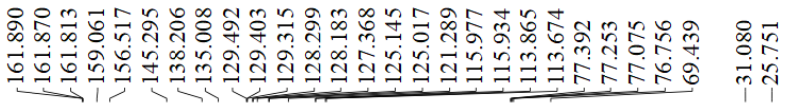
^{13}C NMR (101M, $CDCl_3$) of **3ra**

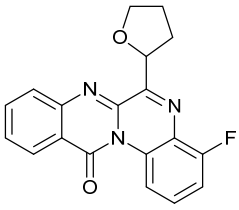




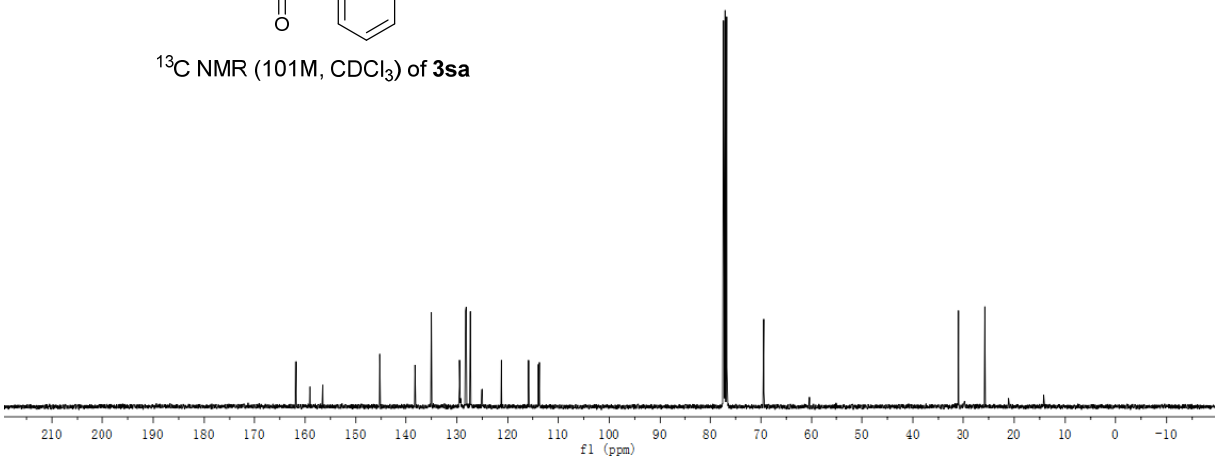
^{1}H NMR (400M, $CDCl_3$) of **3sa**

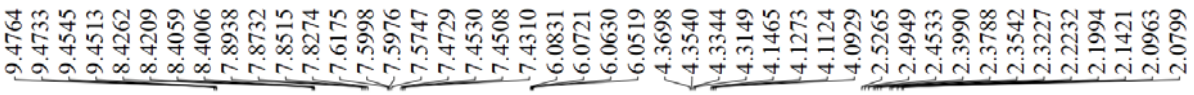


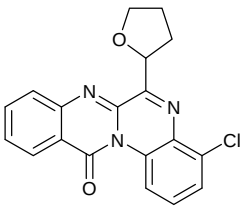




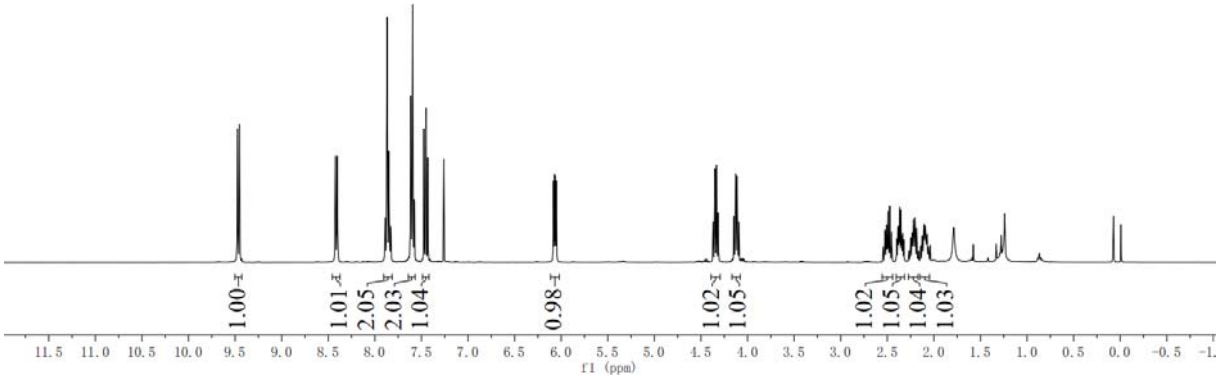
^{13}C NMR (101M, $CDCl_3$) of **3sa**

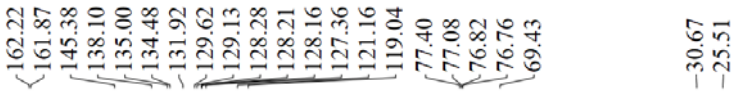


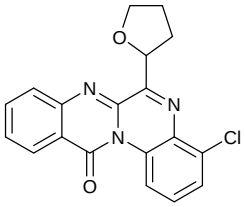




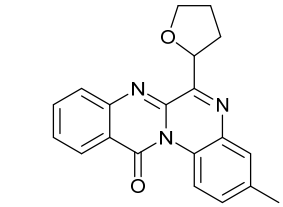
^{1}H NMR (400M, $CDCl_3$) of **3ta**



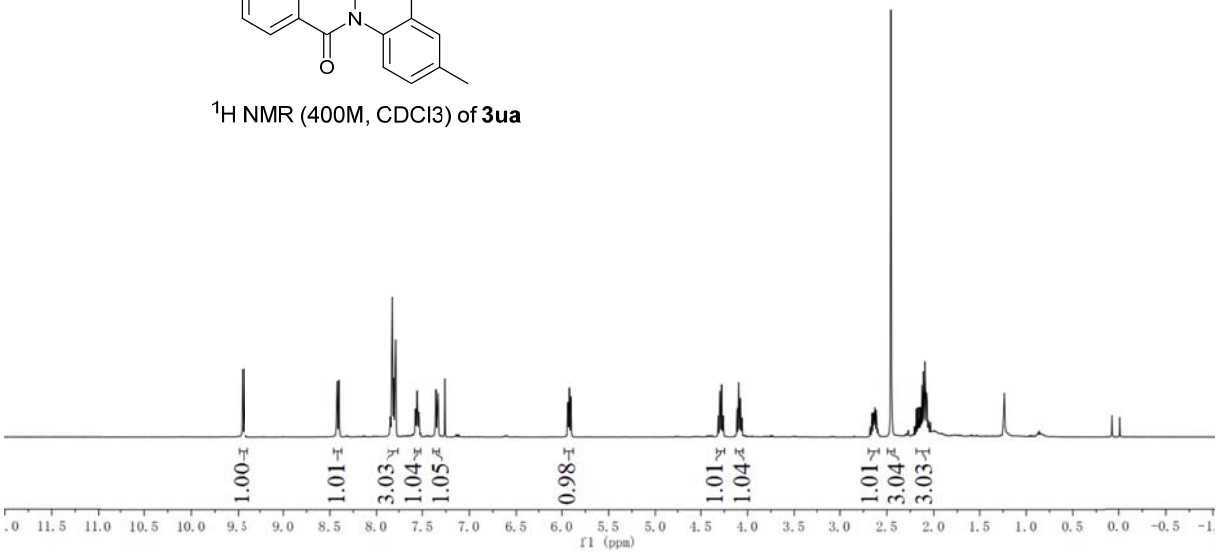


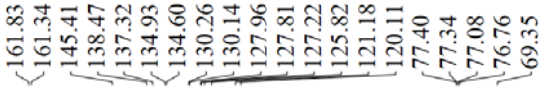


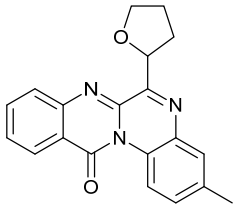
^{13}C NMR (101M, $CDCl_3$) of **3ta**



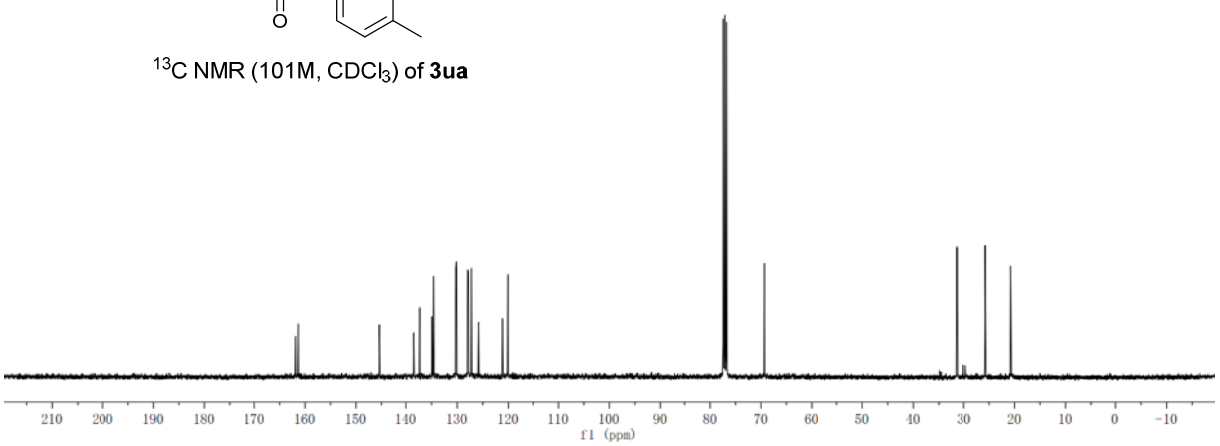
^{1}H NMR (400M, CDCl3) of **3ua**

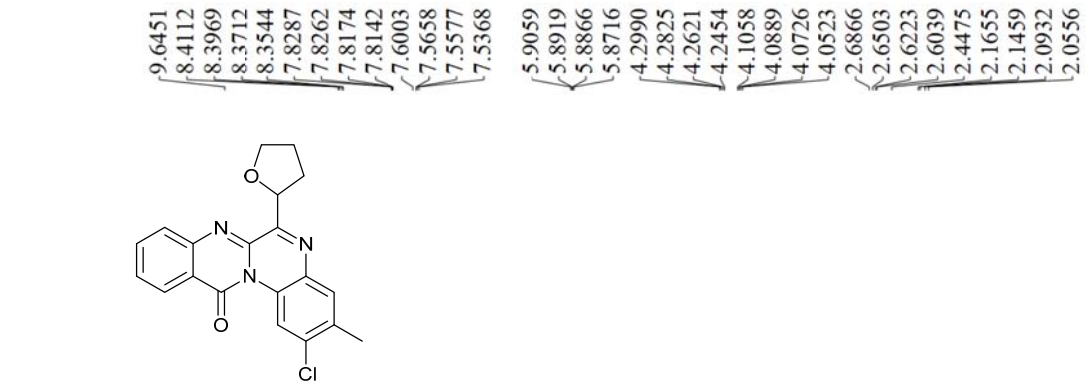




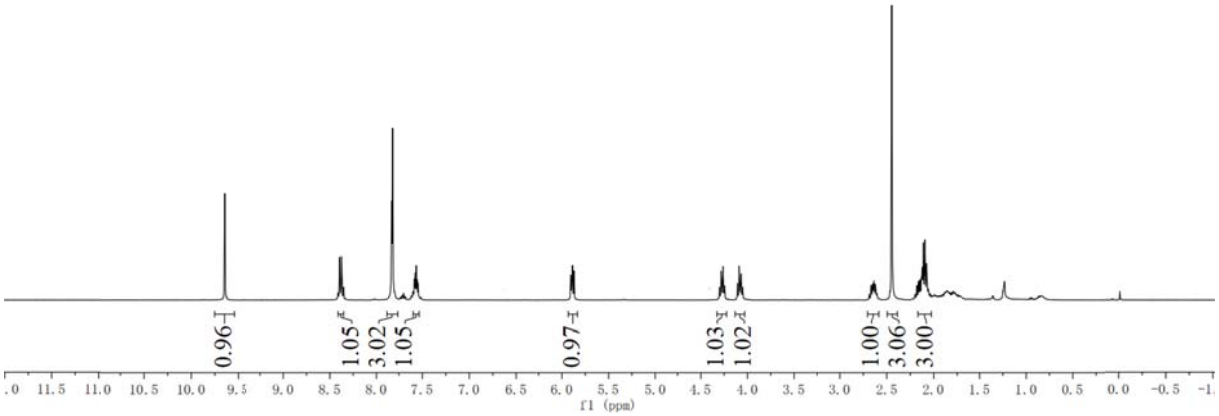


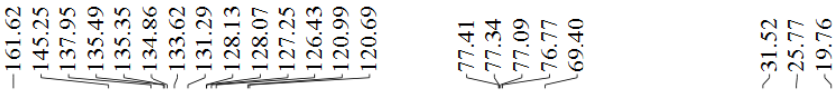
^{13}C NMR (101M, $CDCl_3$) of **3ua**

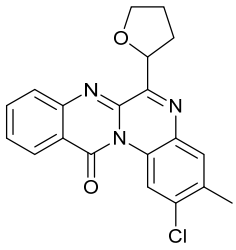




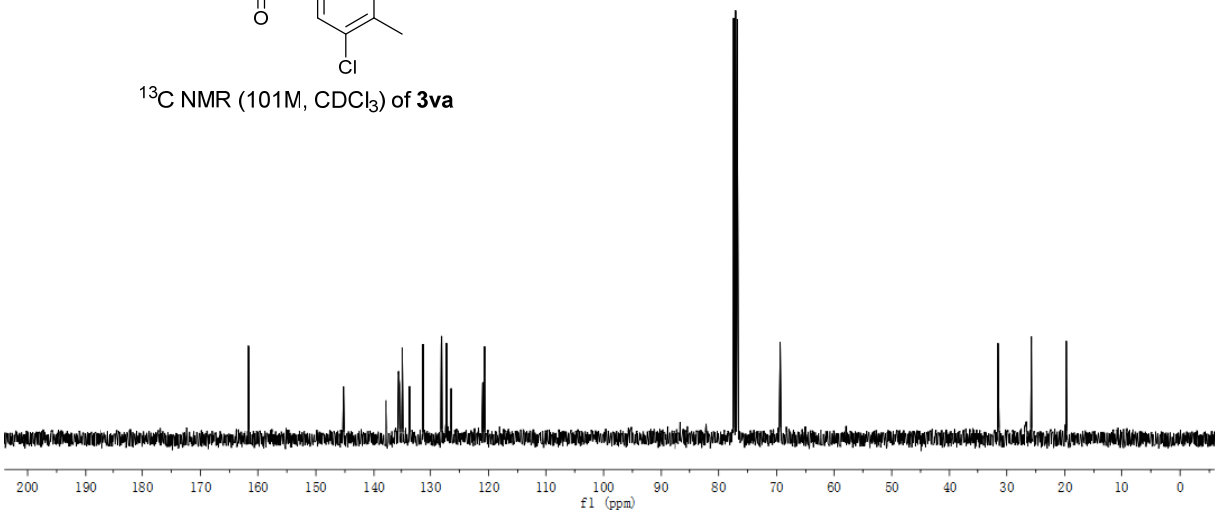
^{1}H NMR (400M, $CDCl_3$) of **3va**

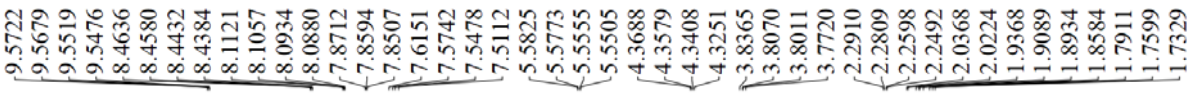


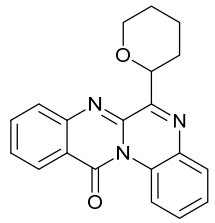




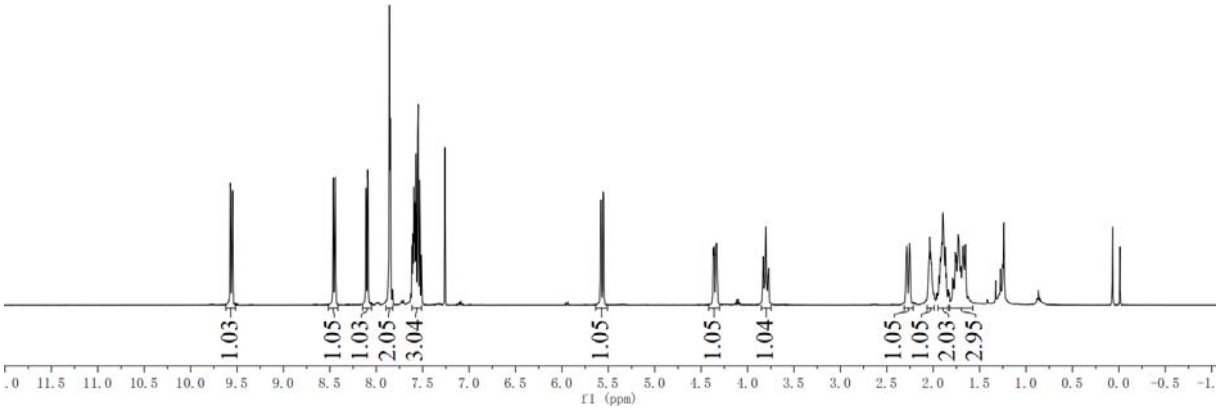
^{13}C NMR (101M, $CDCl_3$) of **3va**

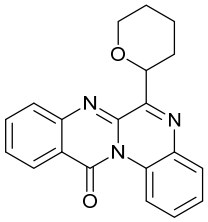




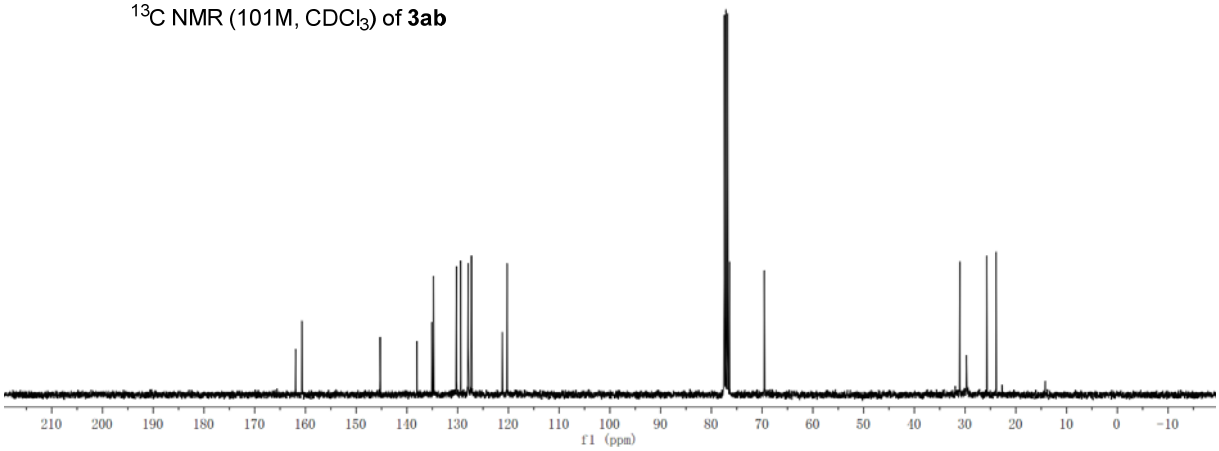


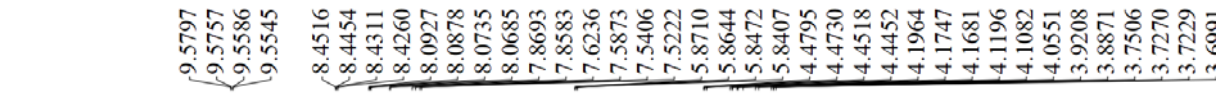
^{1}H NMR (400M, $CDCl_3$) of **3ab**

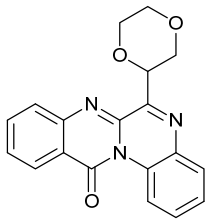




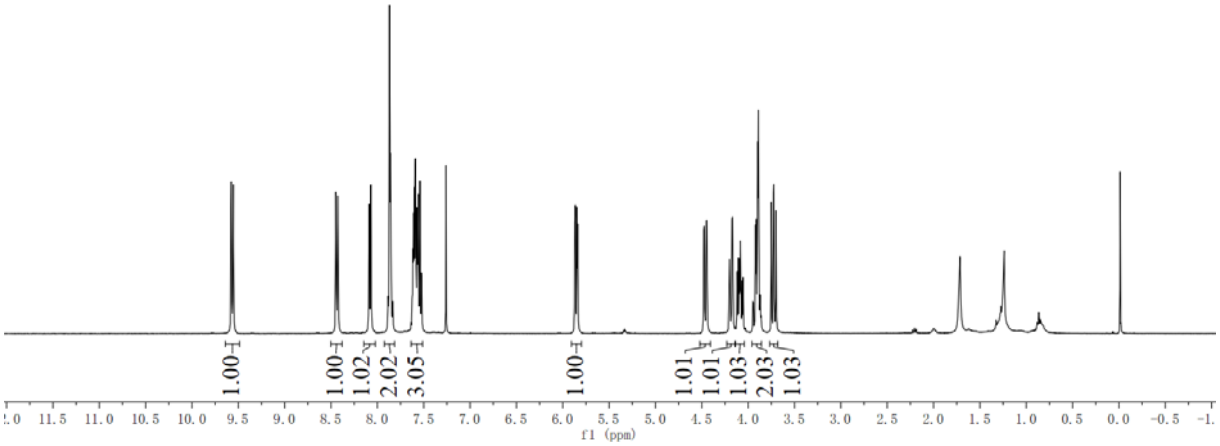
^{13}C NMR (101M, $CDCl_3$) of **3ab**

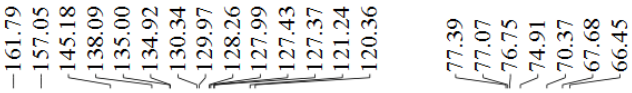


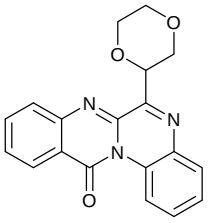




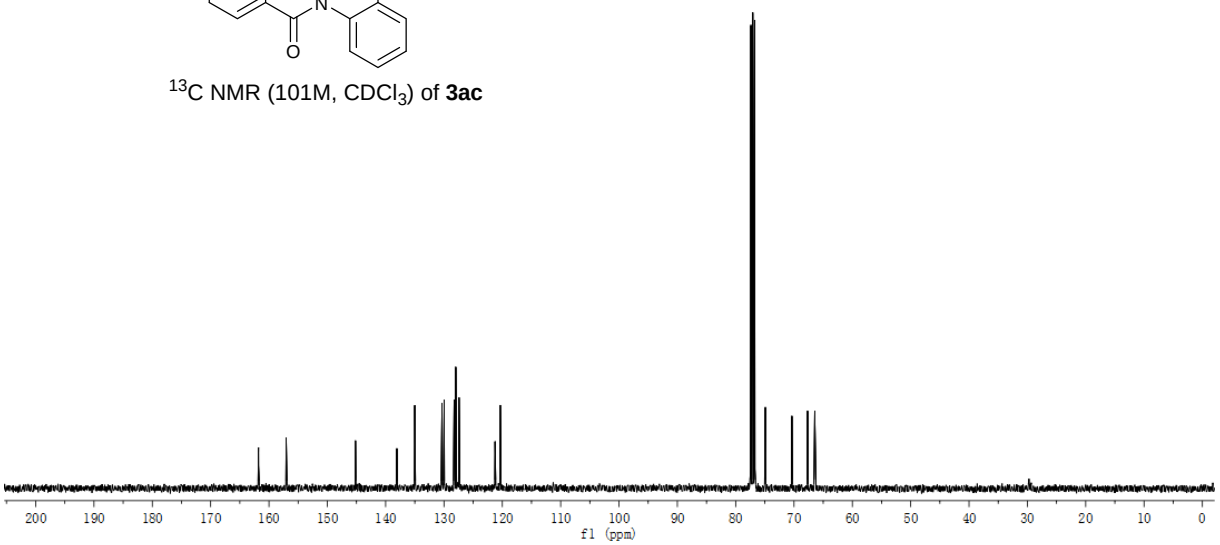
^{1}H NMR (400M, $CDCl_3$) of **3ac**

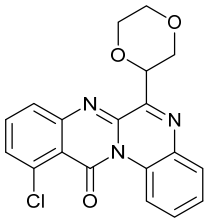




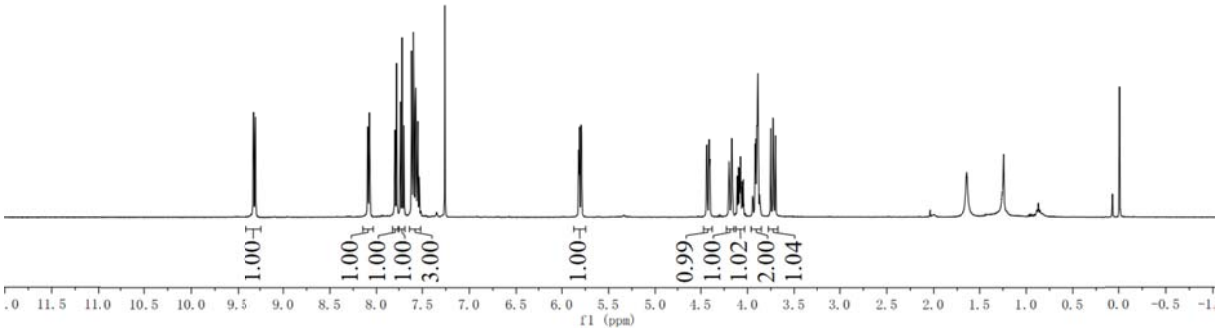


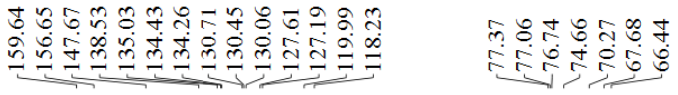
^{13}C NMR (101M, $CDCl_3$) of **3ac**

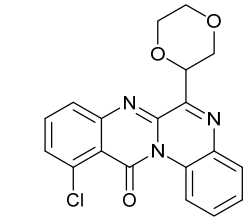




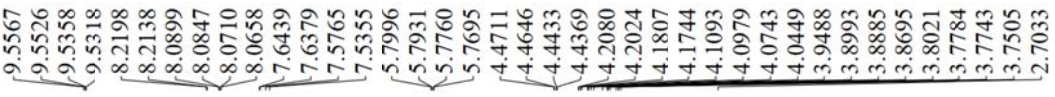
^{1}H NMR (400M, $CDCl_3$) of **3cc**

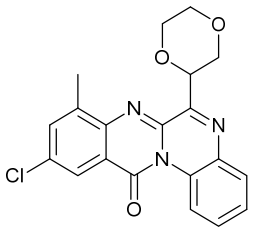




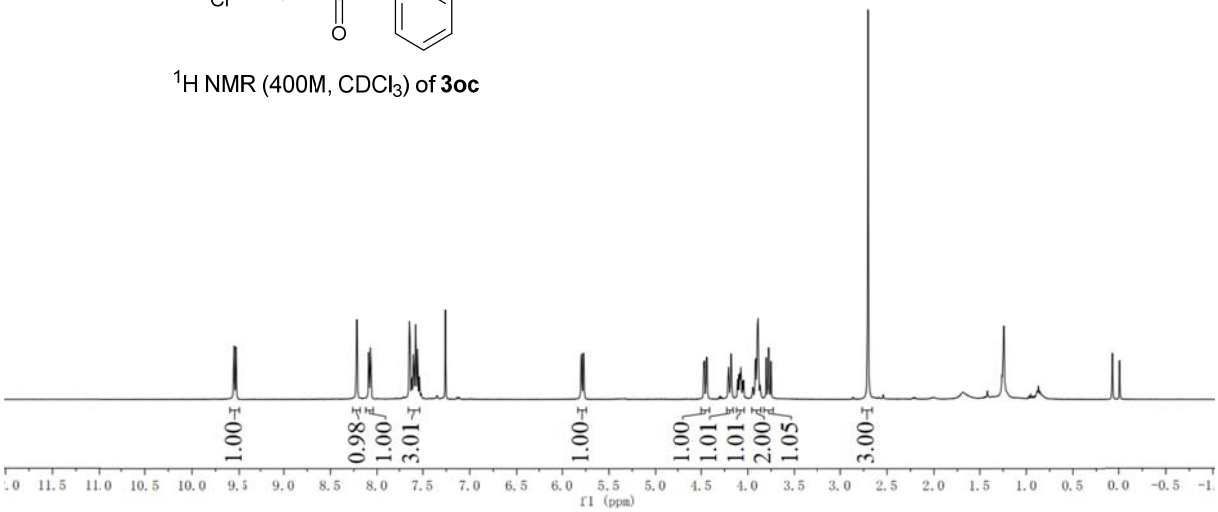


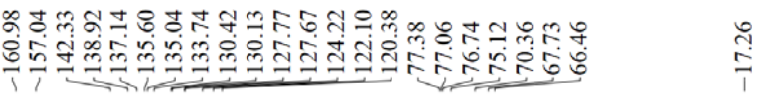
^{13}C NMR (101M, $CDCl_3$) of **3cc**

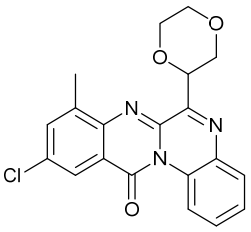




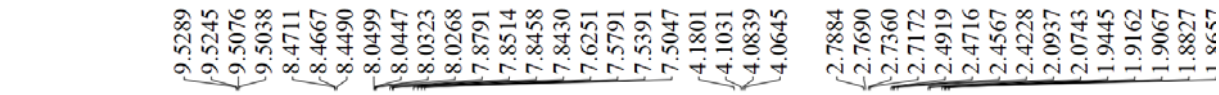
^{1}H NMR (400M, $CDCl_3$) of **3oc**

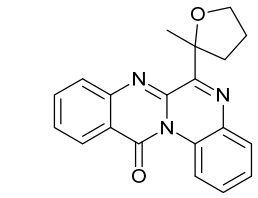




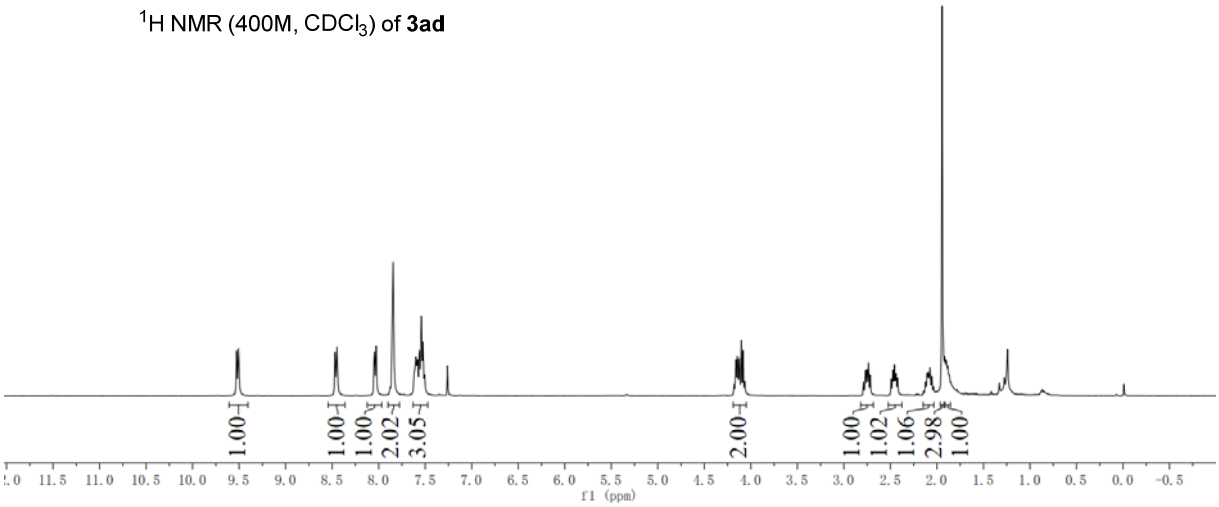


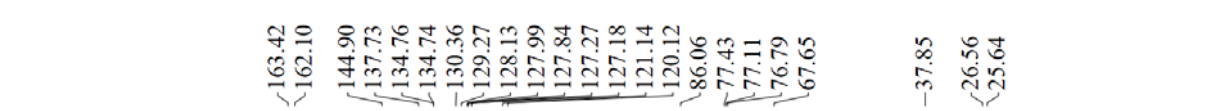
^{13}C NMR (101M, $CDCl_3$) of **3oc**

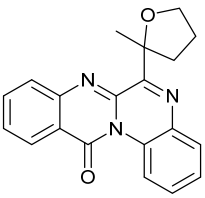




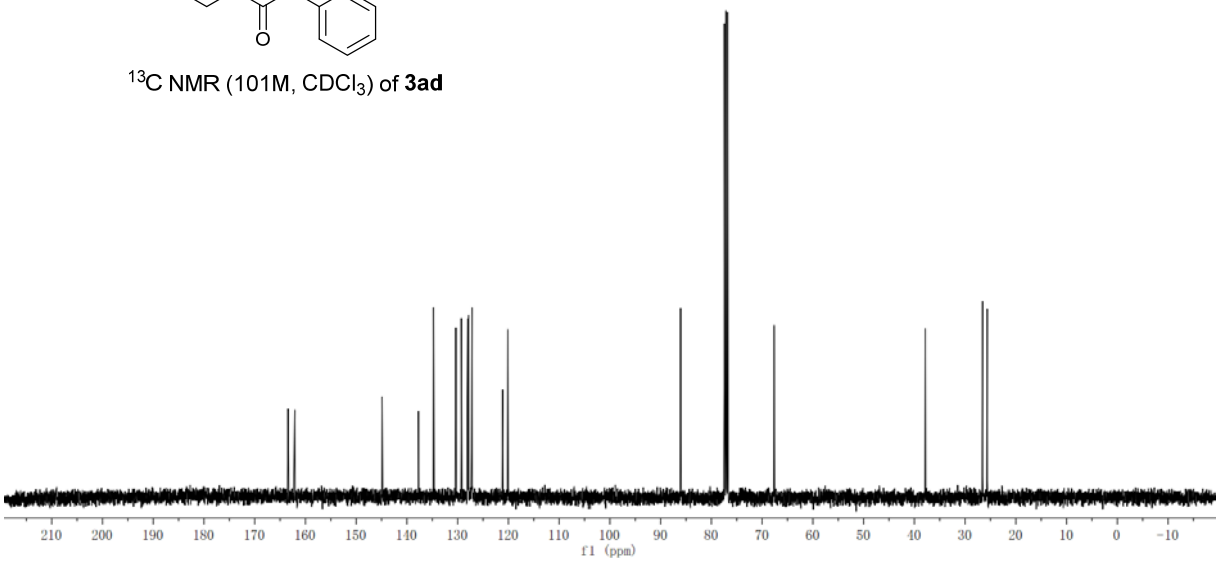
^{1}H NMR (400M, $CDCl_3$) of **3ad**

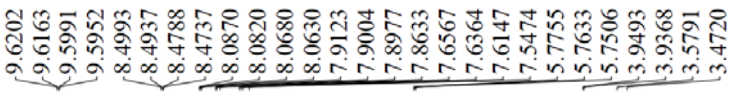


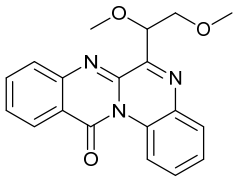




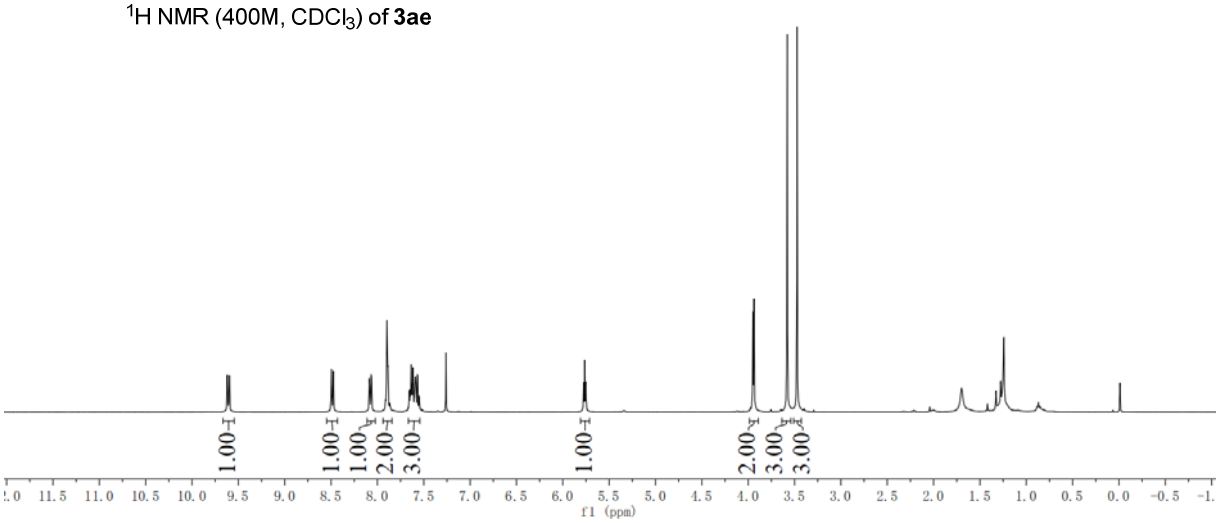
^{13}C NMR (101M, $CDCl_3$) of **3ad**

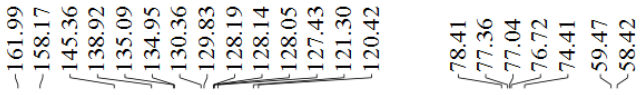


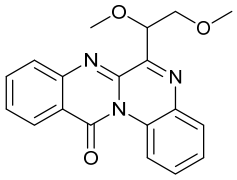




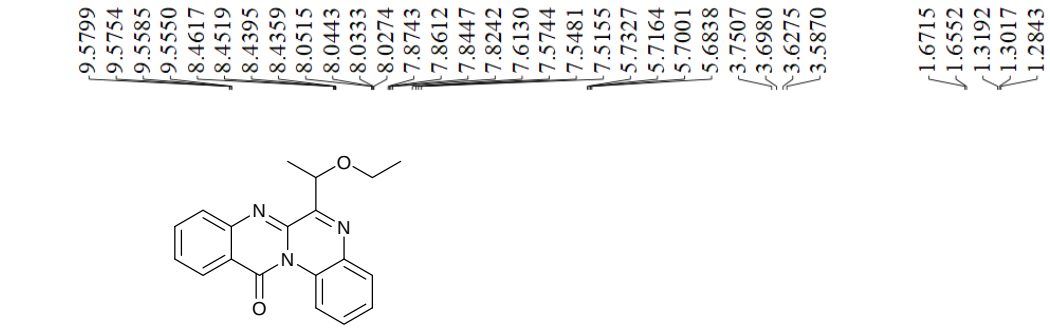
^{1}H NMR (400M, $CDCl_3$) of **3ae**



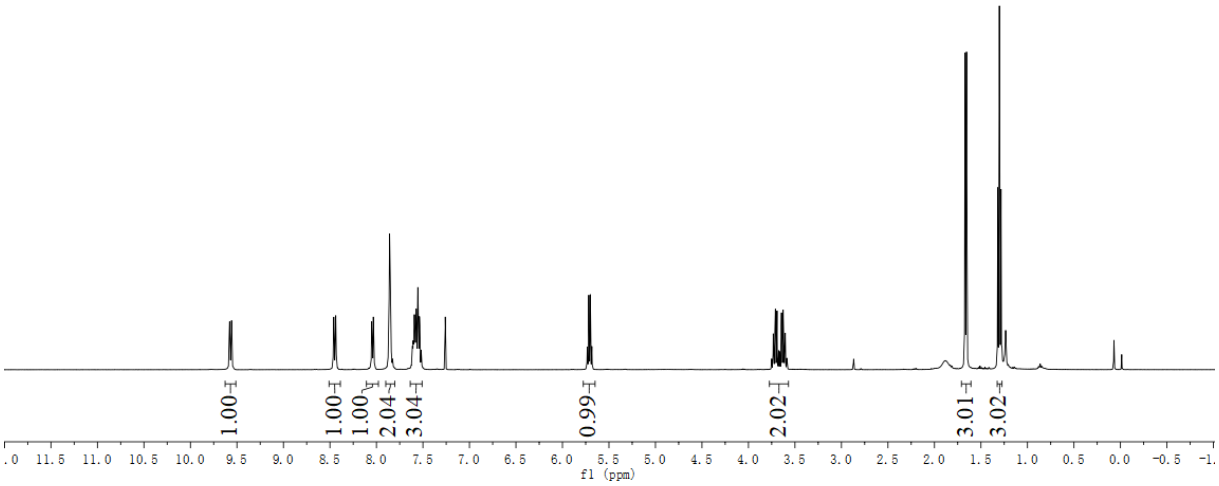


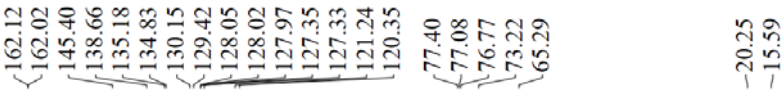


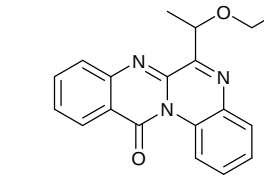
^{13}C NMR (101M, $CDCl_3$) of **3ae**



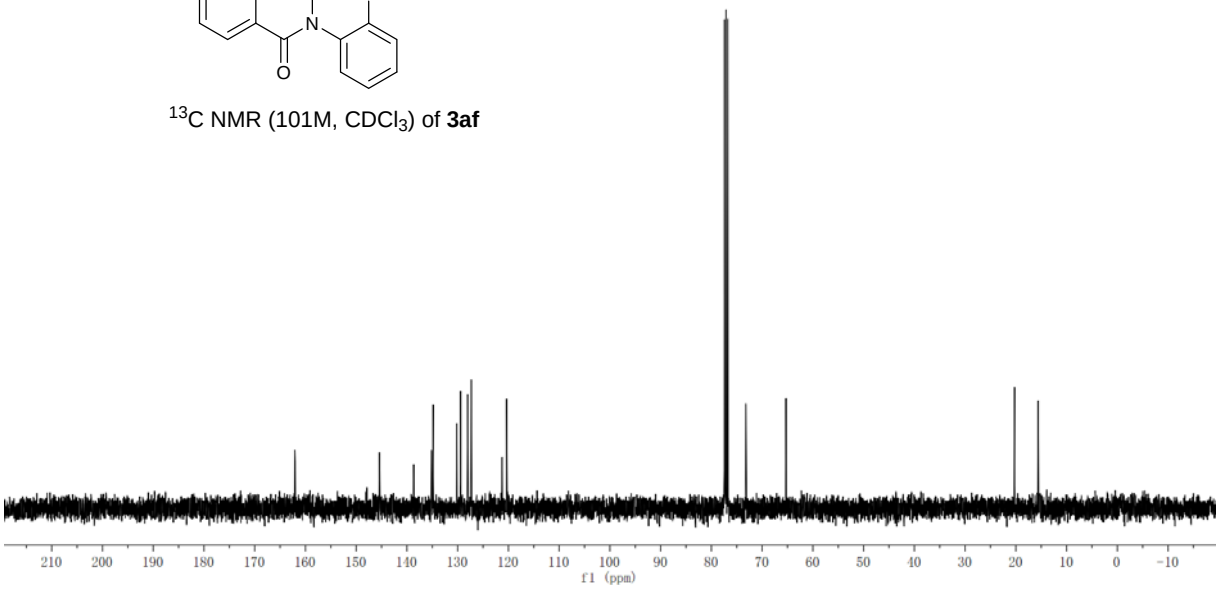
^{1}H NMR (400M, $CDCl_3$) of **3af**

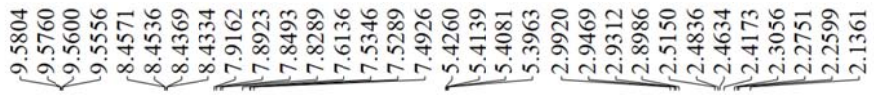


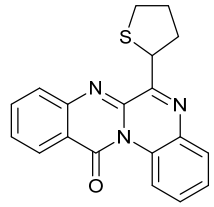




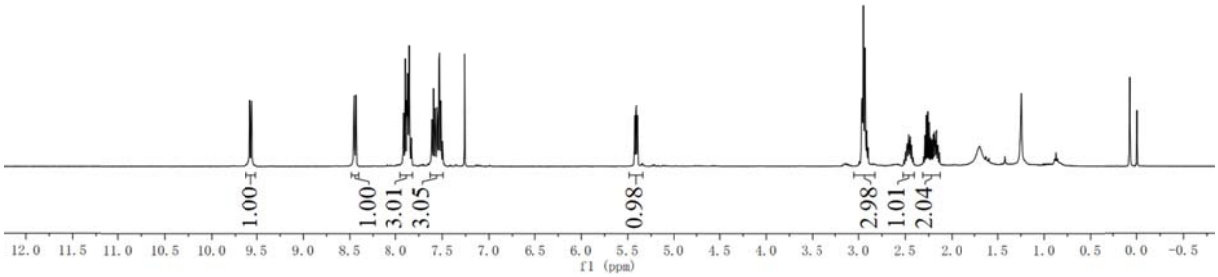
^{13}C NMR (101M, $CDCl_3$) of **3af**

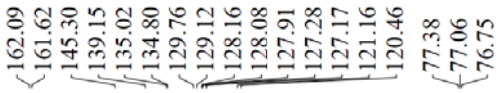


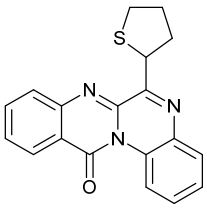




^{1}H NMR (400M, $CDCl_3$) of **3ag**







^{13}C NMR (101M, $CDCl_3$) of **3ag**