

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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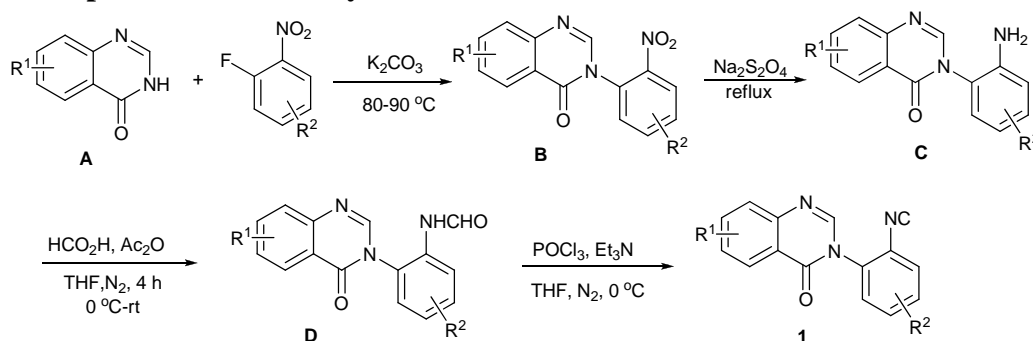
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1. General Considerations

General Information: Unless otherwise noted, all chemicals were purchased and used without further purification. ^1H 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:



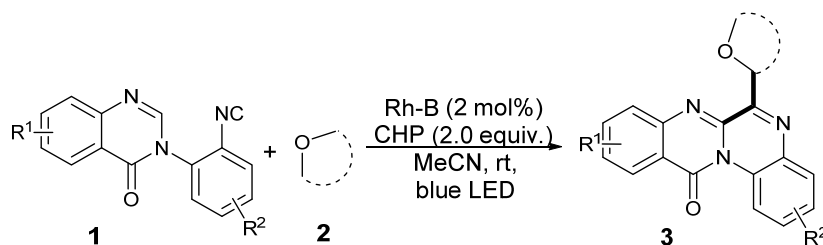
First, to a mixture of quinazolin-4(3H)-one **A** (10.0 mmol) in 25 mL of *N,N*-dimethylformamide (DMF) were added K_2CO_3 (15.0 mmol, 1.5 equiv) and 1-fluoro-2-nitrobenzene (12 mmol, 1.2 equiv) sequentially. The mixture was refluxed at $80-90\text{ }^\circ\text{C}$ for 8 h in a flask equipped with a guard tube. The reaction was quenched with H_2O and extracted with ethyl acetate ($3\times 25\text{ mL}$). 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 $\text{Na}_2\text{S}_2\text{O}_4$ (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 ($2\times 50\text{ mL}$) 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 $55\text{ }^\circ\text{C}$ for 2 h, was added dropwise to a mixture of **C** (4.0 mmol) in 6.0 mL THF at $0\text{ }^\circ\text{C}$. 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 $0\text{ }^\circ\text{C}$ within 2 hours. After that, the resulting mixture was stirred at $0\text{ }^\circ\text{C}$ for another 2 hours. Then, the mixture was quenched with Sat.

NaHCO₃ and extracted with CH₂Cl₂. The combined organic layer was washed with brine, dried over anhydrous Na₂SO₄ 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**.

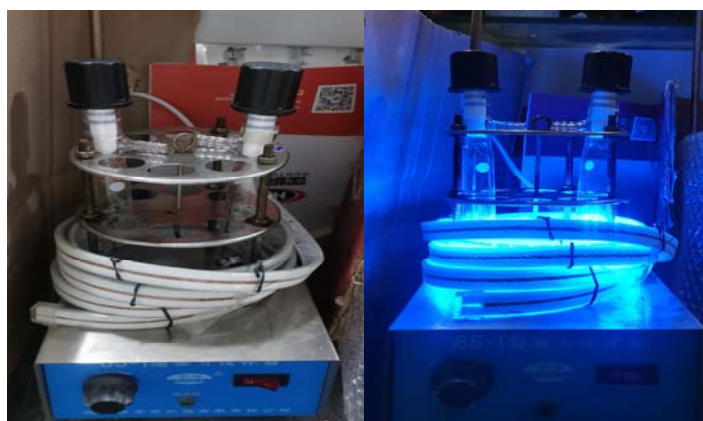
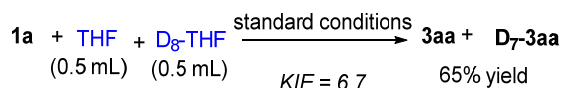


Figure S1 Photoreactor used in this work.

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), D₈-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 **D₇-3aa** in 65% total yield. A KIE value of

6.7 was observed from ^1H NMR spectrum.

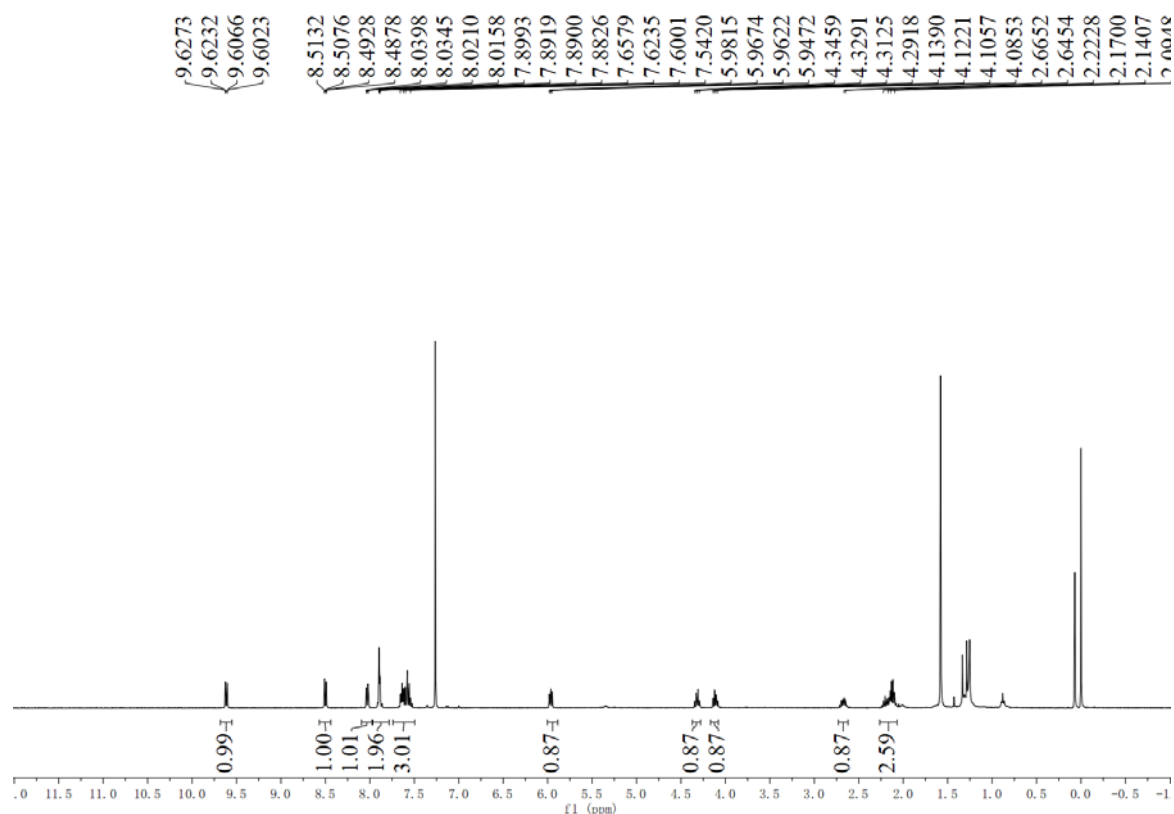
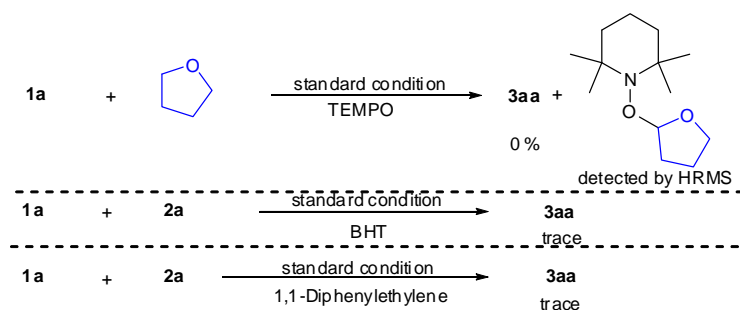


Figure S2. ^1H NMR spectrum of the KIE experiment

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.

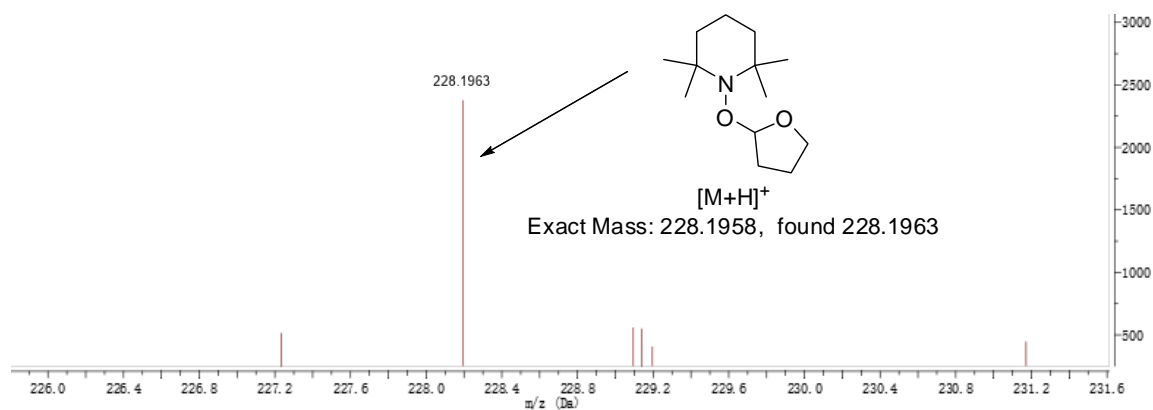


Figure S3. The adduct of TEMPO and tetrahydrofuran-2-yl radical detected by HRMS.

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 $E_{1/2}^{\text{red}} = -0.89$ V vs SCE.

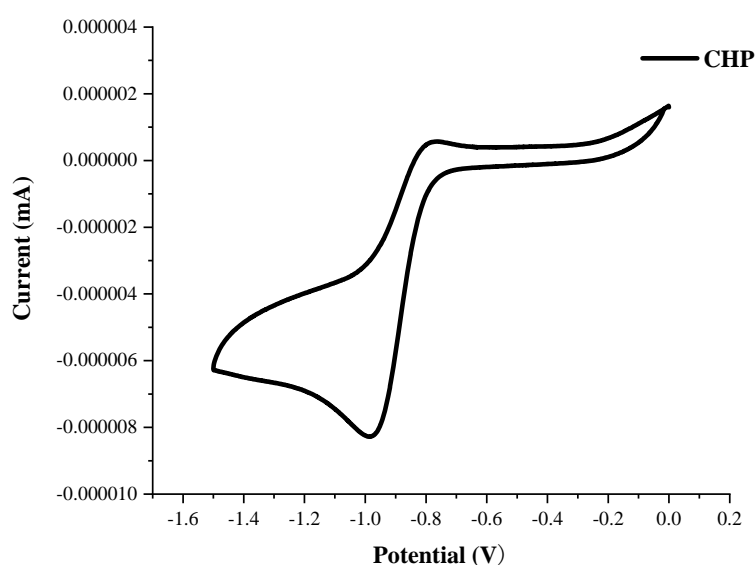
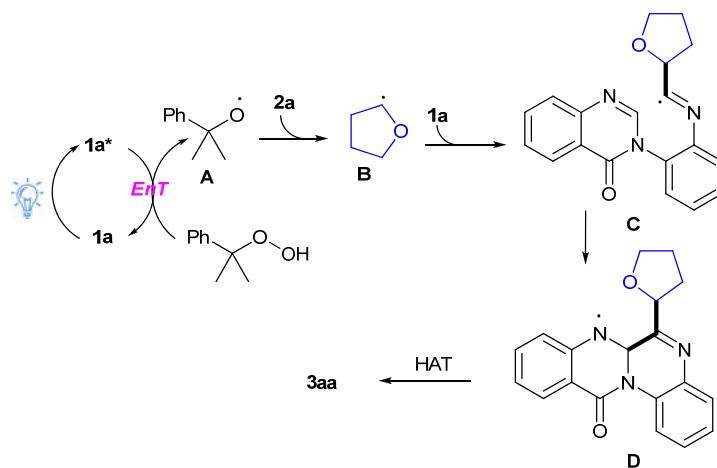


Figure S4. Cyclic voltammetry plots of CHP. Scan direction: from 0 V to -1.5 V, then back to 0 V

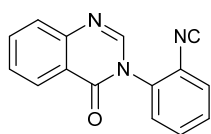
3.4 Alternative mechanism

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 may be involved as proposed in Scheme S1.

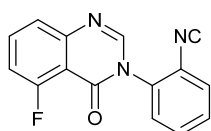


Scheme S1. Alternative mechanism involving the EnT process.

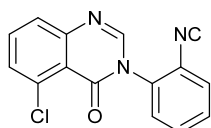
4. Characterization Data for the Substrates and Products



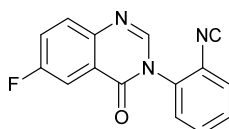
3-(2-Isocyanophenyl)quinazolin-4(3H)-one (1a, 692.3 mg, 70% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.37-8.34 (m, 1H), 7.99 (s, 1H), 7.85-7.77 (m, 2H), 7.62-7.54 (m, 4H), 7.49-7.47 (m, 1H); ^{13}C NMR (101 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 $\text{C}_{15}\text{H}_{10}\text{N}_3\text{O}$ $[\text{M}+\text{H}]^+$ 248.0818, found 248.0811.



5-Fluoro-3-(2-isocyanophenyl)quinazolin-4(3H)-one (1b, 689.6 mg, 65% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H 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, $J_{\text{C-F}}$ = 268.7 Hz), 156.9 (d, $J_{\text{C-F}}$ = 4.1 Hz), 149.8, 145.7, 135.7, 135.6 (d, $J_{\text{C-F}}$ = 10.4 Hz), 133.4, 130.8, 130.7, 129.4, 128.1, 123.8 (d, $J_{\text{C-F}}$ = 4.2 Hz), 114.9 (d, $J_{\text{C-F}}$ = 20.8 Hz), 111.9 (d, $J_{\text{C-F}}$ = 6.1 Hz); HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_8\text{FN}_3\text{O}$ $[\text{M}+\text{Na}]^+$ 288.0544, found 288.0556.

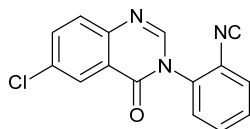


5-Chloro-3-(2-isocyanophenyl)quinazolin-4(3H)-one (1c, 709.9 mg, 63% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 7.98 (s, 1H), 7.68-7.67 (m, 2H), 7.61-7.54 (m, 4H), 7.50-7.48 (m, 1H); ^{13}C NMR (101 MHz, CDCl_3): 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 $\text{C}_{15}\text{H}_8\text{ClN}_3\text{O}$ $[\text{M}+\text{H}]^+$ 282.0429, found 282.0417.

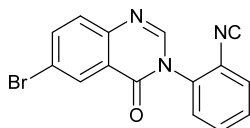


6-Fluoro-3-(2-isocyanophenyl)quinazolin-4(3H)-one (1d, 647.2 mg, 61% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.00-7.96 (m, 2H), 7.82-7.79 (m, 1H), 7.64-7.52 (m, 4H),

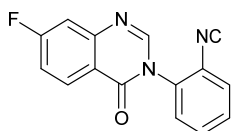
7.50-7.47 (m, 1H); ^{13}C NMR (101 MHz, CDCl_3): δ = 170.4, 161.6 (d, $J_{\text{C-F}}$ = 251.1 Hz), 159.3 (d, $J_{\text{C-F}}$ = 3.2 Hz), 144.4 (d, $J_{\text{C-F}}$ = 2.1 Hz), 144.2 (d, $J_{\text{C-F}}$ = 2.5 Hz), 133.6, 130.8, 130.7, 130.4 (d, $J_{\text{C-F}}$ = 8.2 Hz), 129.2, 128.2, 123.6 (d, $J_{\text{C-F}}$ = 24.0 Hz), 123.5, 112.4 (d, $J_{\text{C-F}}$ = 24.1 Hz); HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_8\text{FN}_3\text{O}$ $[\text{M}+\text{H}]^+$ 266.0724, found 266.0715.



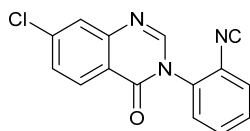
6-Chloro-3-(2-isocyanophenyl)quinazolin-4(3H)-one (1e, 619.7 mg, 55% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.31 (m, 1H), 7.98 (s, 1H), 7.78-7.72 (m, 2H), 7.63-7.58 (m, 3H), 7.49-7.47 (m, 1H); ^{13}C NMR (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 $\text{C}_{15}\text{H}_8\text{ClN}_3\text{O}$ $[\text{M}+\text{H}]^+$ 282.0429, found 282.0421.



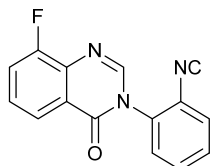
6-Bromo-3-(2-isocyanophenyl)quinazolin-4(3H)-one (1f, 769.7 mg, 59% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.46 (d, J = 2.3 Hz, 1H), 7.99 (s, 1H), 7.90 (m, 1H), 7.67-7.58 (m, 4H), 7.52-7.43 (m, 1H); ^{13}C 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 $\text{C}_{15}\text{H}_8\text{BrN}_3\text{O}$ $[\text{M}+\text{H}]^+$ 325.9924, found 325.9929.



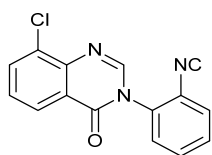
7-Fluoro-3-(2-isocyanophenyl)quinazolin-4(3H)-one (1g, 498.7 mg, 47% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.39 (m, 1H), 8.02 (s, 1H), 7.65-7.59 (m, 3H), 7.51-7.43 (m, 2H), 7.32-7.27 (m, 1H); ^{13}C NMR (101 MHz, CDCl_3): δ = 170.4, 166.8 (d, $J_{\text{C-F}}$ = 256.9 Hz), 159.2, 150.0 (d, $J_{\text{C-F}}$ = 12.9 Hz), 146.1, 133.5, 130.8, 130.7, 130.1 (d, $J_{\text{C-F}}$ = 10.8 Hz), 129.2, 128.2, 118.8 (d, $J_{\text{C-F}}$ = 2.2 Hz), 116.8 (d, $J_{\text{C-F}}$ = 23.6 Hz), 113.5 (d, $J_{\text{C-F}}$ = 22.3 Hz); HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_8\text{FN}_3\text{O}$ $[\text{M}+\text{H}]^+$ 266.0724, found 266.0719.



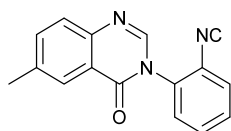
7-Chloro-3-(2-isocyanophenyl)quinazolin-4(3H)-one (1h), 439.5 mg, 39% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.28 (d, J = 8.5 Hz, 1H), 8.00 (s, 1H), 7.77 (d, J = 2.0 Hz, 1H), 7.63-7.57 (m, 3H), 7.53-7.46 (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 $\text{C}_{15}\text{H}_8\text{ClN}_3\text{NaO}$ $[\text{M}+\text{Na}]^+$ 304.0248, found 304.0241.



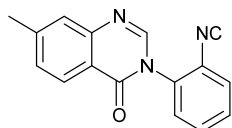
8-Fluoro-3-(2-isocyanophenyl)quinazolin-4(3H)-one (1i), 424.4 mg, 40% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.15-8.12 (m, 1H), 8.03 (s, 1H), 7.64-7.48 (m, 6H); ^{13}C NMR (101 MHz, CDCl_3): δ = 170.5, 159.0 (d, $J_{\text{C-F}}$ = 3.1 Hz), 157.2 (d, $J_{\text{C-F}}$ = 257.8 Hz), 145.4, 137.1 (d, $J_{\text{C-F}}$ = 12.2 Hz), 133.5, 130.9, 130.8, 129.1, 128.4 (d, $J_{\text{C-F}}$ = 7.8 Hz), 128.2, 123.9, 122.8 (d, $J_{\text{C-F}}$ = 4.3 Hz), 120.7 (d, $J_{\text{C-F}}$ = 19.0 Hz); HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_8\text{FN}_3\text{NaO}$ $[\text{M}+\text{Na}]^+$ 288.0544, found 288.0546.



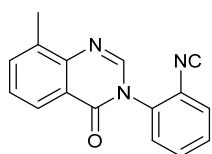
8-Chloro-3-(2-isocyanophenyl)quinazolin-4(3H)-one (1j), 473.3 mg, 42% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.28-8.25 (m, 1H), 8.10 (s, 1H), 7.91-7.89 (m, 1H), 7.64-7.56 (m, 3H), 7.51-7.47 (m, 2H); ^{13}C 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 $\text{C}_{15}\text{H}_8\text{ClN}_3\text{O}$ $[\text{M}+\text{H}]^+$ 282.0429, found 282.0417.



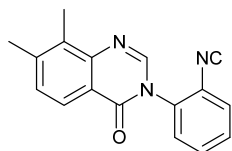
3-(2-Isocyanophenyl)-6-methylquinazolin-4(3H)-one (1k), 606.2 mg, 58% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.14 (s, 1H), 7.94 (s, 1H), 7.68-7.53 (m, 5H), 7.48-7.46 (m, 1H), 2.50 (s, 3H); ^{13}C NMR (101 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 $\text{C}_{16}\text{H}_{11}\text{N}_3\text{O}$ $[\text{M}+\text{H}]^+$ 262.0975, found 262.0975.



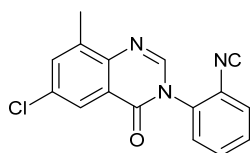
3-(2-Isocyanophenyl)-7-methylquinazolin-4(3H)-one (1l, 459.9 mg, 44% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.24 (d, J = 8.1 Hz, 1H), 7.97 (s, 1H), 7.62-7.54 (m, 4H), 7.49-7.47 (m, 1H), 7.38 (d, J = 8.1 Hz, 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 $\text{C}_{16}\text{H}_{11}\text{N}_3\text{O}$ $[\text{M}+\text{H}]^+$ 262.0975, found 262.0979.



3-(2-Isocyanophenyl)-8-methylquinazolin-4(3H)-one (1m, 658.4 mg, 63% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H 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 $\text{C}_{16}\text{H}_{11}\text{N}_3\text{O}$ $[\text{M}+\text{H}]^+$ 262.0975, found 262.0968.

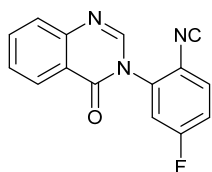


3-(2-Isocyanophenyl)-7,8-dimethylquinazolin-4(3H)-one (1n, 649.7 mg, 59% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.12 (d, J = 8.1 Hz, 1H), 7.98 (s, 1H), 7.62-7.54 (m, 3H), 7.49-7.47 (m, 1H), 7.37 (d, J = 8.1 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 $\text{C}_{17}\text{H}_{13}\text{N}_3\text{O}$ $[\text{M}+\text{H}]^+$ 276.1131, found 276.1120.

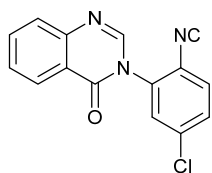


6-Chloro-3-(2-isocyanophenyl)-8-methylquinazolin-4(3H)-one (1o, 674.3 mg, 57% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.15 (d, J = 2.5 Hz, 1H), 7.98 (s, 1H), 7.62-7.57 (m, 4H), 7.48-7.46 (m, 1H), 2.63 (s,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

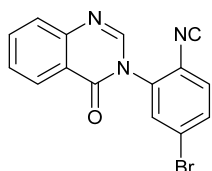
143.8, 138.8, 135.8, 133.6, 133.4, 130.78, 130.75, 129.1, 128.2, 124.8, 124.2, 123.2, 17.5; HRMS (ESI) m/z calcd for $C_{16}H_{10}ClN_3O$ $[M+H]^+$ 296.0585, found 296.0593.



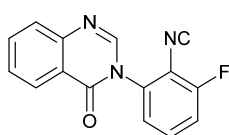
3-(5-Fluoro-2-isocyanophenyl)quinazolin-4(3H)-one (1p), 456.2 mg, 43% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; 1H NMR (400 MHz, $CDCl_3$): δ = 8.38-8.36 (m, 1H), 7.99 (s, 1H), 7.88-7.79 (m, 2H), 7.65-7.58 (m, 2H), 7.33-7.26 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.6, 162.2 (d, J_{C-F} = 256.9 Hz), 159.7, 147.6, 144.2, 135.4, 135.3, 129.7 (d, J_{C-F} = 9.5 Hz), 128.3, 128.0, 127.3, 122.0, 118.0 (d, J_{C-F} = 23.1 Hz), 117.3 (d, J_{C-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(3H)-one (1q), 450.7 mg, 40% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; 1H 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.

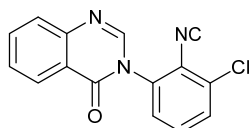


3-(5-Bromo-2-isocyanophenyl)quinazolin-4(3H)-one (1r), 587.1 mg, 45% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; 1H NMR (400 MHz, $CDCl_3$): δ = 8.36-8.34 (m, 1H), 7.97 (s, 1H), 7.86-7.82 (m, 1H), 7.80-7.77 (m, 1H), 7.72-7.66 (m, 2H), 7.60-7.56 (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.

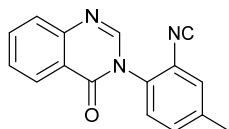


3-(3-Fluoro-2-isocyanophenyl)quinazolin-4(3H)-one (1s), 318.3 mg, 30% yield), flash

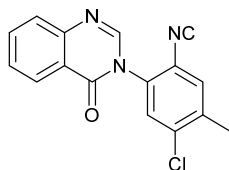
column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.36 (d, J = 8.0 Hz, 1H), 7.99 (s, 1H), 7.86-7.78 (m, 2H), 7.61-7.56 (m, 2H), 7.41 (t, J = 8.5 Hz, 1H), 7.30 (d, J = 8.1 Hz, 1H); ^{13}C NMR (101 MHz, CDCl_3): δ = 176.3, 159.7, 158.2 (d, $J_{\text{C-F}}$ = 261.2 Hz), 147.6, 144.3, 135.3, 135.2, 131.0 (d, $J_{\text{C-F}}$ = 8.9 Hz), 128.3, 128.0, 127.4, 124.5 (d, $J_{\text{C-F}}$ = 3.6 Hz), 121.9, 117.9 (d, $J_{\text{C-F}}$ = 18.9 Hz); HRMS (ESI) m/z calcd for $\text{C}_{15}\text{H}_8\text{FN}_3\text{O}$ $[\text{M}+\text{H}]^+$ 266.0724, found 266.0717.



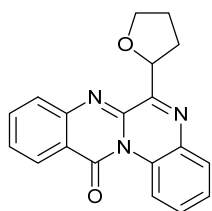
3-(3-Chloro-2-isocyanophenyl)quinazolin-4(3H)-one (1t), 428.2 mg, 38% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.38-7.36 (m, 1H), 7.99 (s, 1H), 7.88-7.79 (m, 2H), 7.70-7.67 (m, 1H), 7.61-7.53 (m, 2H), 7.42-7.40 (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 $\text{C}_{15}\text{H}_8\text{ClN}_3\text{O}$ $[\text{M}+\text{H}]^+$ 282.0429, found 282.0422.



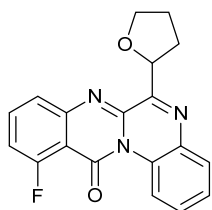
3-(2-Isocyano-4-methylphenyl)quinazolin-4(3H)-one (1u), 480.8 mg, 46% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.37-8.34 (m, 1H), 7.98 (s, 1H), 7.84-7.76 (m, 2H), 7.58-7.54 (m, 1H), 7.41-7.33 (m, 3H), 2.45 (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 $\text{C}_{16}\text{H}_{11}\text{N}_3\text{O}$ $[\text{M}+\text{H}]^+$ 262.0975, found 262.0983.



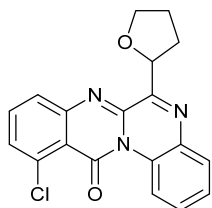
3-(5-Chloro-2-isocyano-4-methylphenyl)quinazolin-4(3H)-one (1v), 508.7 mg, 43% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 2/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 8.36-8.33 (m, 1H), 7.96 (s, 1H), 7.85-7.76 (m, 2H), 7.59-7.55 (m, 1H), 7.48 (d, J = 1.9 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 $\text{C}_{16}\text{H}_{10}\text{ClN}_3\text{O}$ $[\text{M}+\text{H}]^+$ 296.0585, found 296.0595.



6-(Tetrahydrofuran-2-yl)-12H-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; ^1H 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 $\text{C}_{19}\text{H}_{15}\text{N}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 318.1237, found 318.1224.

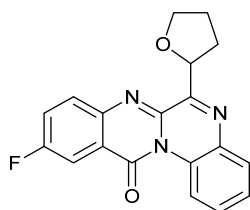


11-Fluoro-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-*b*]quinazolin-12-one (3ba, 44.9 mg, 67% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.41-9.39 (m, 1H), 7.99-7.97 (m, 1H), 7.78-7.73 (m, 1H), 7.65-7.62 (m, 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, $J_{\text{C-F}}$ = 268.4 Hz), 161.1, 158.9 (d, $J_{\text{C-F}}$ = 4.8 Hz), 147.4, 139.1, 135.1 (d, $J_{\text{C-F}}$ = 10.5 Hz), 135.0, 130.2, 129.5, 127.5, 127.4, 123.9 (d, $J_{\text{C-F}}$ = 4.4 Hz), 120.1, 114.2 (d, $J_{\text{C-F}}$ = 20.9 Hz), 110.8 (d, $J_{\text{C-F}}$ = 5.1 Hz), 77.2, 69.4, 31.4, 25.7; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{14}\text{FN}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 336.1143, found 336.1143.

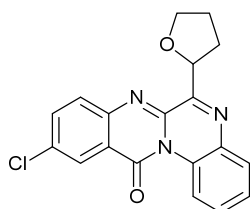


11-Chloro-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-*b*]quinazolin-12-one (3ca, 52.1 mg, 74% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.30-9.28 (m, 1H), 7.99-7.97 (m, 1H), 7.75-7.72 (m, 1H), 7.66 (t, J = 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 $\text{C}_{19}\text{H}_{14}\text{ClN}_3\text{O}_2$ $[\text{M}+\text{H}]^+$

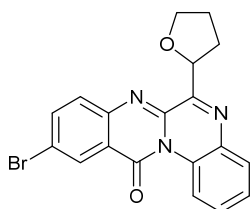
352.0847, found 352.0842.



10-Fluoro-6-(tetrahydrofuran-2-yl)-12H-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; ^1H 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, $J_{\text{C-F}}$ = 251.8 Hz), 161.3, 161.2 (d, $J_{\text{C-F}}$ = 3.8 Hz), 142.1 (d, $J_{\text{C-F}}$ = 2.0 Hz), 137.9 (d, $J_{\text{C-F}}$ = 2.2 Hz), 135.1, 130.6 (d, $J_{\text{C-F}}$ = 8.2 Hz), 130.2, 129.4, 127.9, 127.5, 123.8 (d, $J_{\text{C-F}}$ = 24.4 Hz), 122.5 (d, $J_{\text{C-F}}$ = 8.8 Hz), 120.4, 112.1 (d, $J_{\text{C-F}}$ = 24.2 Hz), 77.3, 69.4, 31.4, 25.8; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{14}\text{FN}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 336.1143, found 336.1140.

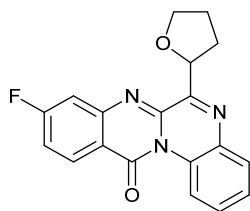


10-Chloro-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3ea, 47.8 mg, 68% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.54-9.51 (m, 1H), 8.38-8.38 (m, 1H), 8.01-7.98 (m, 1H), 7.81-7.74 (m, 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 $\text{C}_{19}\text{H}_{14}\text{ClN}_3\text{O}_2$ $[\text{M}+\text{Na}]^+$ 374.0667, found 374.0665.

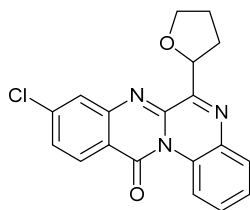


10-Bromo-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3fa, 58.6 mg, 74% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.51-9.49 (m, 1H), 8.53 (d, J = 2.3 Hz, 1H), 7.99-7.97 (m, 1H), 7.89-7.87 (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,

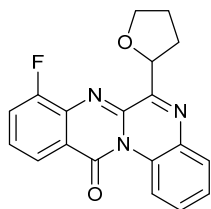
129.7, 129.5, 127.9, 127.5, 122.4, 121.7, 120.3, 77.3, 69.4, 31.4, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}BrN_3O_2$ $[M+H]^+$ 396.0342, found 396.0328.



9-Fluoro-6-(tetrahydrofuran-2-yl)-12H-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; 1H 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-F} = 257.0 Hz), 161.2, 161.1, 147.5 (d, J_{C-F} = 13.4 Hz), 139.4, 135.0, 130.25, 130.23 (d, J_{C-F} = 10.8 Hz), 129.5, 127.9, 127.4, 120.3, 117.97 (d, J_{C-F} = 1.8 Hz), 117.0 (d, J_{C-F} = 23.9 Hz), 112.9 (d, J_{C-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.

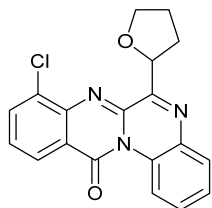


9-Chloro-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3ha, 49.3 mg, 70% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; 1H NMR (400 MHz, $CDCl_3$): δ = 9.55-9.53 (m, 1H), 8.36 (d, J = 8.6 Hz, 1H), 8.02-8.00 (m, 1H), 7.86 (d, 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.

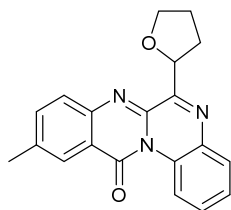


8-Fluoro-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3ia, 53.7 mg, 80% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; 1H NMR (400 MHz, $CDCl_3$): δ = 9.54-9.51 (m, 1H), 8.22-8.19 (m, 1H), 8.03-8.00 (m, 1H), 7.59-7.49 (m, 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,

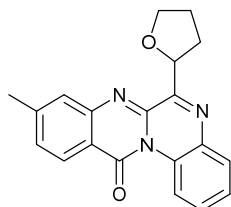
$J_{C-F} = 3.2$ Hz), 157.3 (d, $J_{C-F} = 259.9$ Hz), 138.5, 135.3, 135.1, 130.3, 129.5, 128.0 (d, $J_{C-F} = 7.6$ Hz), 127.8, 127.6, 123.0, 122.8 (d, $J_{C-F} = 4.6$ Hz), 120.3, 120.0 (d, $J_{C-F} = 18.4$ Hz), 77.7, 69.4, 31.7, 25.8; HRMS (ESI) m/z calcd for $C_{19}H_{14}FN_3O_2$ $[M+H]^+$ 336.1143,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



8-Chloro-6-(tetrahydrofuran-2-yl)-12H-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; 1H NMR (400 MHz, $CDCl_3$): $\delta = 9.52$ -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, $CDCl_3$): $\delta = 161.8$, 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.

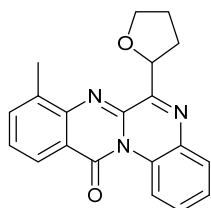


10-Methyl-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-*b*]quinazolin-12-one (3ka, 45.1 mg, 68% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; 1H NMR (400 MHz, $CDCl_3$): $\delta = 9.59$ -9.56 (m, 1H), 8.24-8.22 (m, 1H), 8.00-7.98 (m, 1H), 7.76-7.74 (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, $CDCl_3$): $\delta = 161.9$, 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.

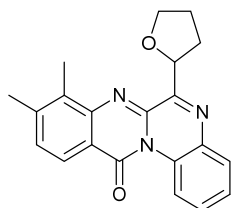


9-Methyl-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-*b*]quinazolin-12-one (3la, 48.3 mg, 73% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; 1H NMR (400 MHz, $CDCl_3$): $\delta = 9.59$ -9.56 (m, 1H), 8.31 (d, $J = 8.2$ Hz, 1H), 8.00-7.97 (m, 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,

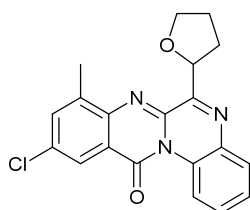
3H); ^{13}C NMR (101 MHz, CDCl_3): $\delta = 161.9, 161.5, 146.0, 145.5, 138.6, 135.0, 130.1, 129.7, 129.3, 128.3, 127.6, 127.1, 120.4, 118.9, 77.4, 69.4, 31.6, 25.7, 22.0$; HRMS (ESI) m/z calcd for $\text{C}_{20}\text{H}_{17}\text{N}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 332.1394, found 332.1384.



8-Methyl-6-(tetrahydrofuran-2-yl)-12H-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 solid; ^1H NMR (400 MHz, CDCl_3): $\delta = 9.57\text{-}9.55$ (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): $\delta = 162.1, 161.9, 143.8, 137.2, 136.5, 135.1, 135.0, 130.1, 129.2, 128.1, 127.7, 127.2, 124.9, 121.2, 120.4, 77.6, 69.4, 32.0, 25.6, 17.3$; HRMS (ESI) m/z calcd for $\text{C}_{20}\text{H}_{17}\text{N}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 332.1394, found 332.1387.

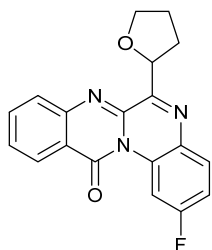


8,9-Dimethyl-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3na, 51.1 mg, 74% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): $\delta = 9.61\text{-}9.58$ (m, 1H), 8.16 (d, $J = 8.2$ Hz, 1H), 8.01-7.98 (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): $\delta = 162.2, 162.0, 143.9, 143.5, 137.2, 135.0, 134.4, 130.2, 130.1, 129.2, 128.2, 127.1, 124.1, 120.4, 119.2, 77.6, 69.4, 32.0, 25.6, 20.9, 13.1$; HRMS (ESI) m/z calcd for $\text{C}_{21}\text{H}_{19}\text{N}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 346.1550, found 346.1558.

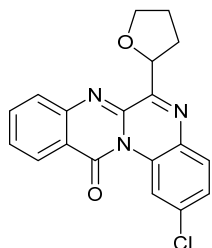


10-Chloro-8-methyl-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3oa, 52.0 mg, 71% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): $\delta = 9.52\text{-}9.50$ (m, 1H), 8.16 (d, $J = 2.3$ Hz, 1H), 8.00-7.97 (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,

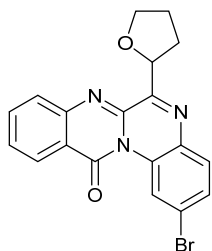
3H); ^{13}C NMR (101 MHz, CDCl_3): δ = 161.7, 161.0, 142.5, 138.8, 137.4, 135.3, 135.1, 133.4, 130.2, 129.4, 127.8, 127.5, 124.1, 122.0, 120.3, 77.4, 69.4, 31.9, 25.7, 17.2; HRMS (ESI) m/z calcd for $\text{C}_{20}\text{H}_{16}\text{ClN}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 366.1004, found 366.1004.



2-Fluoro-6-(tetrahydrofuran-2-yl)-12H-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; ^1H 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, $J_{\text{C-F}}$ = 248.9 Hz), 161.8, 160.6, 145.3, 138.0, 135.0, 131.7, 131.4 (d, $J_{\text{C-F}}$ = 9.9 Hz), 128.9 (d, $J_{\text{C-F}}$ = 12.5 Hz), 128.2, 128.1, 127.3, 120.9, 114.8 (d, $J_{\text{C-F}}$ = 23.2 Hz), 108.1 (d, $J_{\text{C-F}}$ = 32.0 Hz), 77.3, 69.4, 31.5, 25.7; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{14}\text{FN}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 336.1143, found 336.1138.

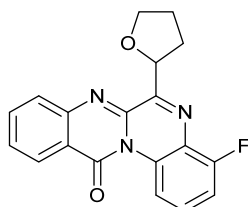


2-Chloro-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3qa, 49.3 mg, 78% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.68 (d, J = 2.2 Hz, 1H), 8.44-8.42 (m, 1H), 7.91 (d, J = 8.5 Hz, 1H), 7.87-7.85 (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 $\text{C}_{19}\text{H}_{14}\text{ClN}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 352.0847, found 352.0841.

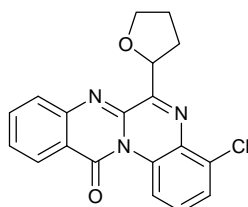


2-Bromo-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3ra, 60.2

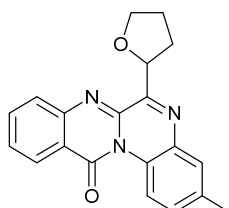
mg, 76% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.85 (t, J = 1.9 Hz, 1H), 8.47-8.44 (m, 1H), 7.88-7.84 (m, 3H), 7.67-7.61 (m, 2H), 5.93-7.89 (m, 1H), 4.31-4.26 (m, 1H), 4.12-4.07 (m, 1H), 2.70-2.63 (m, 1H), 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 $\text{C}_{19}\text{H}_{14}\text{BrN}_3\text{O}_2$ $[\text{M}+\text{Na}]^+$ 418.0162, found 418.0168.



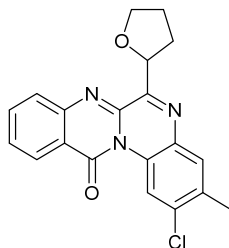
4-Fluoro-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3sa, 40.2 mg, 60% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.37-9.34 (m, 1H), 8.45-8.42 (m, 1H), 7.89-7.84 (m, 2H), 7.63-7.59 (m, 1H), 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, $J_{\text{C-F}}$ = 2.1 Hz), 161.81, 157.8 (d, $J_{\text{C-F}}$ = 256.9 Hz), 145.3, 138.2, 135.0, 129.4 (d, $J_{\text{C-F}}$ = 8.9 Hz), 129.3, 128.3, 128.2, 127.4, 125.1 (d, $J_{\text{C-F}}$ = 12.8 Hz), 121.3, 116.0 (d, $J_{\text{C-F}}$ = 4.3 Hz), 113.8 (d, $J_{\text{C-F}}$ = 19.3 Hz), 77.3, 69.4, 31.1, 25.8; HRMS (ESI) m/z calcd for $\text{C}_{19}\text{H}_{14}\text{FN}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 336.1143, found 336.1140.



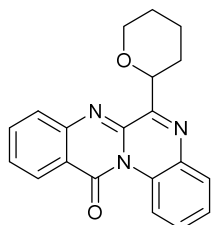
4-Chloro-6-(tetrahydrofuran-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3ta, 50.0 mg, 71% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.48-9.45 (m, 1H), 8.43-8.40 (m, 1H), 7.89-7.83 (m, 2H), 7.62-7.57 (m, 2H), 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 $\text{C}_{19}\text{H}_{14}\text{ClN}_3\text{O}_2$ $[\text{M}+\text{H}]^+$ 352.0847, found 352.0845.



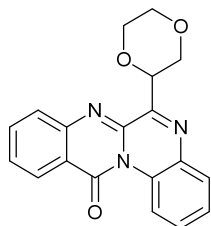
3-Methyl-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (3ua, 47.1 mg, 71% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ¹H NMR (400 MHz, CDCl₃): δ = 9.46-9.43 (m, 1H), 8.43-8.40 (m, 1H), 7.84-7.78 (m, 3H), 7.58-7.53 (m, 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); ¹³C NMR (101 MHz, CDCl₃): 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 C₂₀H₁₇N₃O₂ [M+H]⁺ 332.1394, found 332.1391.



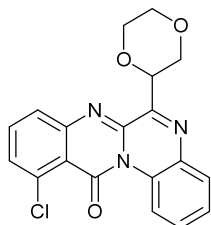
2-Chloro-3-methyl-6-(tetrahydrofuran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (3va, 57.8 mg, 79% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ¹H NMR (400 MHz, CDCl₃): δ = 9.65 (s, 1H), 8.41-8.35 (m, 1H), 7.83-7.81 (m, 3H), 7.60-7.54 (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); ¹³C NMR (101 MHz, CDCl₃): 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 C₂₀H₁₆ClN₃O₂ [M+H]⁺ 366.1004, found 366.1010.



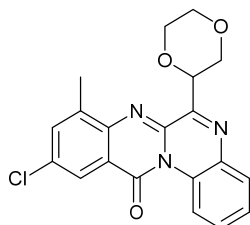
6-(Tetrahydro-2*H*-pyran-2-yl)-12*H*-quinoxalino[2,1-*b*]quinazolin-12-one (3ab, 42.4 mg, 64% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ¹H NMR (400 MHz, CDCl₃): δ = 9.57-9.55 (m, 1H), 8.46-8.44 (m, 1H), 8.11-8.09 (m, 1H), 7.87-7.82 (m, 2H), 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); ¹³C NMR (101 MHz, CDCl₃): 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 C₂₀H₁₇N₃O₂ [M+H]⁺ 332.1394, found 332.1389.



6-(1,4-Dioxan-2-yl)-12H-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; ^1H 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 $\text{C}_{19}\text{H}_{15}\text{N}_3\text{O}_3$ $[\text{M}+\text{H}]^+$ 334.1186, found 334.1192.

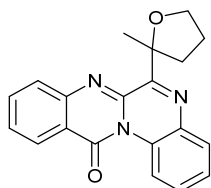


11-Chloro-6-(1,4-dioxan-2-yl)-12H-quinoxalino[2,1-*b*]quinazolin-12-one (3cc), 44.1 mg, 60% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.32-9.30 (m, 1H), 8.10-8.07 (m, 1H), 7.80-7.77 (m, 1H), 7.72 (t, J = 7.9 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 $\text{C}_{19}\text{H}_{14}\text{ClN}_3\text{O}_3$ $[\text{M}+\text{H}]^+$ 368.0796, found 368.0813.

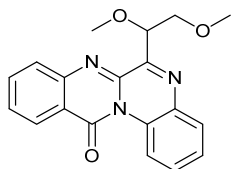


10-Chloro-6-(1,4-dioxan-2-yl)-8-methyl-12H-quinoxalino[2,1-*b*]quinazolin-12-one (3oc), 44.3 mg, 58% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.56-9.53 (m, 1H), 8.22 (d, J = 2.4 Hz, 1H), 8.09-8.07 (m, 1H), 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

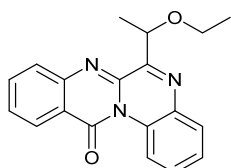
NMR (101 MHz, CDCl₃): δ = 161.0, 157.0, 142.3, 138.9, 137.1, 135.6, 135.0, 133.7, 130.4, 130.1, 127.8, 127.7, 124.2, 122.1, 120.4, 75.1, 70.4, 67.7, 66.5, 17.3; HRMS (ESI) *m/z* calcd for C₂₀H₁₆ClN₃O₃ [M+H]⁺ 382.0953, found 382.0945.



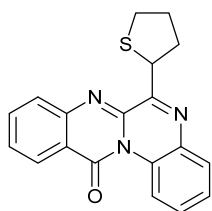
6-(2-Methyltetrahydrofuran-2-yl)-12H-quinoxalino[2,1-*b*]quinazolin-12-one (3ad, 45.1 mg, 68% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ¹H NMR (400 MHz, CDCl₃): δ = 9.53-9.50 (m, 1H), 8.47-8.45 (m, 1H), 8.06-8.03 (m, 1H), 7.88-7.84 (m, 2H), 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); ¹³C NMR (101 MHz, CDCl₃): 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 C₂₀H₁₇N₃O₂ [M+H]⁺ 332.1394, found 332.1386.



6-(1,2-Dimethoxyethyl)-12H-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; ¹H NMR (400 MHz, CDCl₃): 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); ¹³C NMR (101 MHz, CDCl₃): 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 C₁₉H₁₇N₃O₂ [M+H]⁺ 336.1343, found 336.1355.



6-(1-Ethoxyethyl)-12H-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; ¹H NMR (400 MHz, CDCl₃): 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); ¹³C NMR (101 MHz, CDCl₃): 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 C₁₉H₁₅N₃O₂ [M+Na]⁺ 320.1394, found 320.1386.



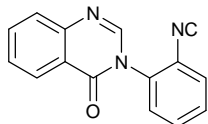
6-(Tetrahydrothiophen-2-yl)-12H-quinoxalino[2,1-b]quinazolin-12-one (3ag), 34.0 mg, 51% yield), flash column chromatography on silica gel (petroleum ether/ethyl acetate 5/1) gave yellow solid; ^1H NMR (400 MHz, CDCl_3): δ = 9.58-9.56 (m, 1H), 8.46-8.43 (m, 1H), 7.92-7.83 (m, 3H), 7.61-7.49 (m, 3H), 5.43-5.40 (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 $\text{C}_{19}\text{H}_{15}\text{N}_3\text{OS}$ $[\text{M}+\text{H}]^+$ 334.1009, found 334.1019.

5. References

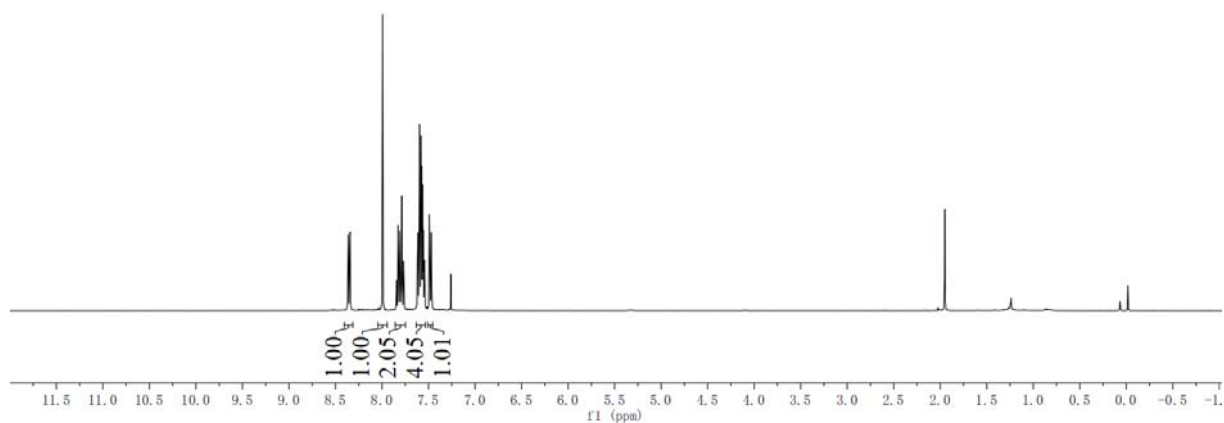
1. A. Banerjee, P. Subramanian and K. P. Kaliappan, *J. Org. Chem.*, 2016, **81**, 10424.
2. V. A. Mamedov, V. L. Mamedova, V. V. Syakaev, D. E. Korshin, G. Z. Khikmatova, E. V. Mironova, O. B. Bazanova, I. Kh. Rizvanov and S. K. Latypov, *Tetrahedron.*, 2017, **73**, 5082.
3. Y. Liu, X.-L. Chen, X.-Y. 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 ^1H NMR and ^{13}C NMR Spectra

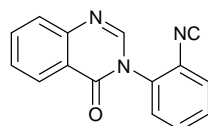
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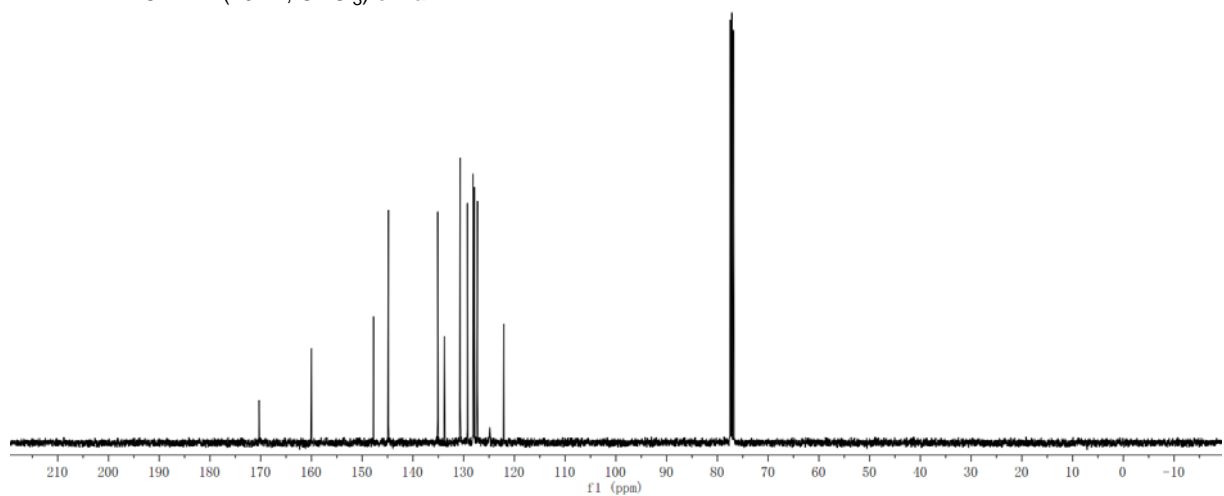
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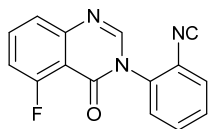
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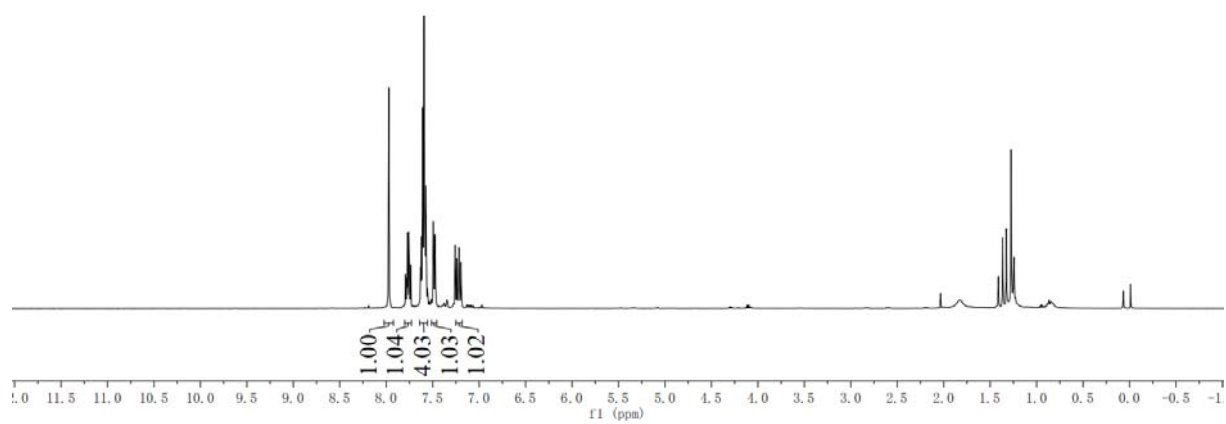
^{13}C NMR (101M, CDCl_3) of **1a**



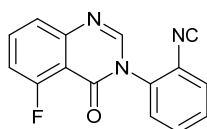
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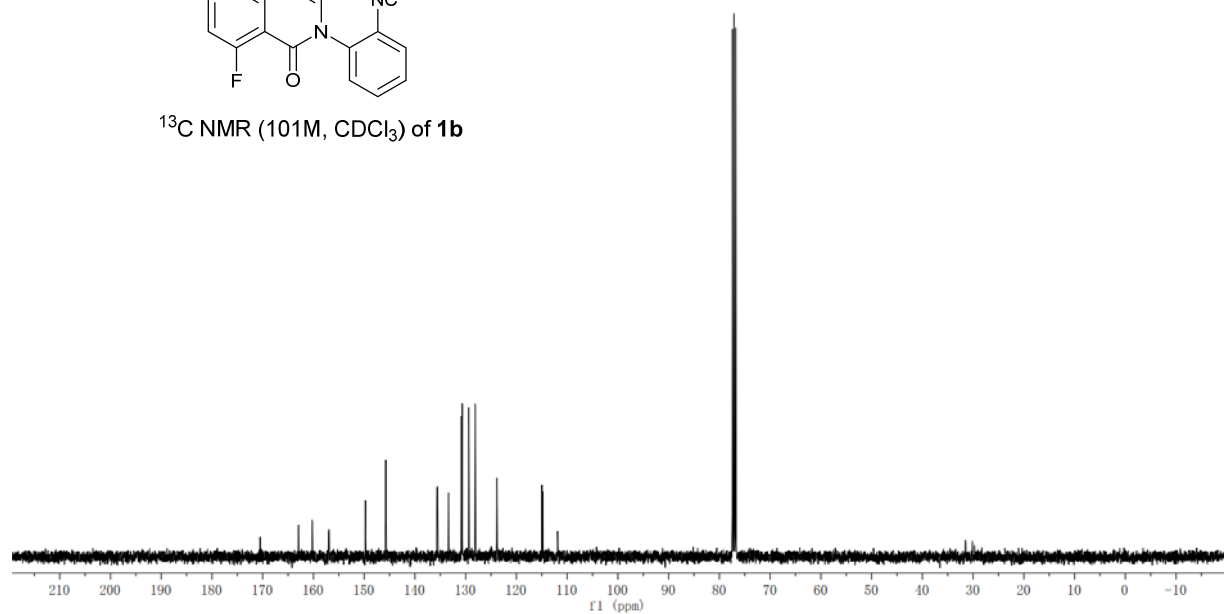
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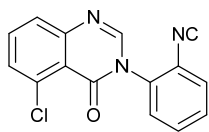
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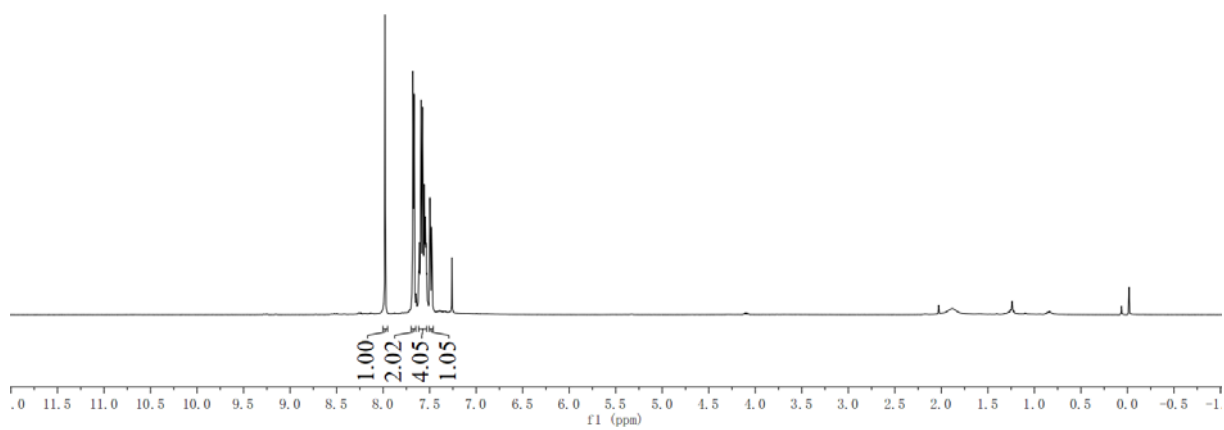
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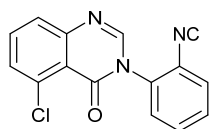
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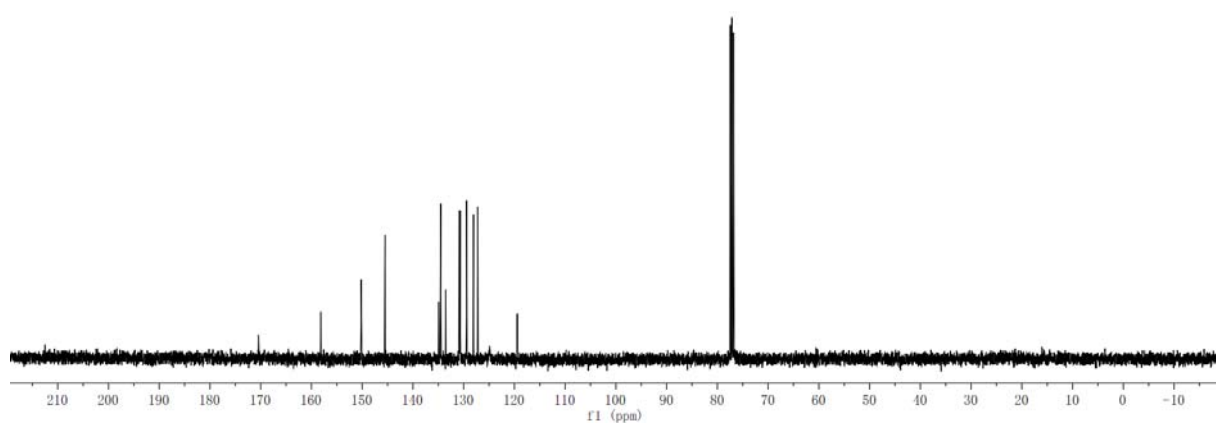
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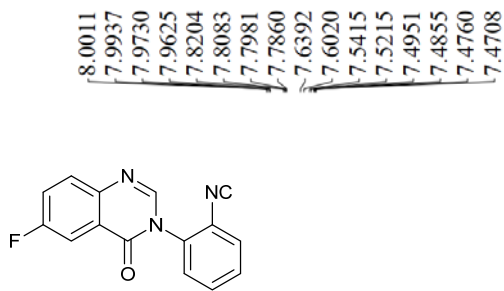


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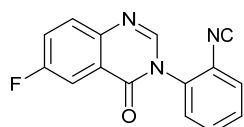
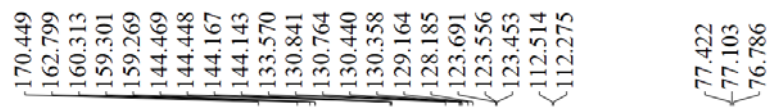
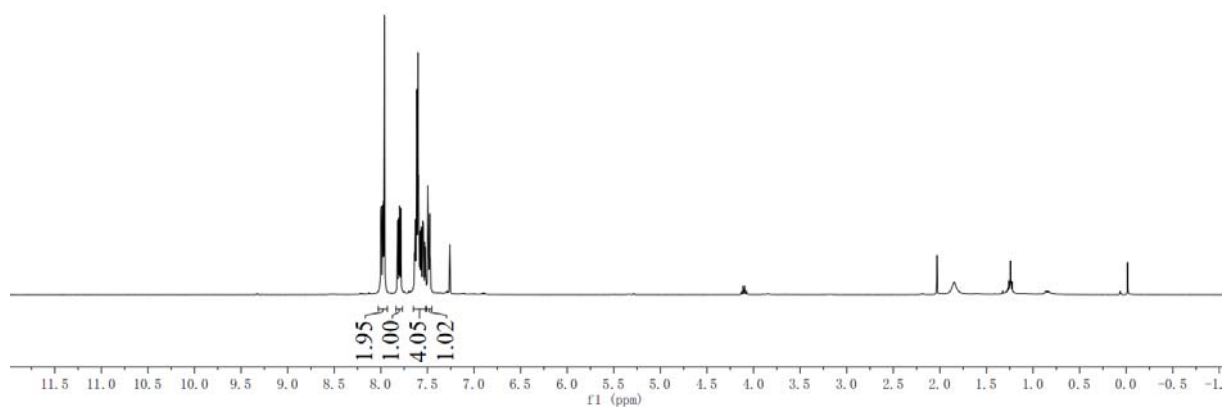


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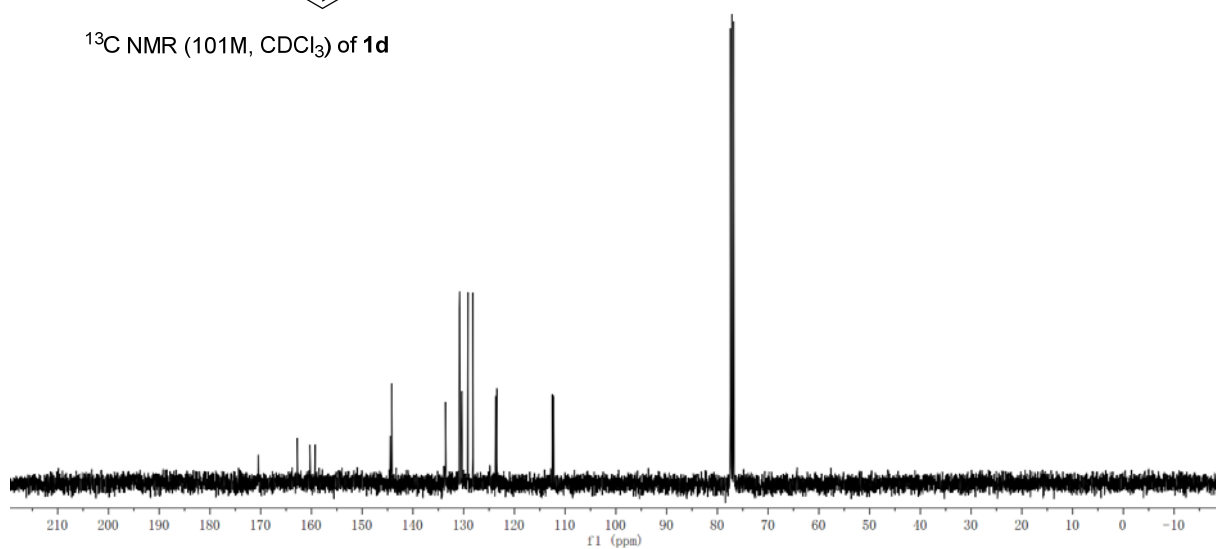




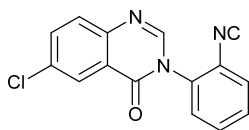
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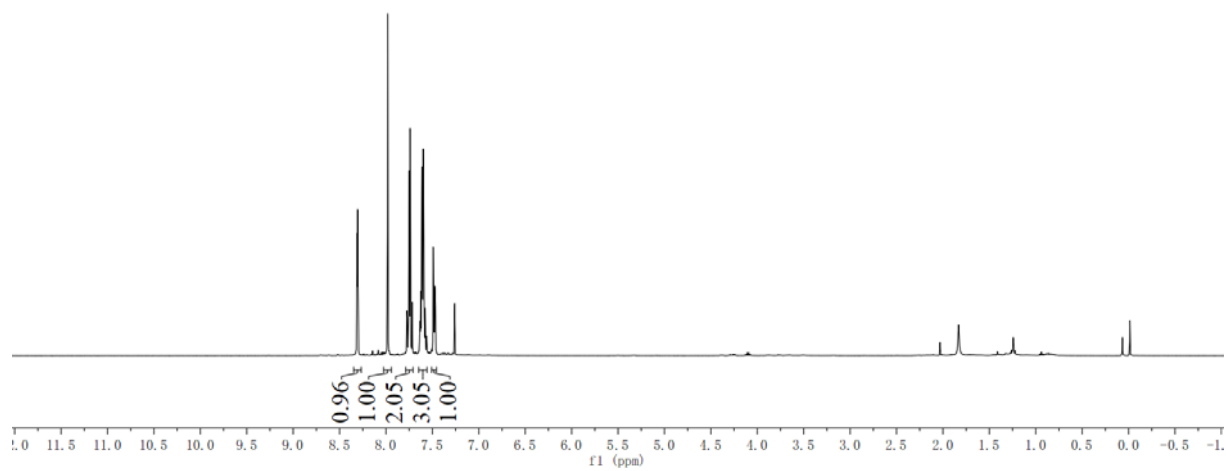
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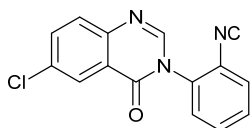
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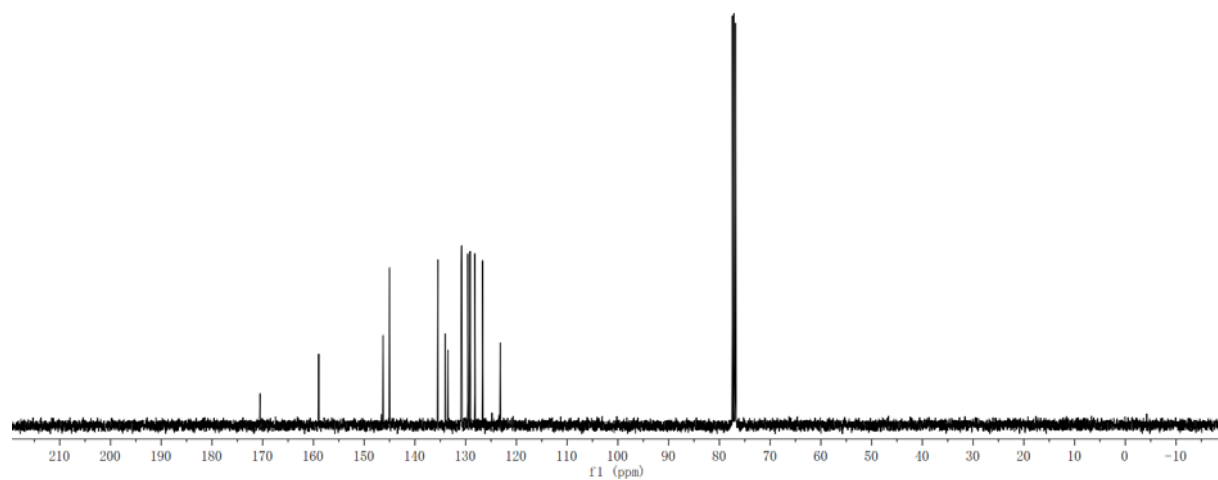
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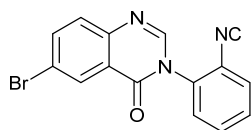
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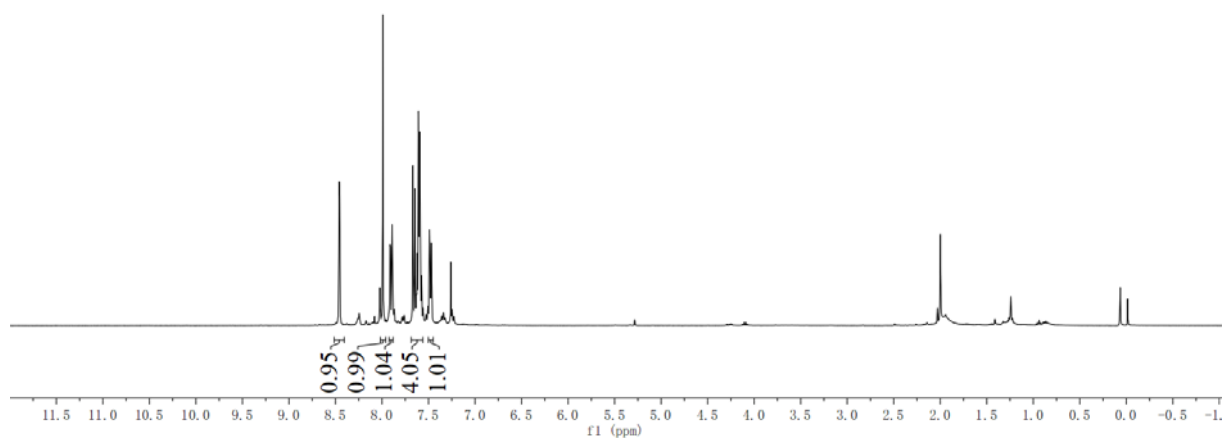
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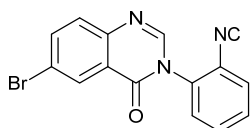
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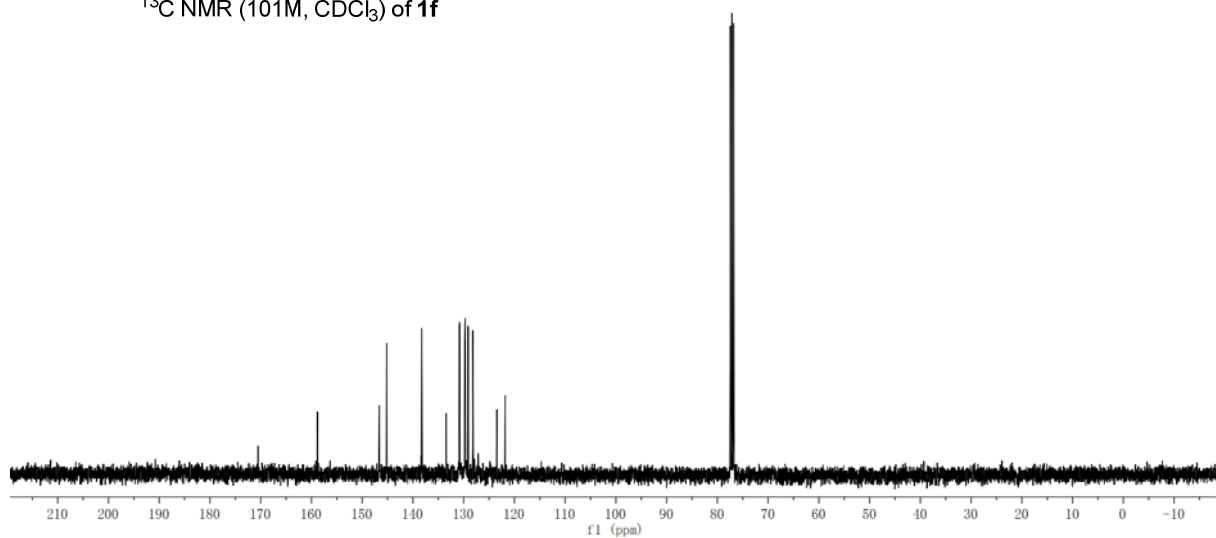
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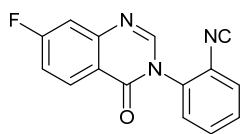
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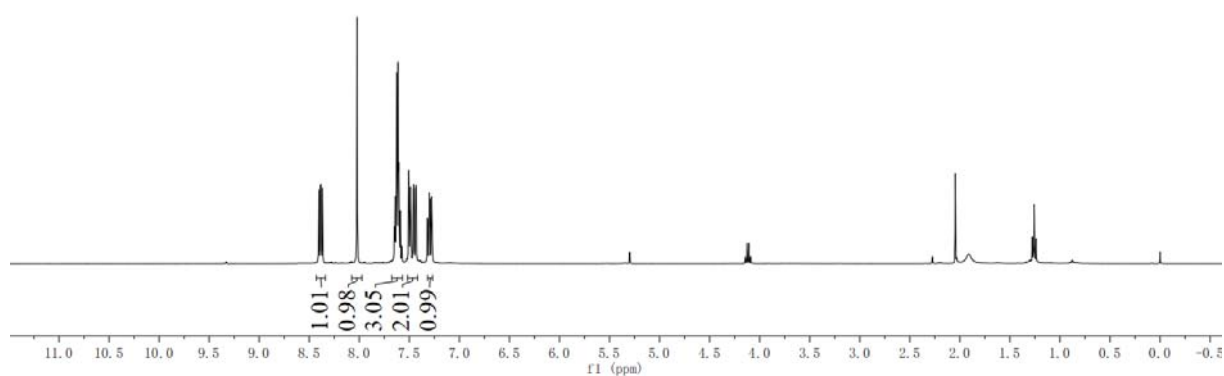
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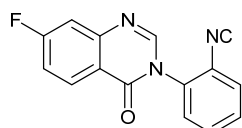
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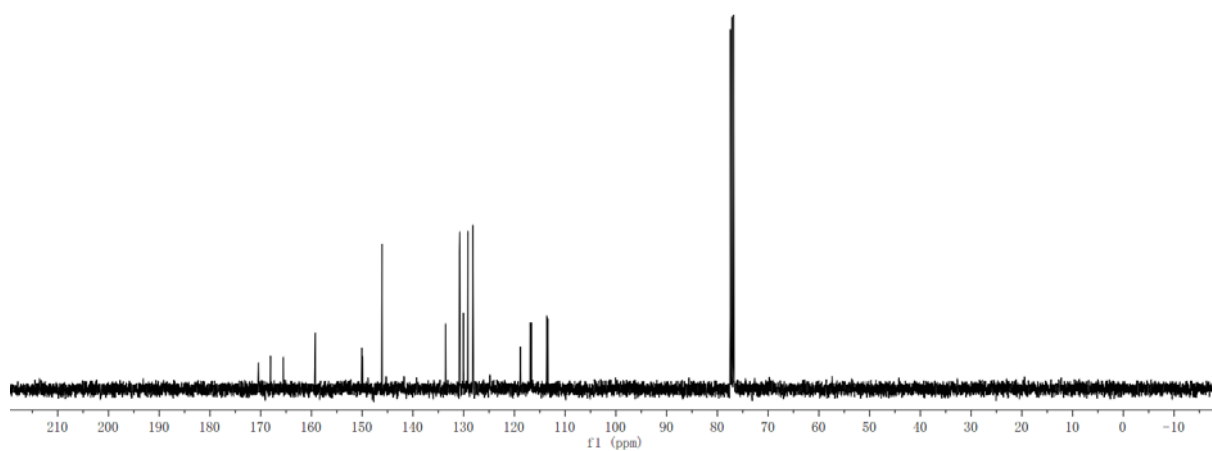
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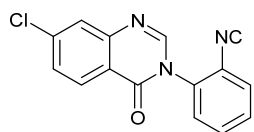
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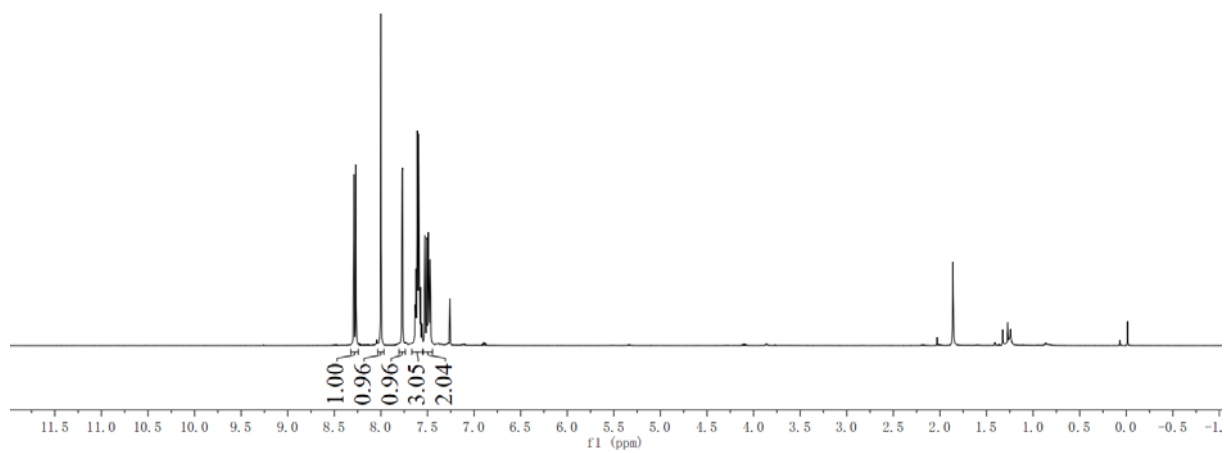
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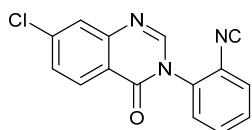
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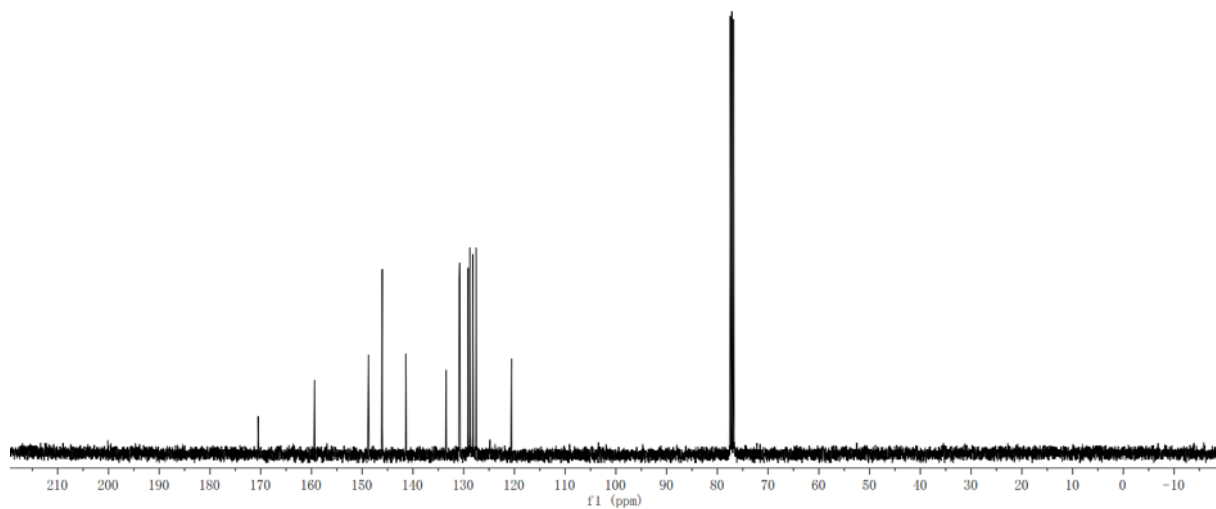
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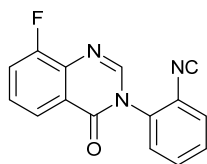
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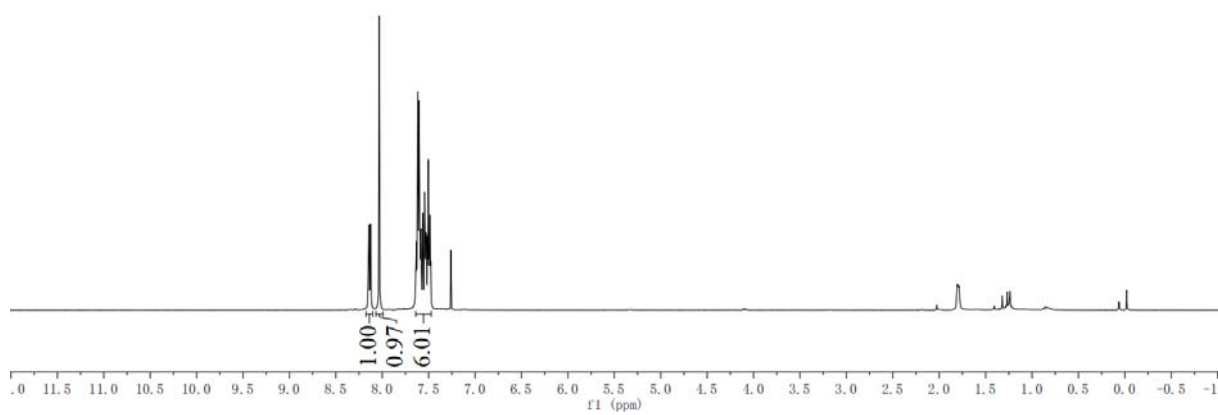
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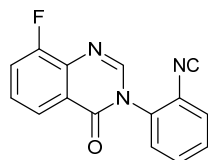
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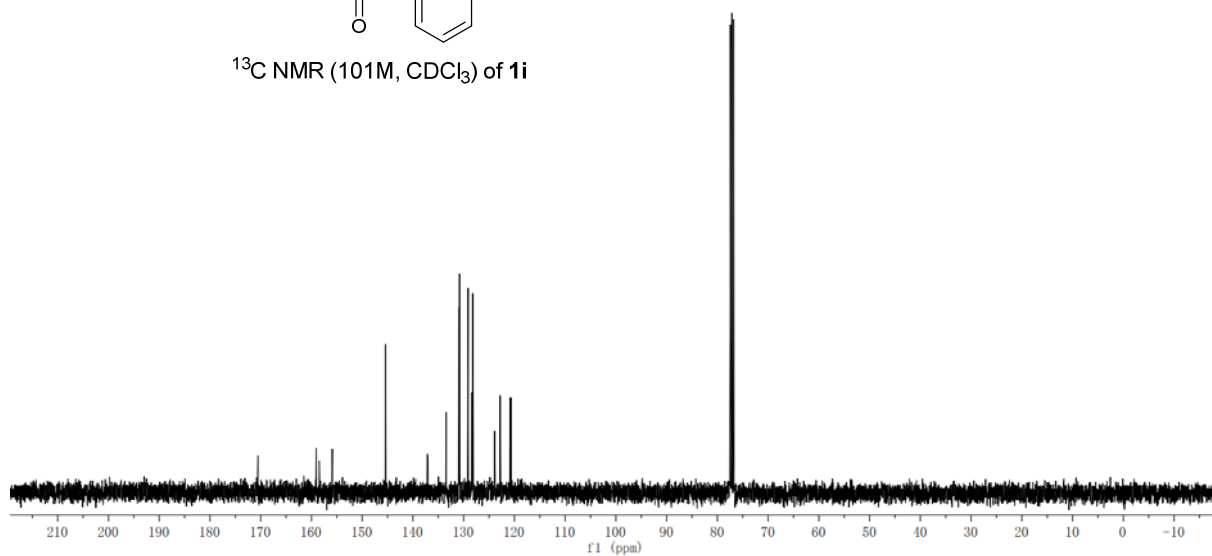
¹H NMR (400M, CDCl₃) of 1i



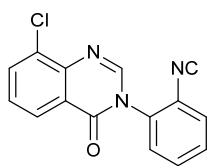
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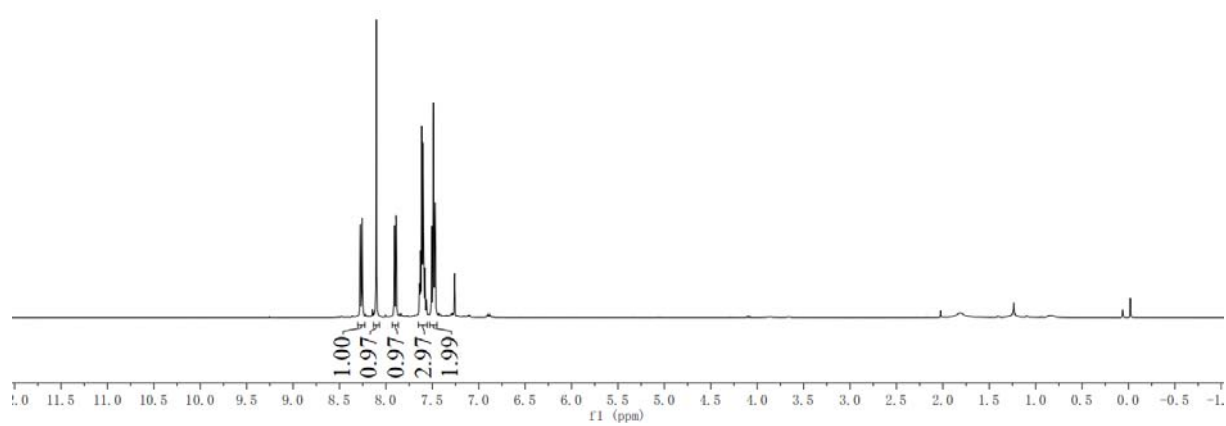
¹³C NMR (101M, CDCl₃) of 1i



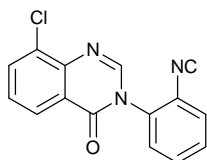
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7.4677



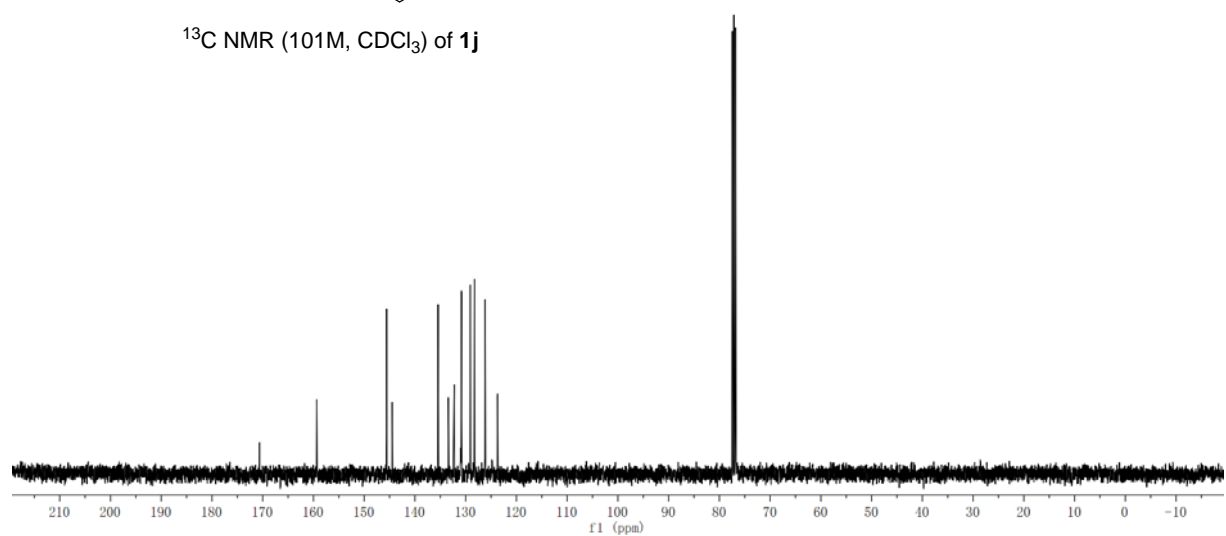
¹H NMR (400M, CDCl₃) of **1j**



170.62
159.35
145.57
144.47
135.44
133.41
132.24
130.95
130.83
129.08
128.26
128.23
126.16
124.84
123.71
77.44
77.13
76.81

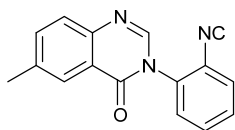


¹³C NMR (101M, CDCl₃) of **1j**

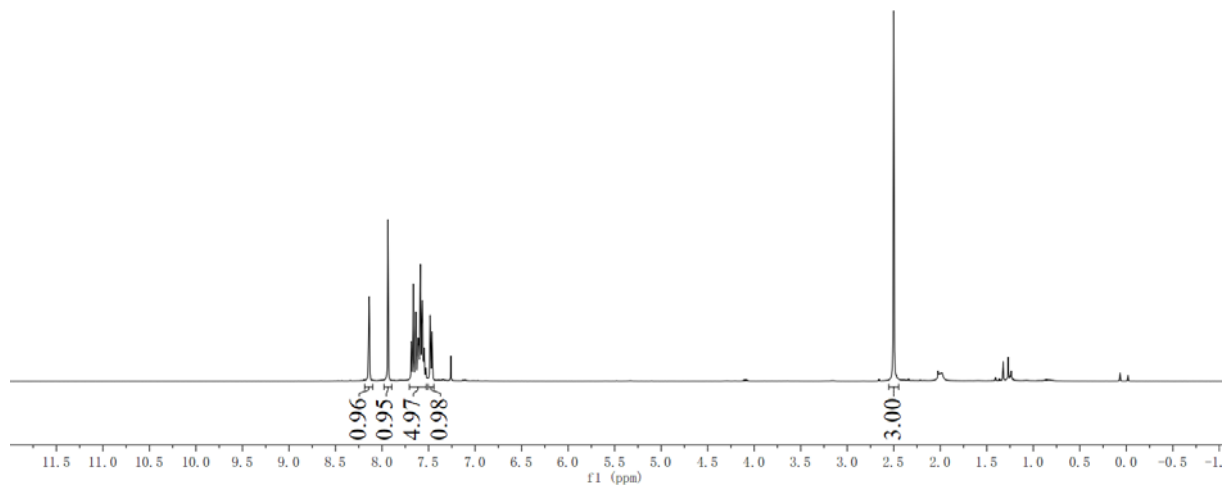


8.1384
7.9362
7.6844
7.6638
7.5916
7.5293
7.4831
7.4747
7.4643
7.4587

-2.5004

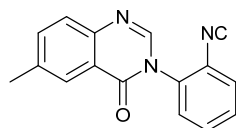


^1H NMR (400M, CDCl_3) of **1k**

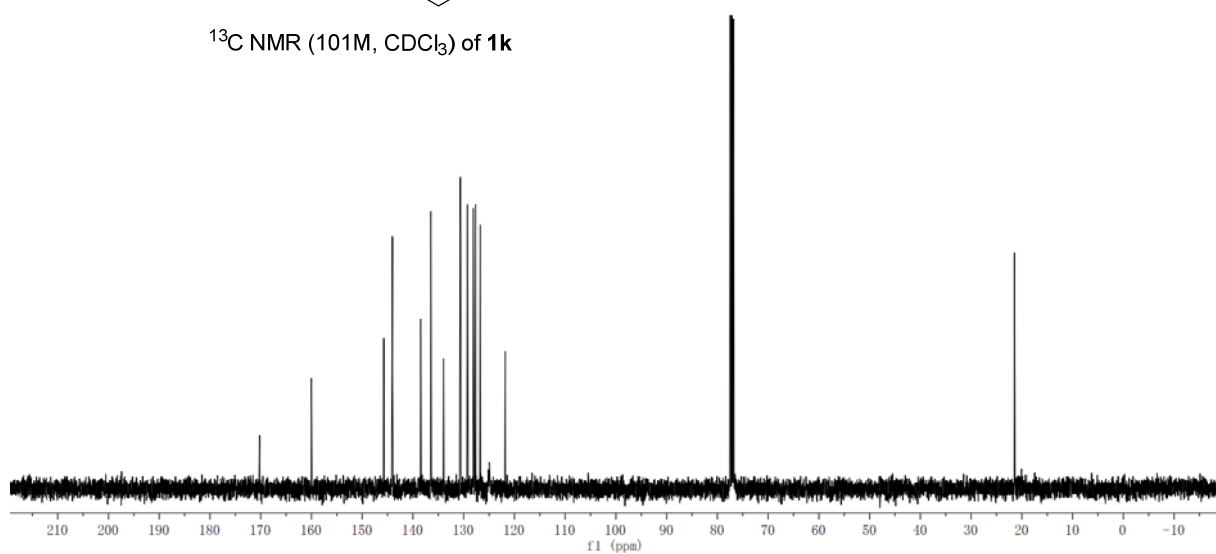


-170.23
-149.91
-145.93
-144.05
-138.46
-136.46
-133.98
-130.68
-130.59
-129.24
-128.11
-127.67
-126.74
-124.92
-121.81
77.46
77.14
76.82

-21.43

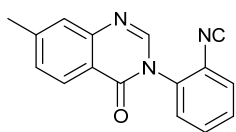


^{13}C NMR (101M, CDCl_3) of **1k**

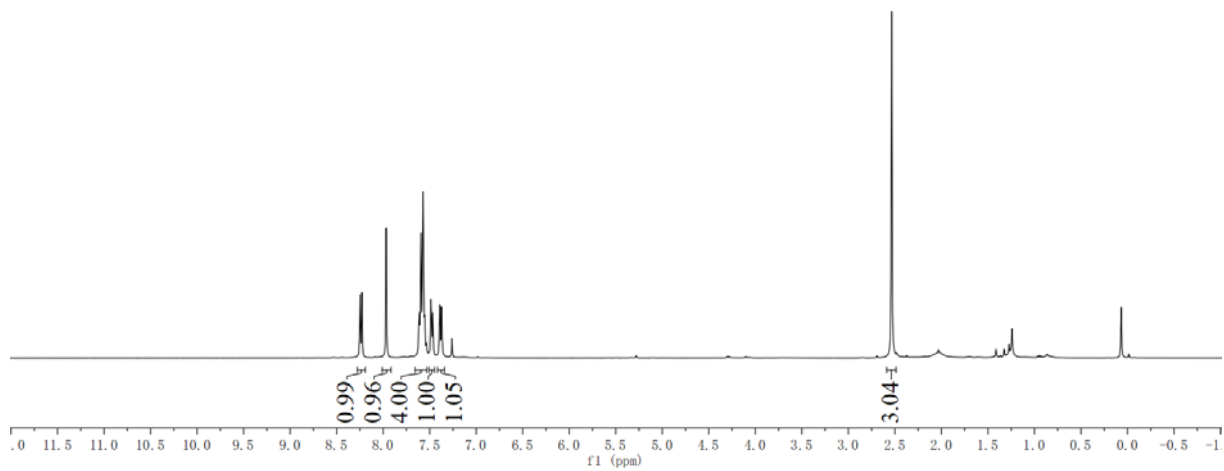


8.2488
8.2285
7.9671
7.6168
7.5945
7.5703
7.5360
7.4876
7.4824
7.4685
7.3917
7.3715

-2.5349

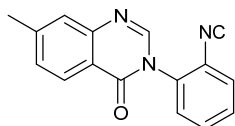


^1H NMR (400M, CDCl_3) of **11**

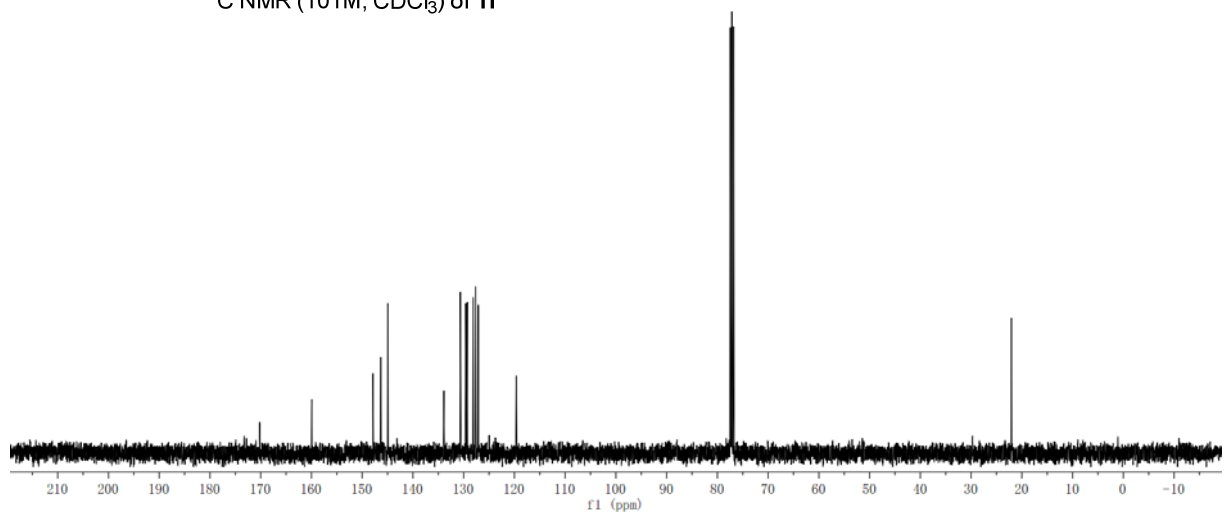


-170.21
-159.95
-147.87
-146.32
-144.92
-133.91
-130.66
-130.60
-129.58
-129.29
-128.13
-127.67
-127.12
-124.96
-119.64
-77.44
-77.12
-76.80

-22.04

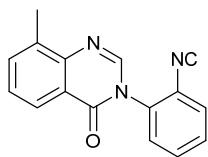


^{13}C NMR (101M, CDCl_3) of **11**

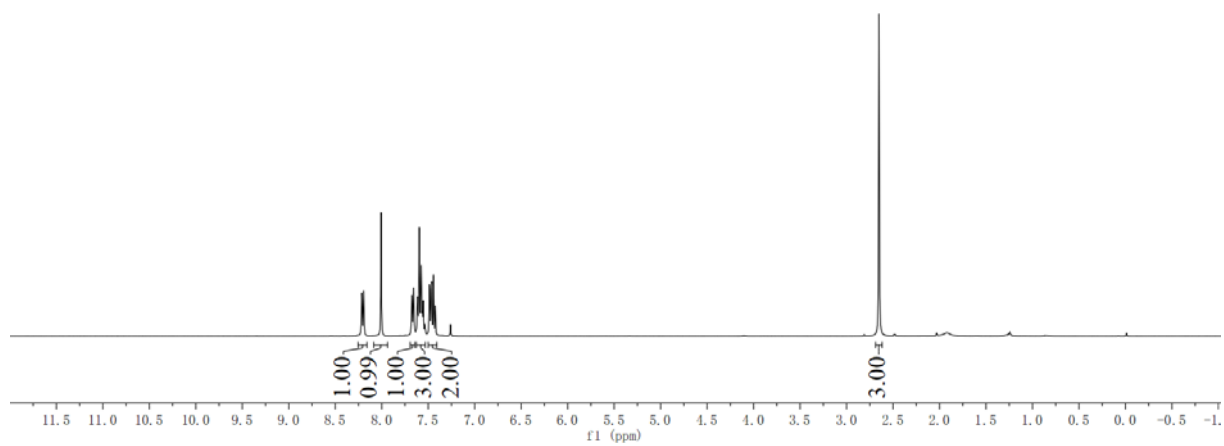


8.2166
8.2128
8.1965
8.1927
8.0072
7.6761
7.6577
7.6186
7.5965
7.5710
7.5338
7.4878
7.4621
7.4427
7.4236

-2.6514

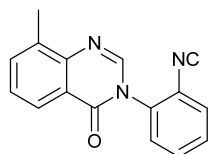


^1H NMR (400M, CDCl_3) of **1m**

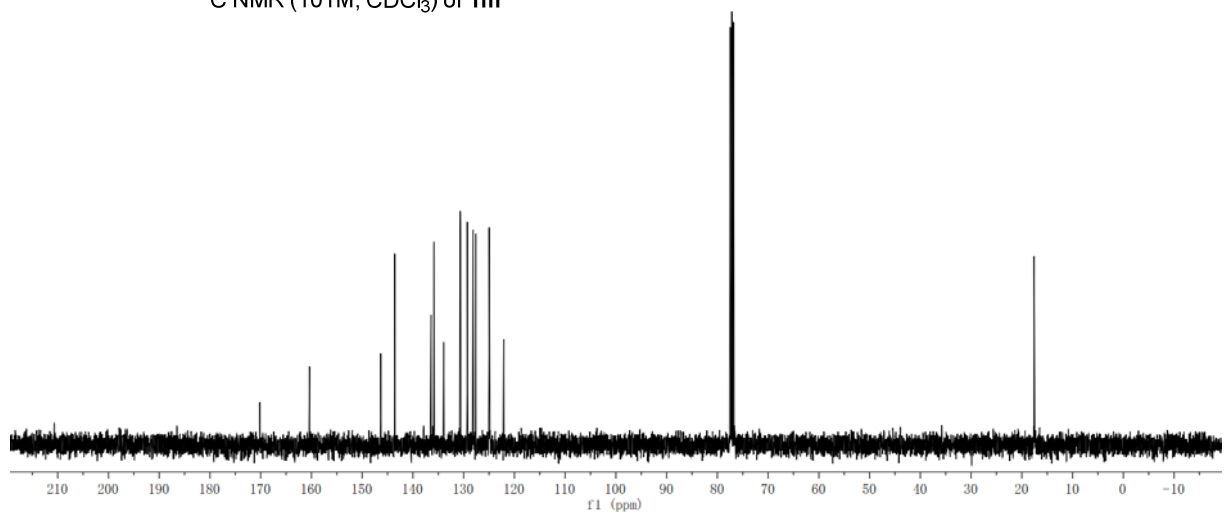


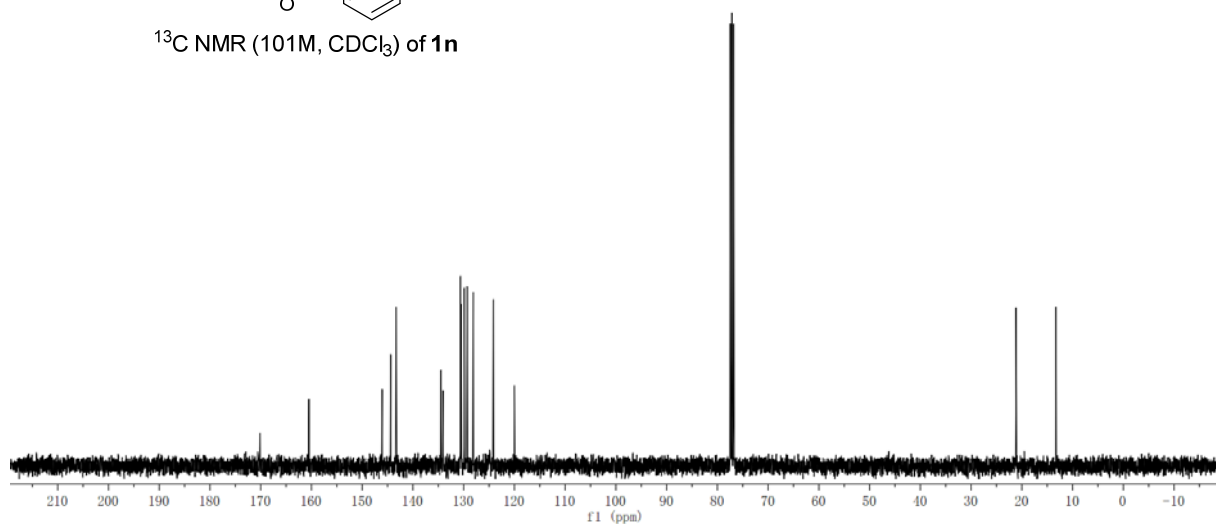
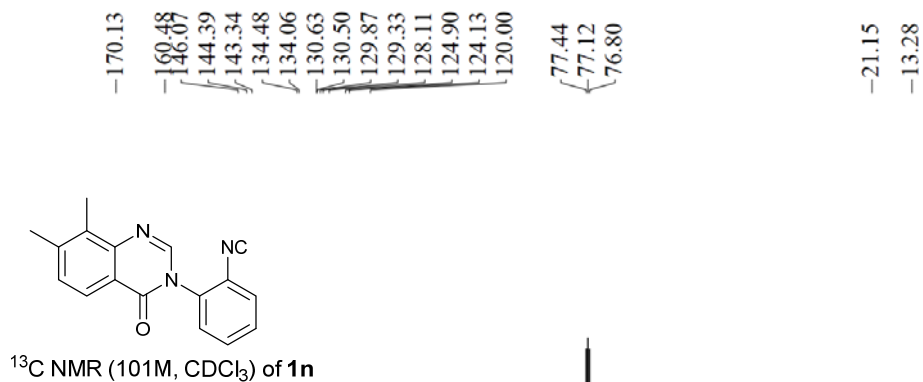
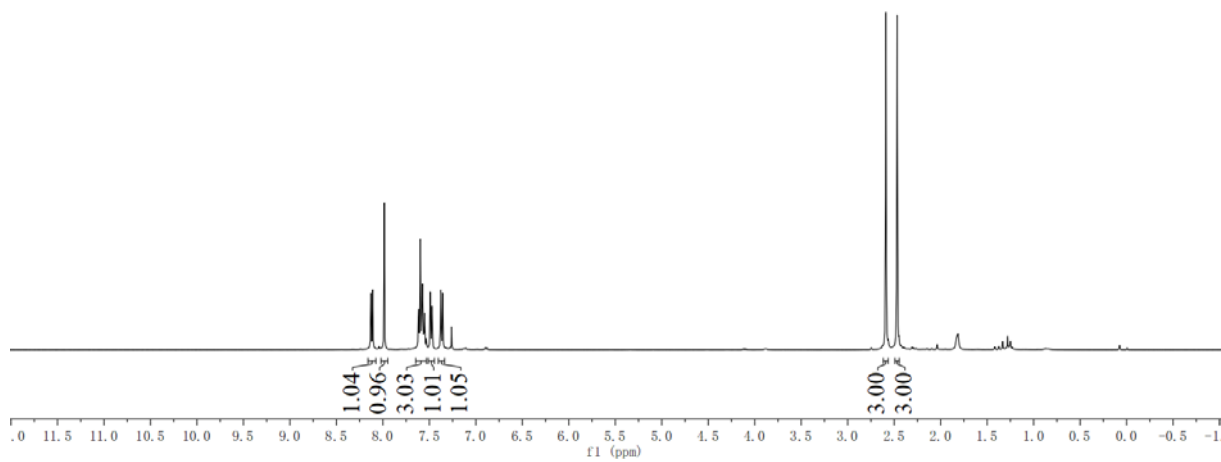
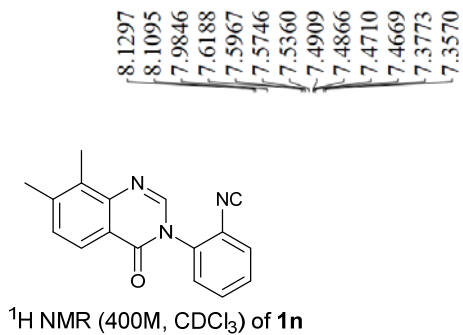
-170.17
160.38
146.34
143.57
136.42
135.84
133.95
130.70
130.61
129.27
128.14
127.64
124.96
123.80
122.11
77.47
77.15
76.83

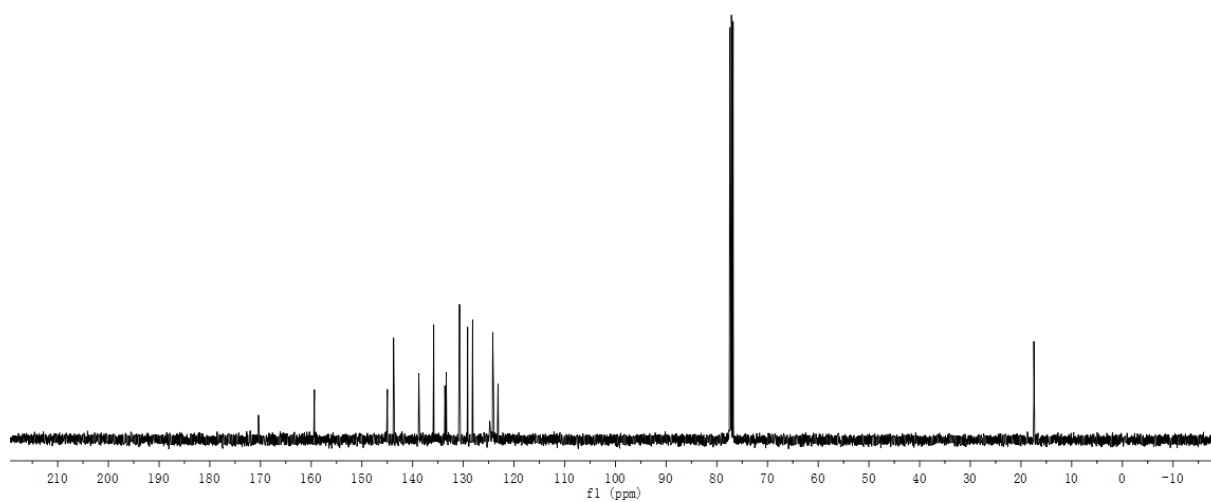
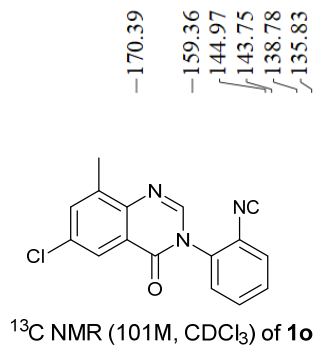
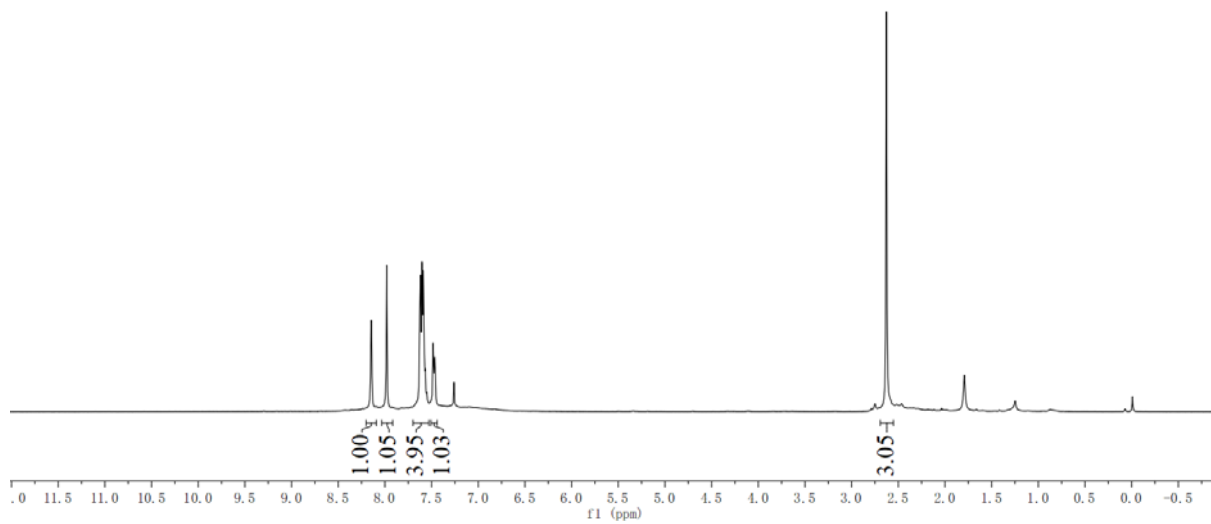
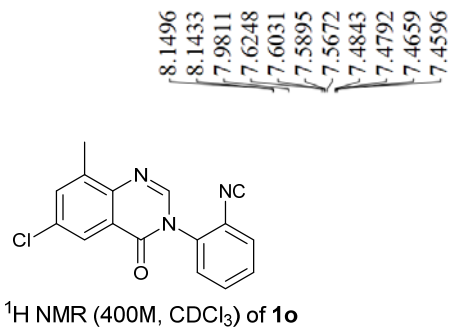
-17.59



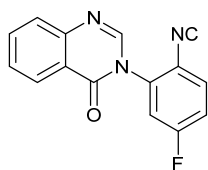
^{13}C NMR (101M, CDCl_3) of **1m**



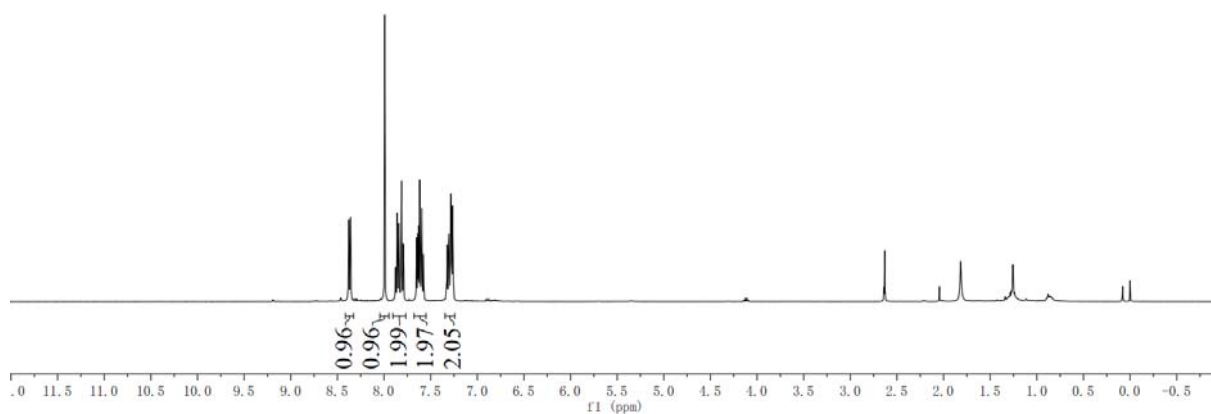




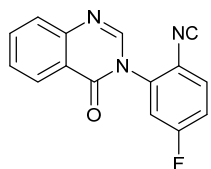
8.3808
8.3769
8.3609
8.3570
7.9924
7.8794
7.8551
7.8114
7.7911
7.6521
7.6302
7.5991
7.5756
7.3291
7.3106
7.2847
7.2583



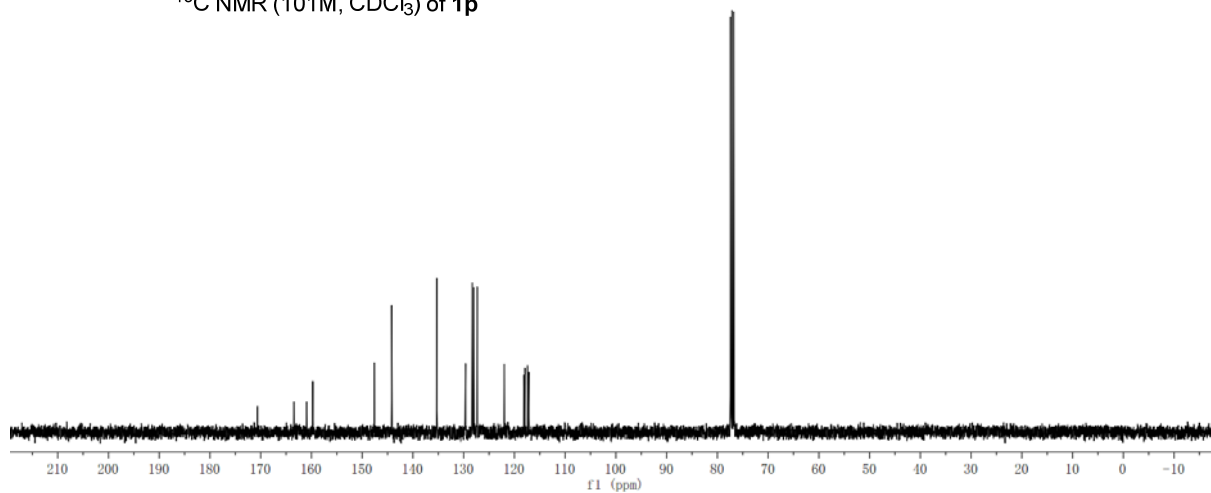
$^1\text{H NMR}$ (400M, CDCl_3) of **1p**



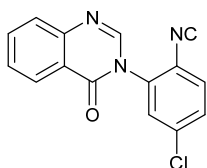
170.633
163.476
160.932
159.744
147.626
144.187
135.403
135.302
129.725
129.631
128.288
127.997
127.327
121.984
118.149
117.920
117.395
117.145
77.407
77.090
76.771



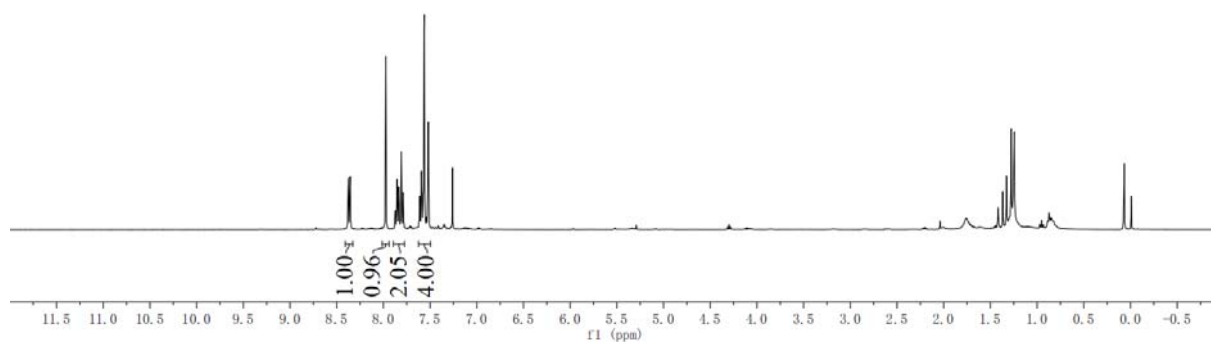
$^{13}\text{C NMR}$ (101M, CDCl_3) of **1p**



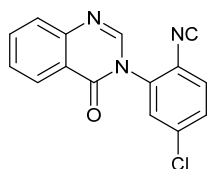
8.3785
8.3750
8.3584
8.3549
7.9745
7.8752
7.8333
7.8106
7.7868
7.6135
7.5931
7.5223
7.5157



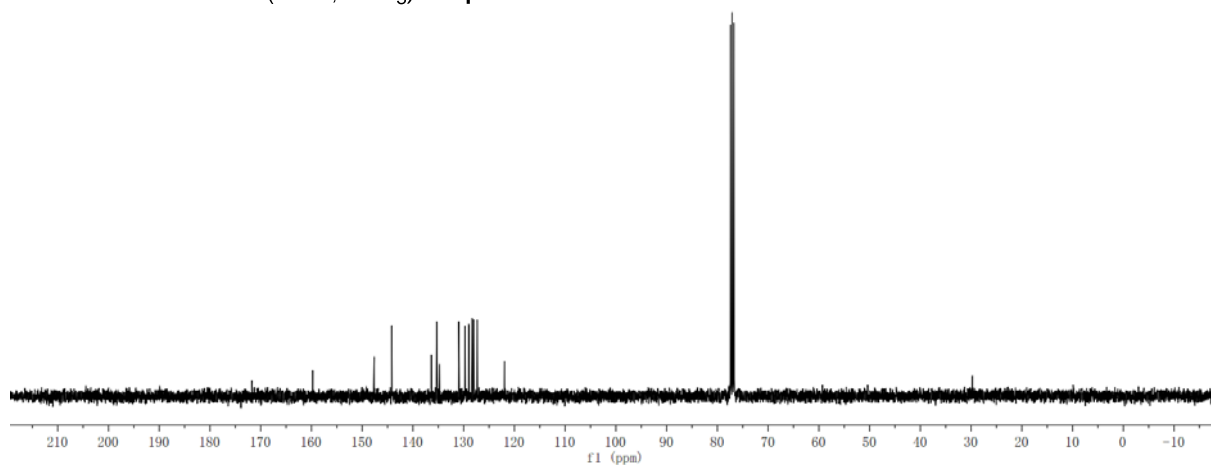
^1H NMR (400M, CDCl_3) of **1q**



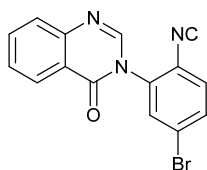
-171.74
-159.77
147.64
144.17
136.38
135.32
134.76
130.96
129.71
128.98
128.31
128.01
127.34
121.96
77.39
77.07
76.76



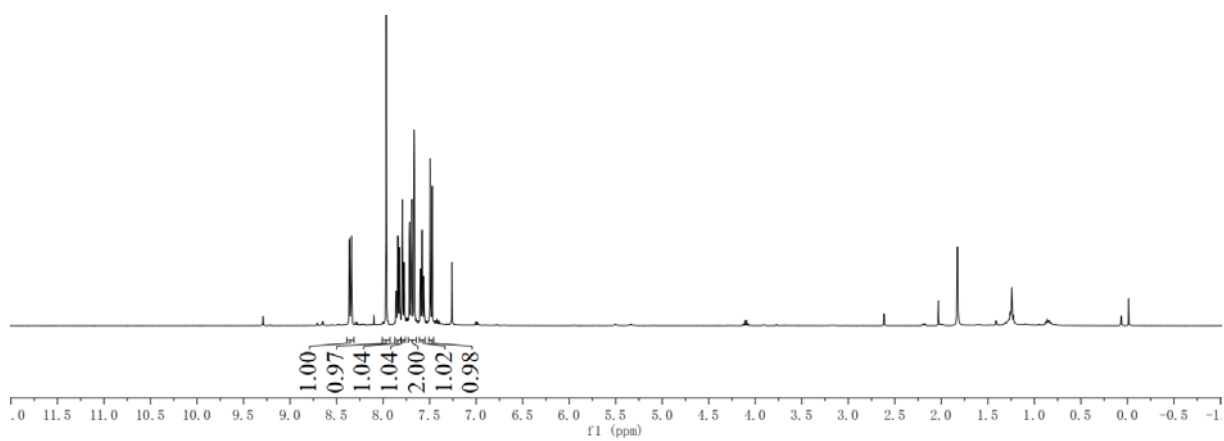
^{13}C NMR (101M, CDCl_3) of **1q**



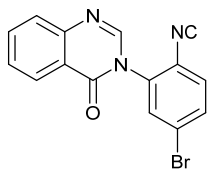
8.3627
8.3587
8.3428
8.3391
7.9657
7.8628
7.8453
7.8247
7.8209
7.7961
7.7929
7.7758
7.7726
7.7184
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7.6919
7.6632
7.6005
7.5971
7.5632
7.5597
7.4937
7.4725



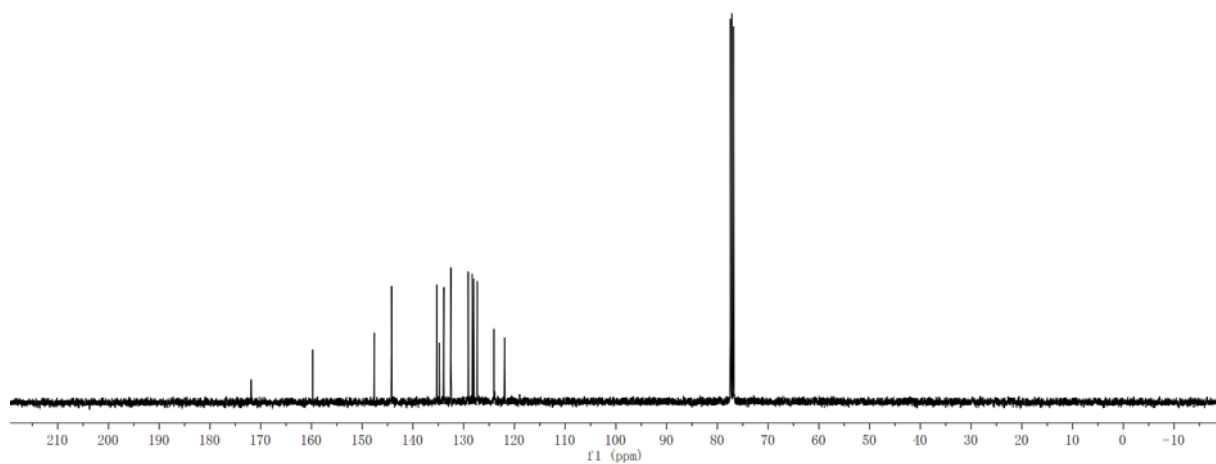
$^1\text{H NMR}$ (400M, CDCl_3) of **1r**



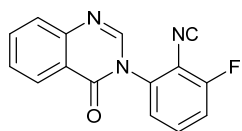
-171.91
-159.77
-147.62
-144.19
-135.31
-134.78
-133.91
-132.52
-129.10
-128.30
-128.00
-127.33
-124.02
-123.88
-121.94
77.42
77.11
76.79



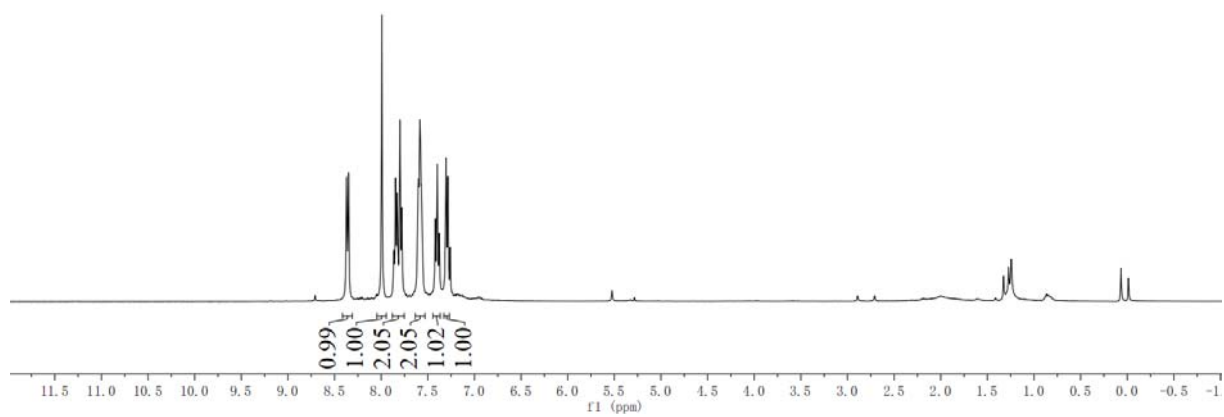
$^{13}\text{C NMR}$ (101M, CDCl_3) of **1r**



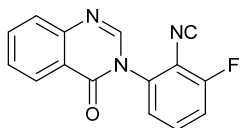
8.3705
8.3506
7.9929
7.8652
7.8455
7.7992
7.7790
7.6127
7.5919
7.5785
7.5568
7.4197
7.3984
7.3772
7.3056
7.2854



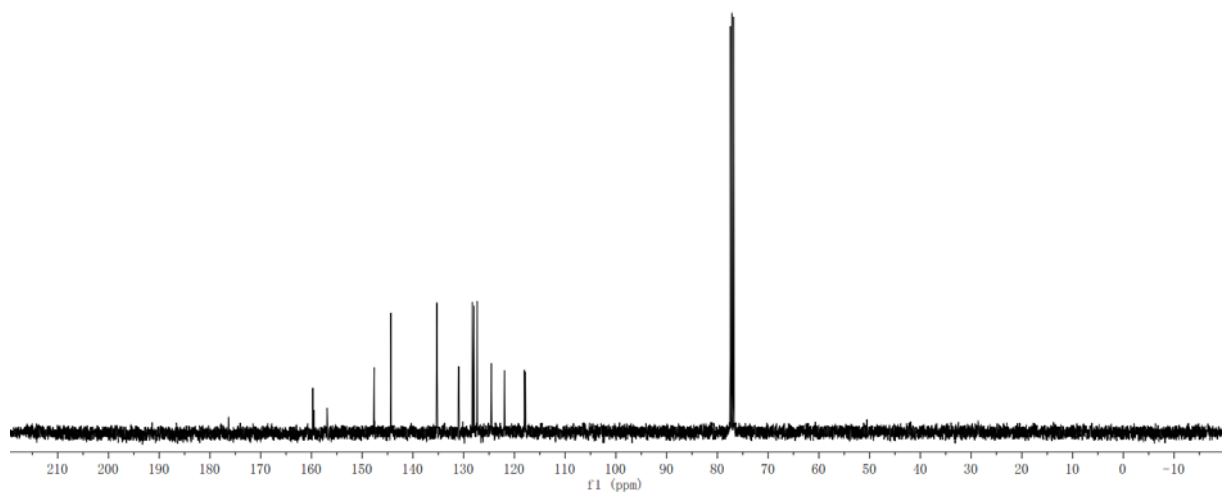
^1H NMR (400M, CDCl_3) of **1s**



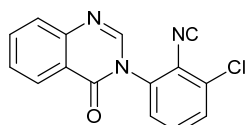
-176.290
159.735
159.491
156.905
147.643
144.341
135.287
135.178
131.031
130.943
128.282
127.958
127.346
124.561
124.525
121.961
118.026
117.839
77.419
77.100
76.783



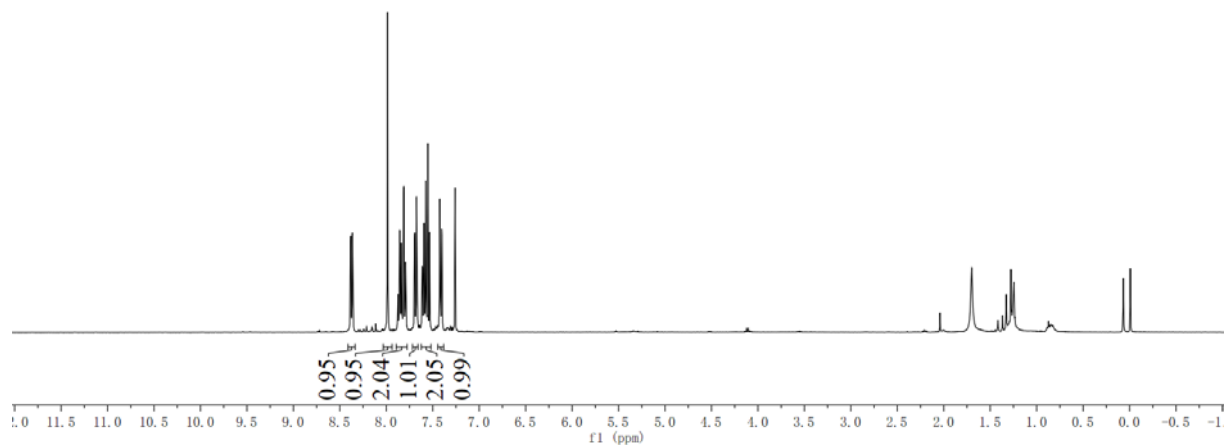
^{13}C NMR (101M, CDCl_3) of **1s**



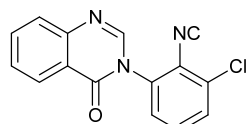
8.3848
8.3810
8.3648
8.3609
7.9860
7.8767
7.8387
7.8103
7.7901
7.6961
7.6927
7.6754
7.6720
7.6148
7.5973
7.5535
7.5330
7.4245
7.4212
7.4045
7.4013



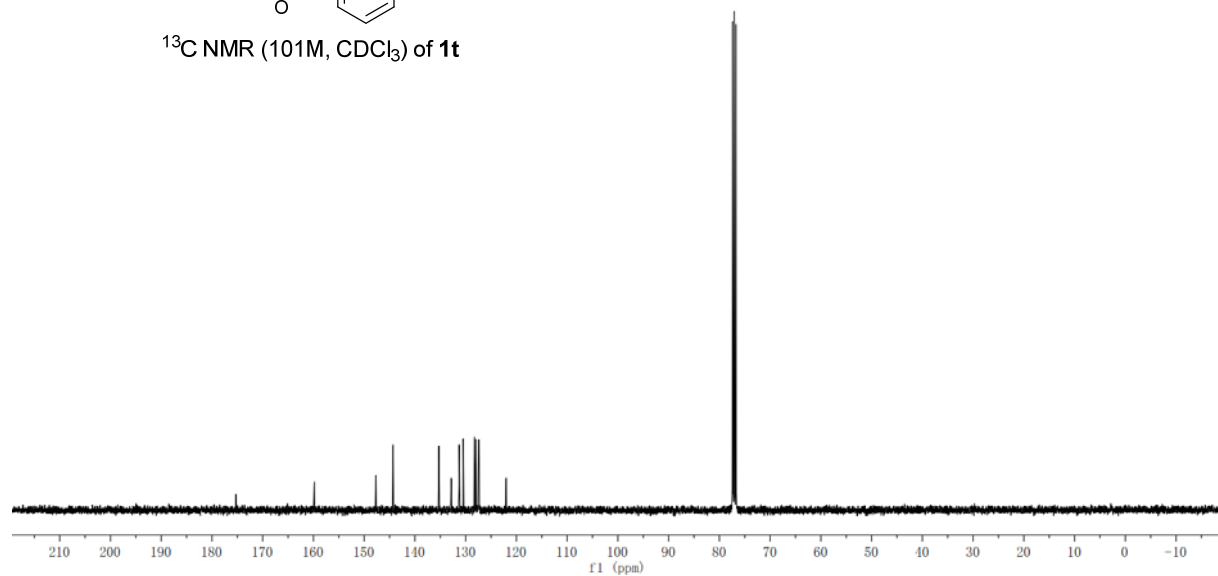
$^1\text{H NMR}$ (400M, CDCl_3) of **1t**



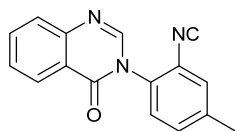
-175.30
-159.81
147.68
144.31
135.32
135.28
132.84
131.27
130.49
128.27
127.98
127.47
127.36
122.01
77.38
77.07
76.75



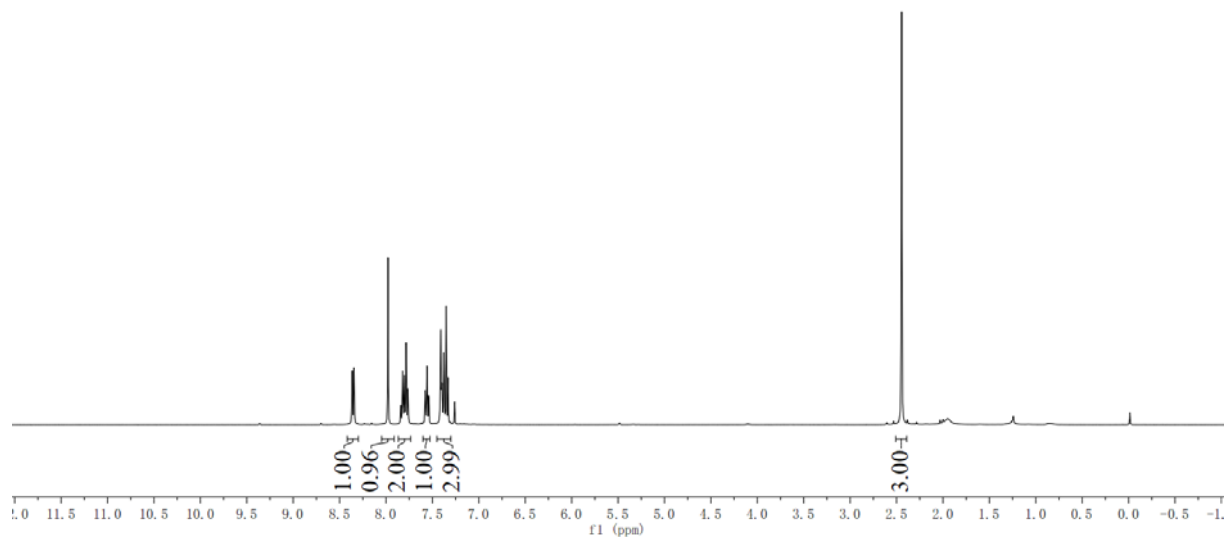
$^{13}\text{C NMR}$ (101M, CDCl_3) of **1t**



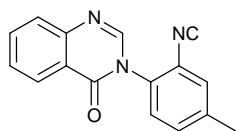
8.3665
8.3627
8.3464
8.3428
7.9785
7.8420
7.8177
7.8005
7.7613
7.5789
7.5752
7.5416
7.5379
7.4134
7.3742
7.3516
7.3315



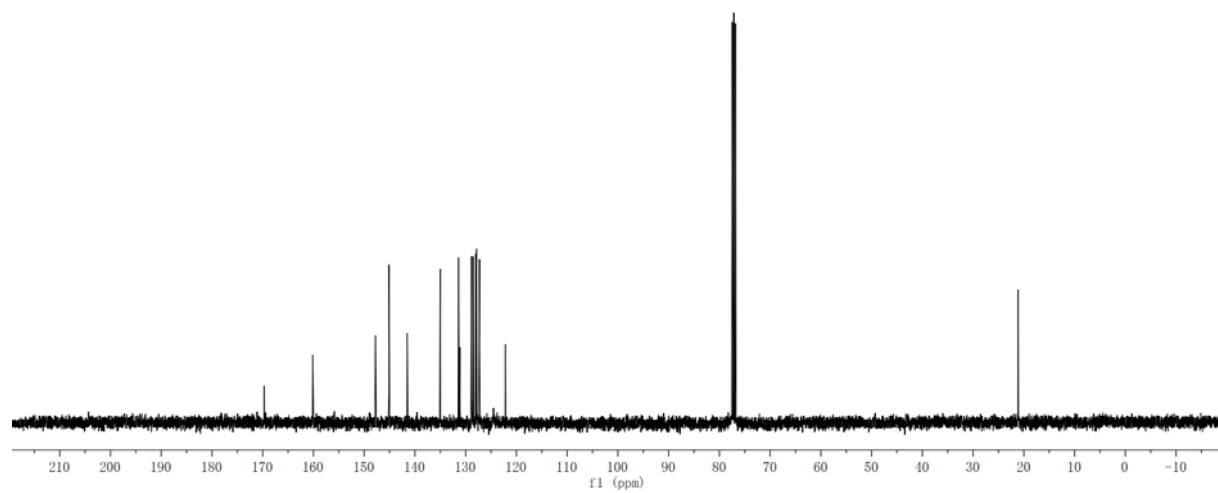
^1H NMR (400M, CDCl_3) of **1u**

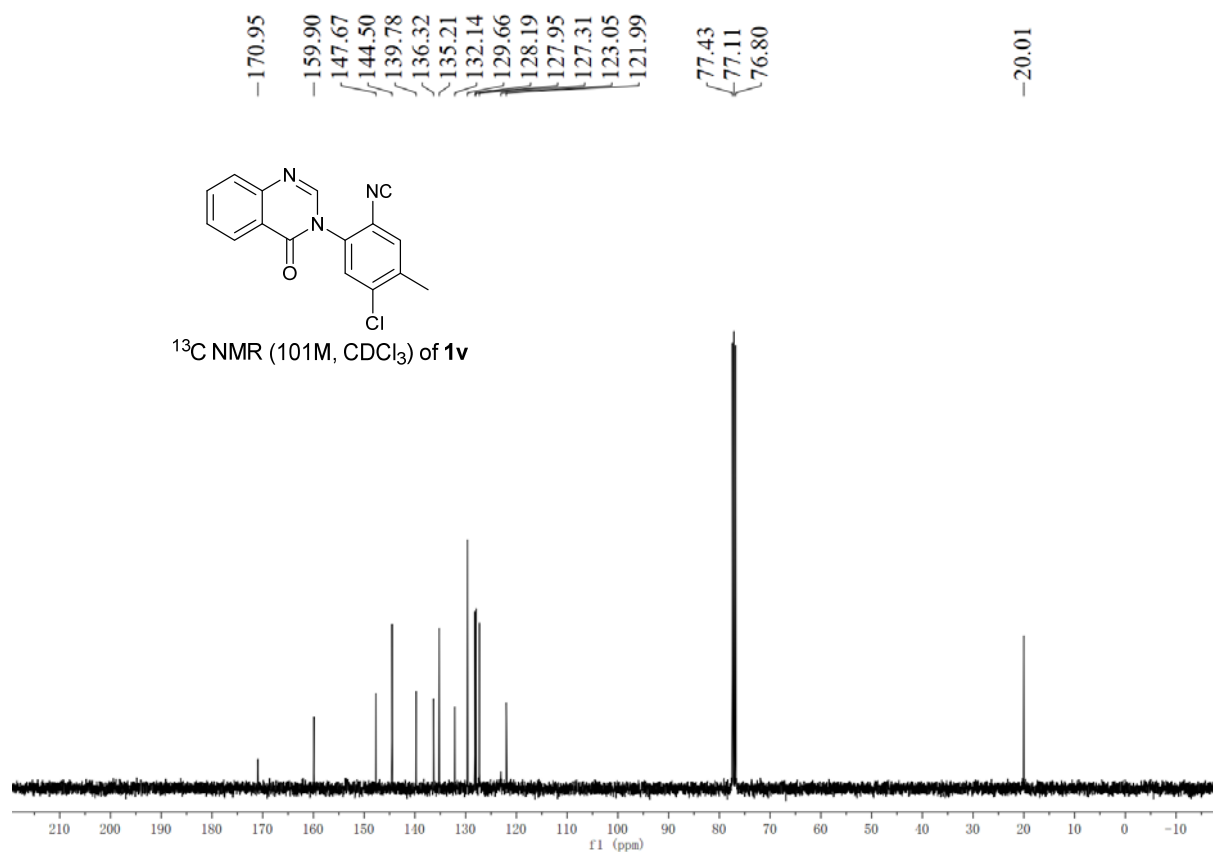
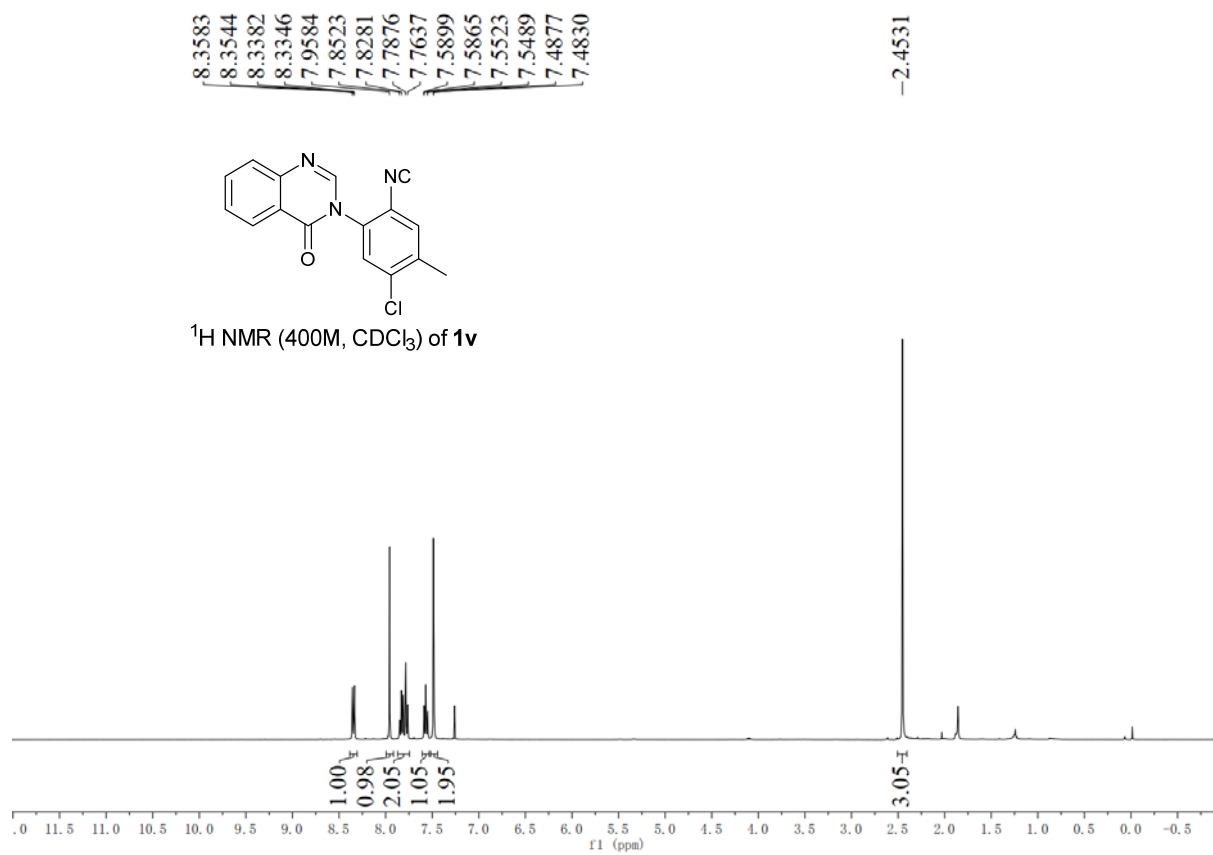


169.69
147.80
145.11
141.52
135.01
131.39
131.15
128.84
128.46
128.00
127.85
127.29
122.15
77.44
77.12
76.81
21.11

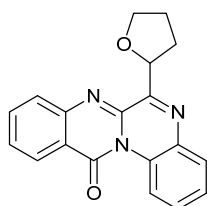


^{13}C NMR (101M, CDCl_3) of **1u**

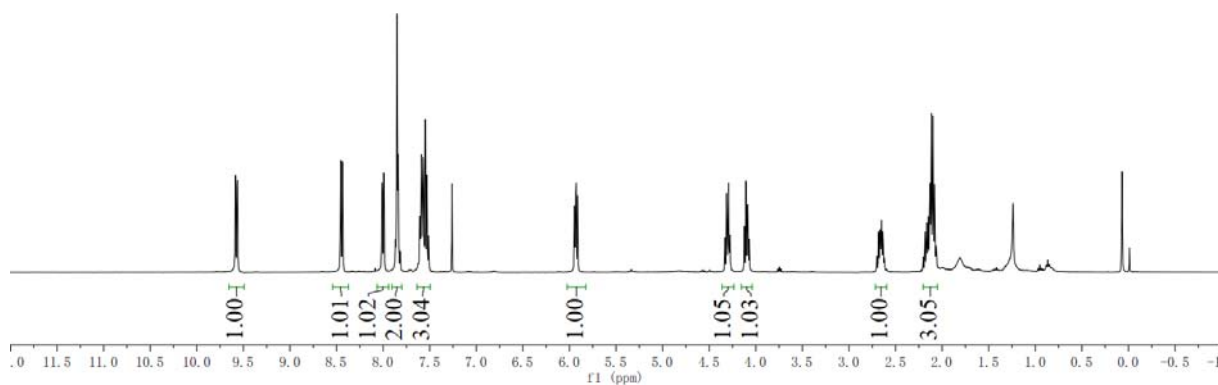




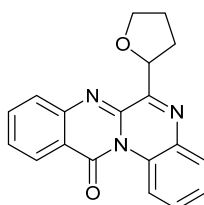
9.5860
9.5817
9.5657
9.5614
8.4574
8.4547
8.4366
8.4337
8.0128
8.0074
7.9942
7.9888
7.8665
7.8521
7.8351
7.8144
7.6082
7.5824
7.5502
7.5080
5.9463
5.9323
5.9271
5.9123
4.3301
4.3136
4.2932
4.2765
4.1232
4.1061
4.0856
4.0696
2.7014
2.6827
2.6515
2.1683
2.1155
2.0612



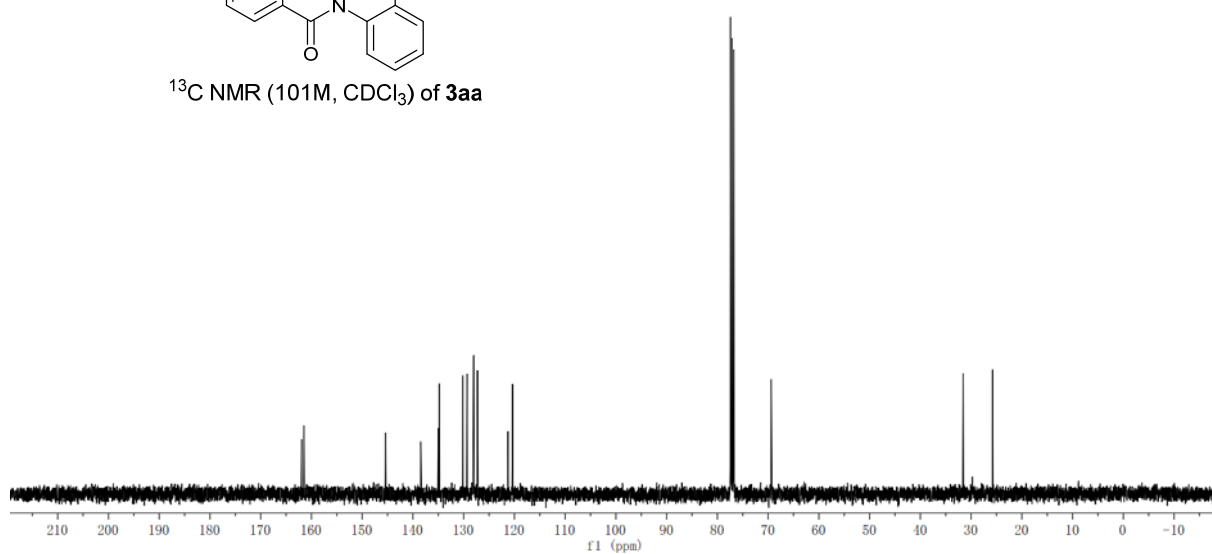
$^1\text{H NMR}$ (400M, CDCl_3) of 3aa



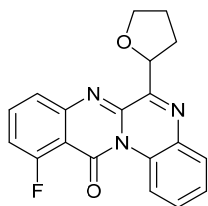
161.93
161.50
145.38
138.46
135.00
134.78
130.16
129.33
128.13
128.01
127.99
127.31
127.25
121.26
120.36
77.40
77.28
77.08
76.77
69.39
-31.54
-25.74



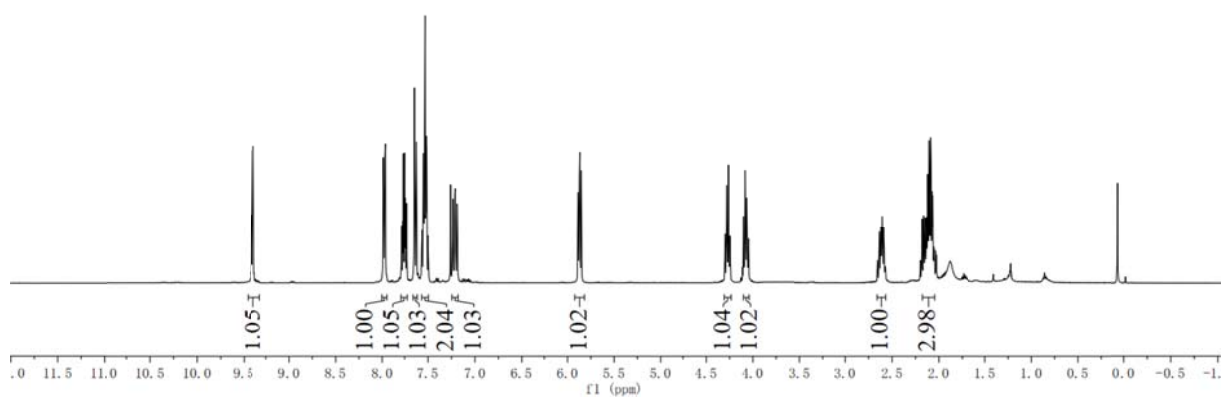
$^{13}\text{C NMR}$ (101M, CDCl_3) of 3aa



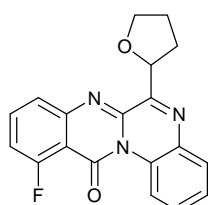
9.4123
9.4066
9.3911
9.3872
7.9896
7.9848
7.9815
7.9657
7.7824
7.7487
7.7415
7.7284
7.6472
7.6428
7.6264
7.6222
7.5496
7.5002
7.2375
7.2173
7.2078
7.1877
5.8869
5.8730
5.8677
5.8527
4.2987
4.2653
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4.0995
4.0660
4.0612
4.0459
2.6358
2.5901
2.5842
2.1067



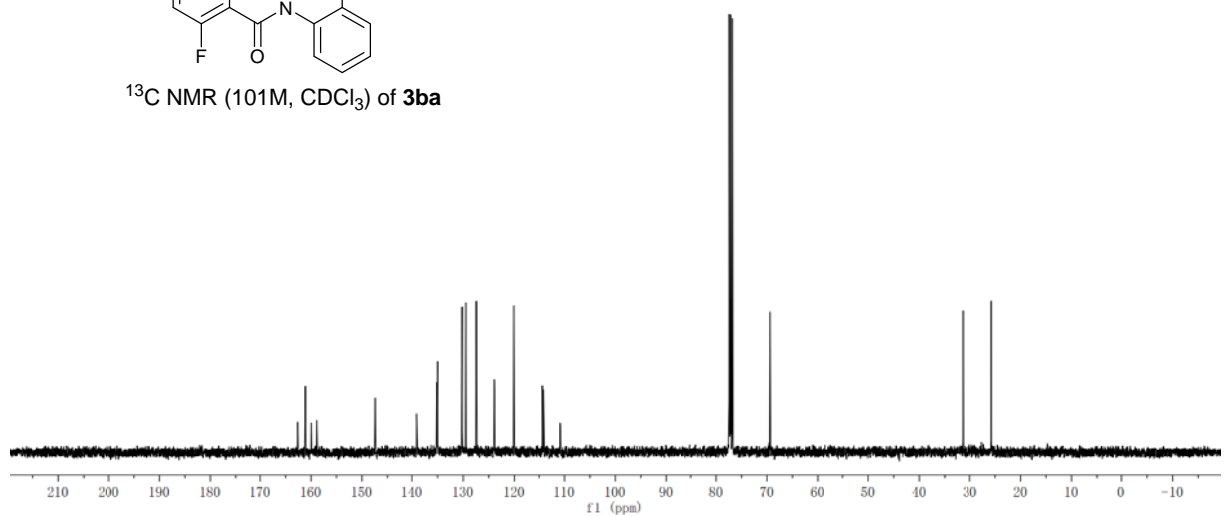
^1H NMR (400M, CDCl_3) of 3ba



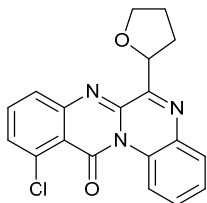
162.623
161.121
159.965
158.887
158.839
147.380
139.074
135.162
135.057
134.995
130.224
129.499
127.477
127.428
123.945
123.901
120.129
114.344
114.135
110.867
110.815
77.416
77.240
77.098
76.780
69.396
-31.415
-25.743



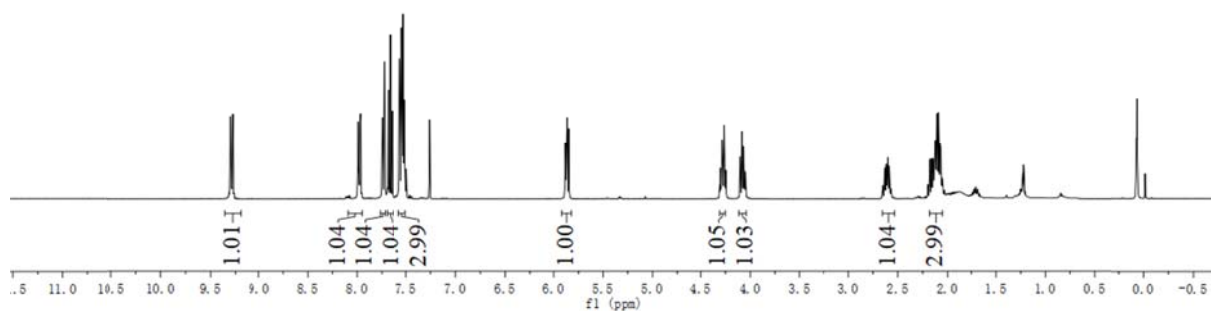
^{13}C NMR (101M, CDCl_3) of 3ba



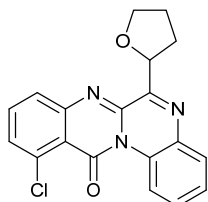
9.3017
9.2961
9.2808
9.2768
7.9901
7.9853
7.9727
7.9661
7.7465
7.7432
7.7261
7.7227
7.6833
7.6639
7.6437
7.5641
7.5334
7.5192
7.5102
5.8822
5.8684
5.8630
5.8480
4.3089
4.2921
4.2677
4.2468
4.1024
4.0815
4.0689
4.0488
2.6511
2.6210
2.5871
2.1965
2.1630
2.0924
2.0502



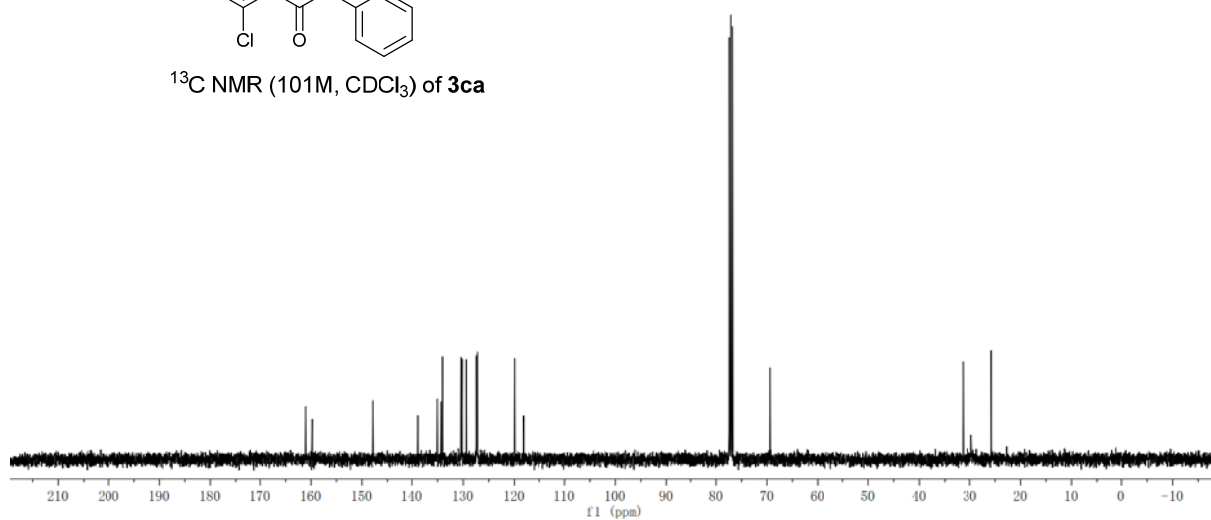
$^1\text{H NMR}$ (400M, CDCl_3) of 3ca



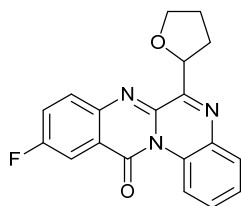
161.05
159.76
147.84
138.86
135.05
134.29
134.02
130.43
130.23
129.39
127.42
127.31
127.20
119.97
118.20
77.41
77.13
77.09
76.77
69.40
-31.41
-25.75



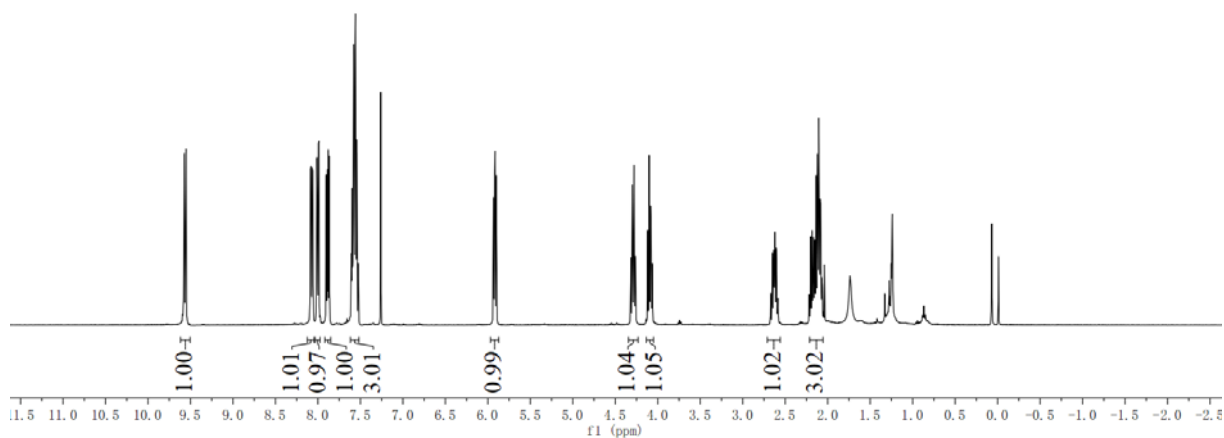
$^{13}\text{C NMR}$ (101M, CDCl_3) of 3ca



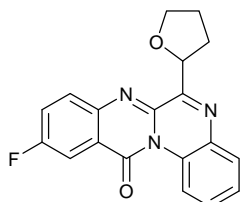
9.5776
 9.5724
 9.5565
 9.5524
 8.0887
 8.0814
 8.0674
 8.0600
 8.0124
 8.0077
 7.9945
 7.9883
 7.9021
 7.8898
 7.8797
 7.8675
 7.6056
 7.5859
 7.5584
 7.5270
 5.9339
 5.9203
 5.9147
 5.8998
 4.3167
 4.3000
 4.2968
 4.2628
 4.1187
 4.0851
 4.0805
 4.0650
 2.6706
 2.6342
 2.6059
 2.5870
 2.2185
 2.1625
 2.1171
 2.0639



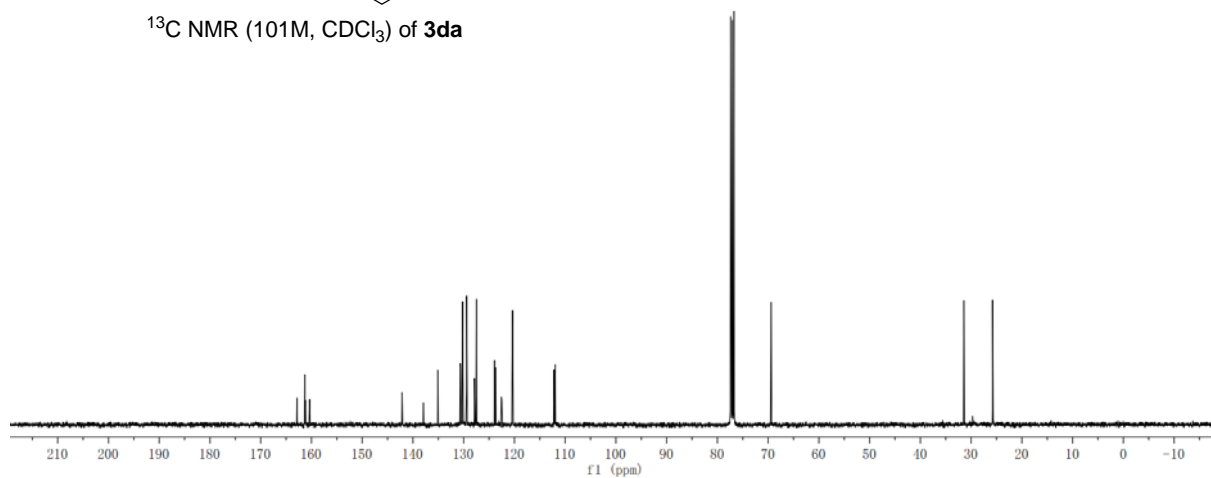
¹H NMR (400M, CDCl₃) of **3da**



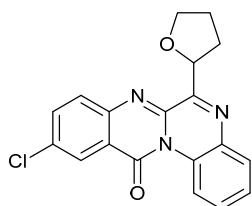
162.860
 161.329
 161.177
 161.139
 160.367
 142.135
 142.115
 137.959
 137.937
 135.071
 130.670
 130.588
 130.210
 129.424
 127.884
 127.485
 123.934
 123.692
 122.584
 122.497
 120.369
 112.211
 111.971
 77.377
 77.281
 77.062
 76.742
 69.394
 -31.408
 -25.759



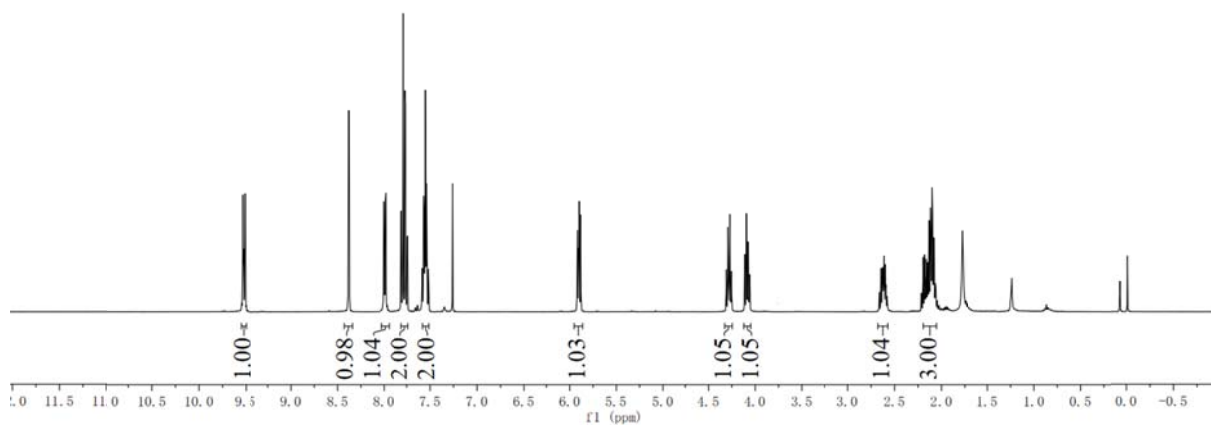
¹³C NMR (101M, CDCl₃) of **3da**



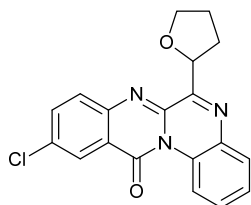
9.5356
 9.5301
 9.5145
 9.5106
 8.3827
 8.3811
 8.3768
 8.3754
 8.0052
 8.0004
 7.9876
 7.9812
 7.8092
 7.8077
 7.7462
 7.7405
 7.5882
 7.5442
 7.5201
 7.5157
 5.9174
 5.9037
 5.8981
 5.8832
 4.3093
 4.2925
 4.2892
 4.2552
 4.1123
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 4.0736
 4.0587
 2.6631
 2.6442
 2.6325
 2.1662
 2.1128
 0.0508



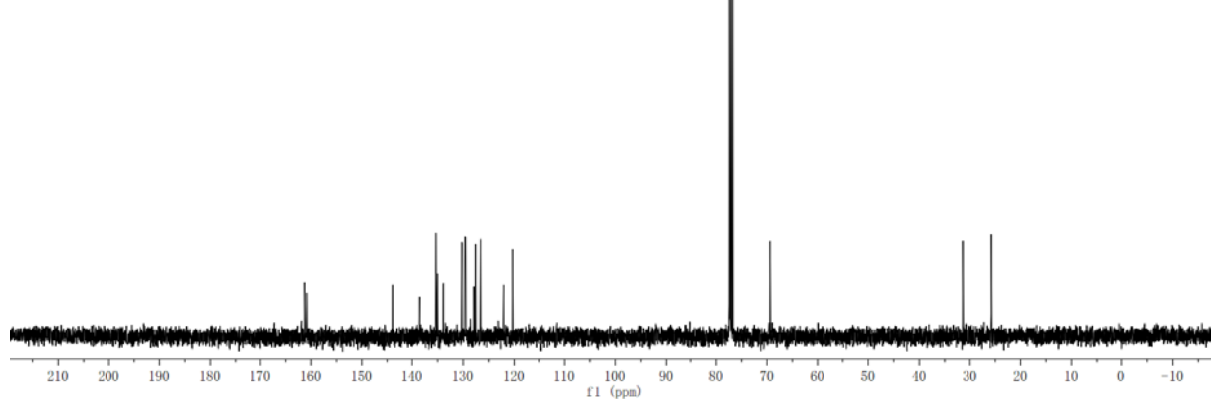
¹H NMR (400M, CDCl₃) of 3ea



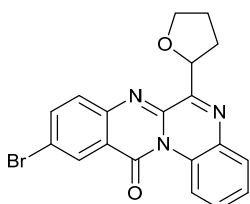
161.26
 160.87
 143.86
 138.52
 135.34
 135.03
 133.86
 130.24
 129.66
 129.52
 127.89
 127.55
 126.59
 122.11
 120.32
 77.40
 77.28
 77.08
 76.76
 69.41
 -31.43
 -25.76



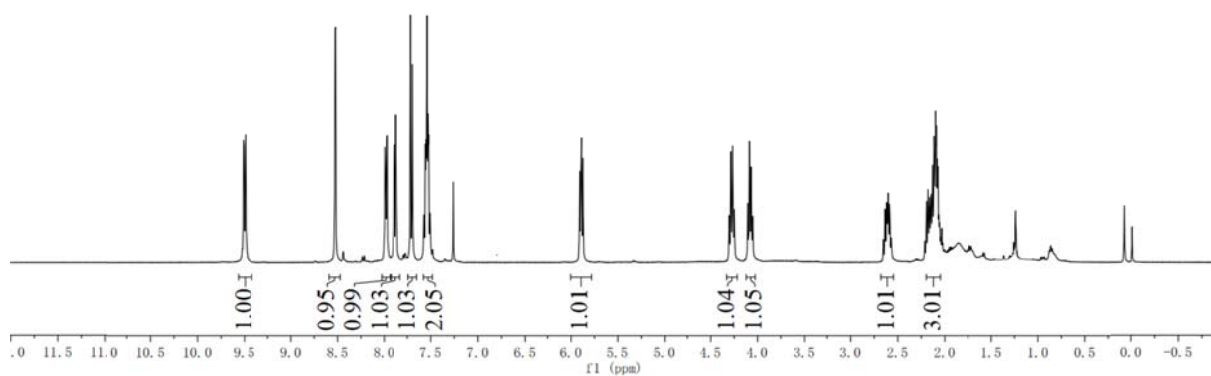
¹³C NMR (101M, CDCl₃) of 3ea



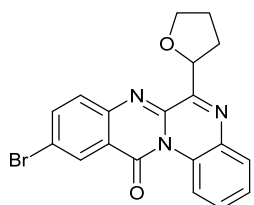
9.5119
9.5062
9.4912
9.4870
8.5280
8.5224
7.9942
7.9892
7.9769
7.9703
7.8947
7.8889
7.8729
7.8672
7.7157
7.6940
7.5753
7.5699
7.5084
7.5030
5.9078
5.8941
5.8886
5.8738
4.3022
4.2840
4.2658
4.2482
4.1050
4.0873
4.0515
2.6340
2.5881
2.5696
2.1954
2.1150
2.1082
0.0334



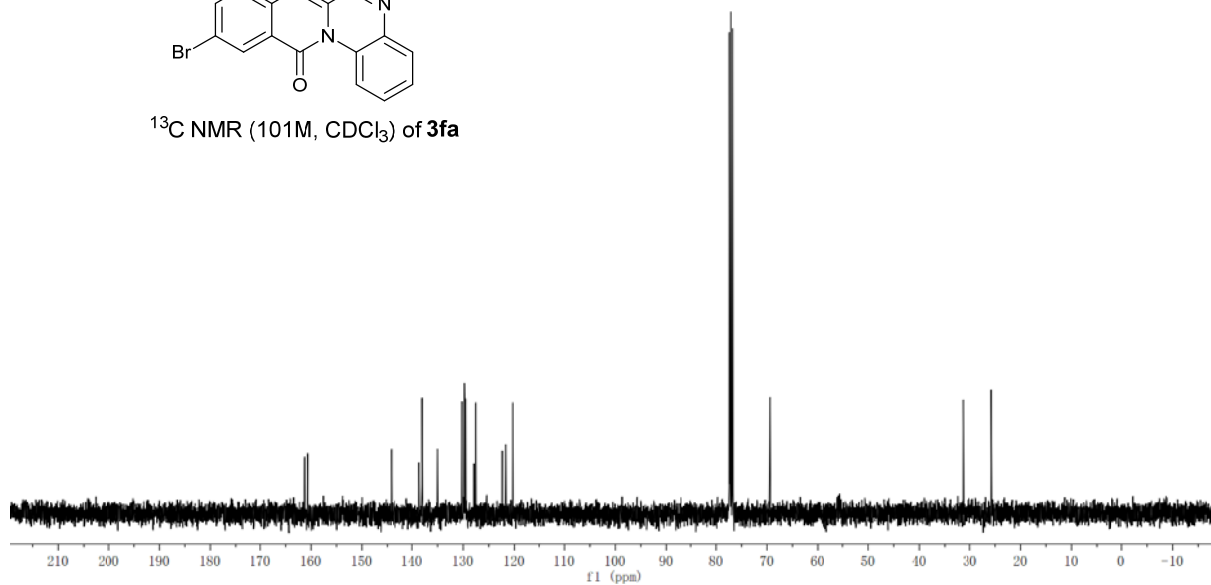
$^1\text{H NMR}$ (400M, CDCl_3) of **3fa**

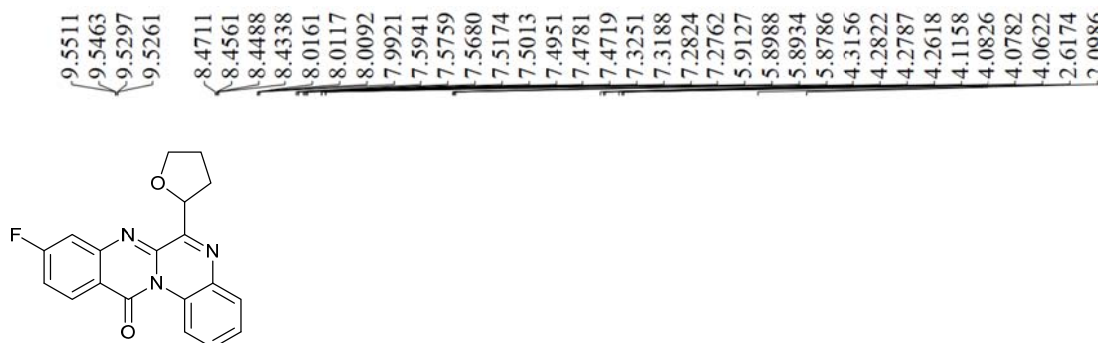


161.25
160.68
144.17
138.63
138.03
135.03
130.24
129.78
129.73
129.51
127.89
127.54
122.38
121.68
120.30
77.40
77.26
77.08
76.76
69.39
-31.41
-25.76

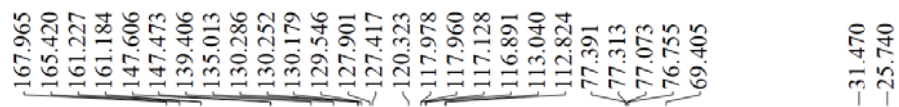
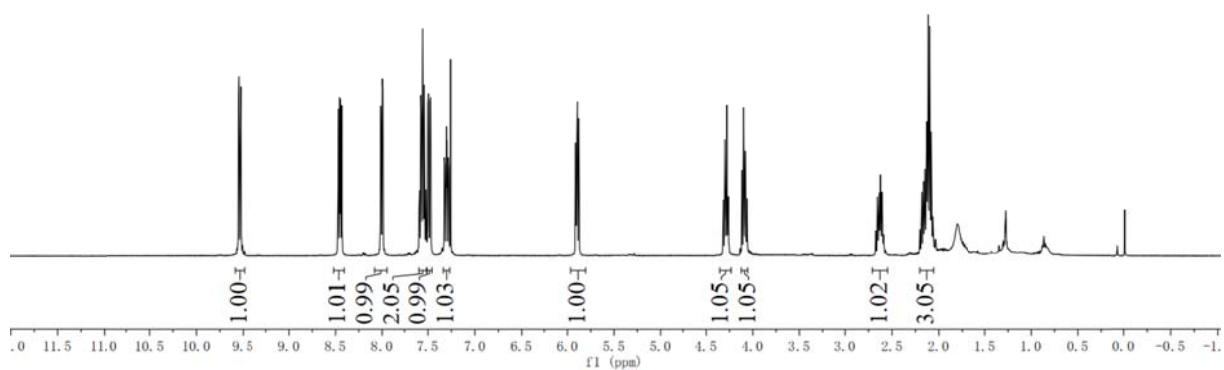


$^{13}\text{C NMR}$ (101M, CDCl_3) of **3fa**

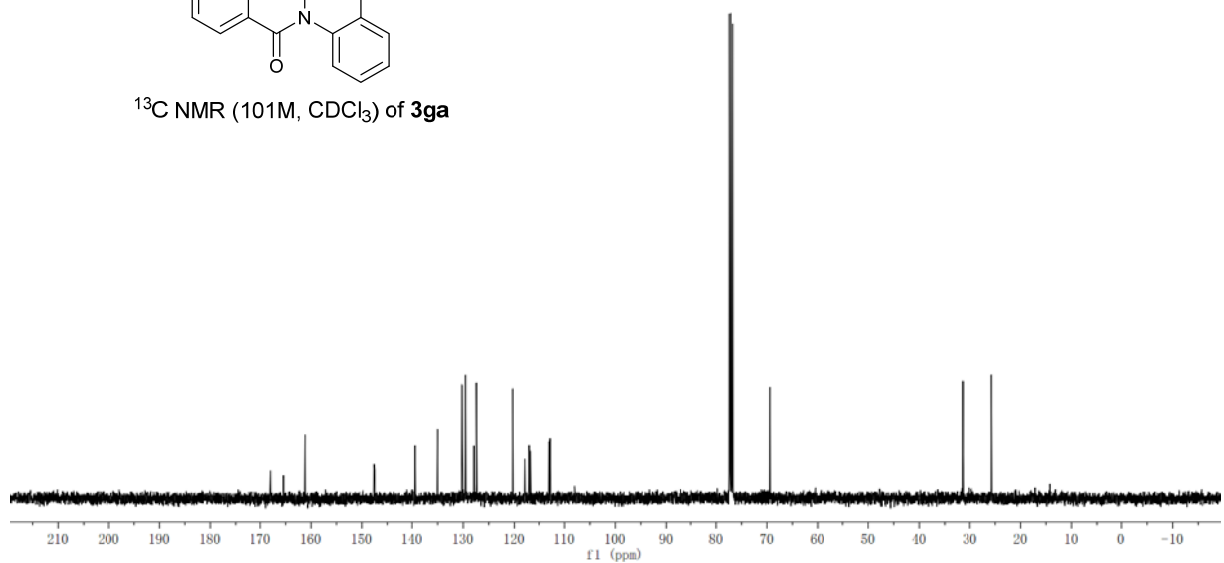


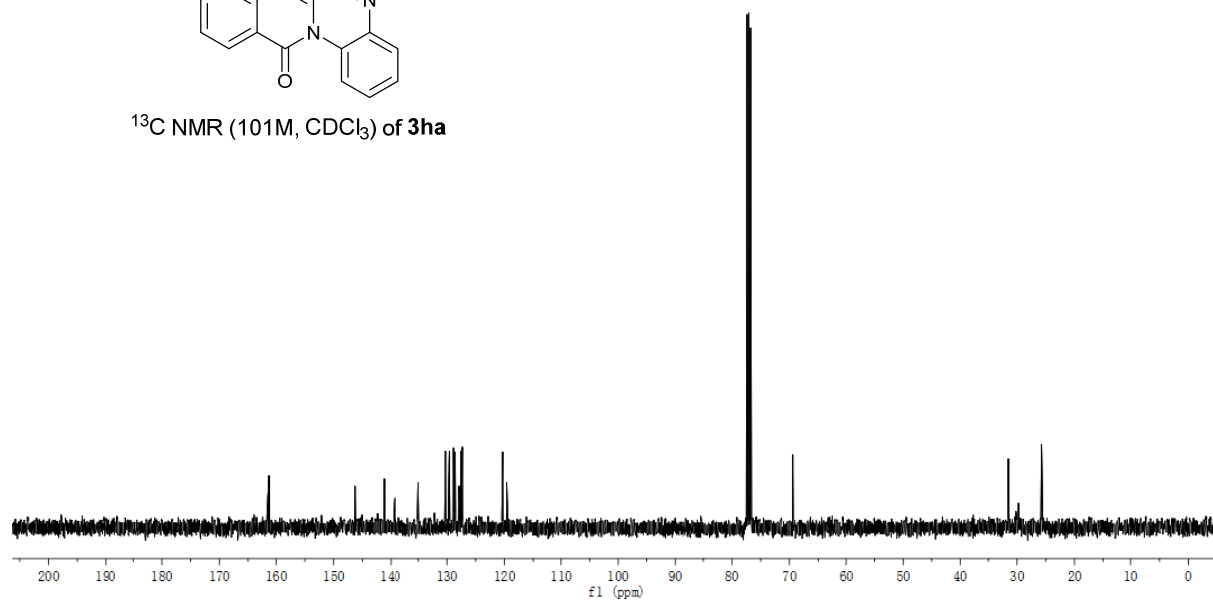
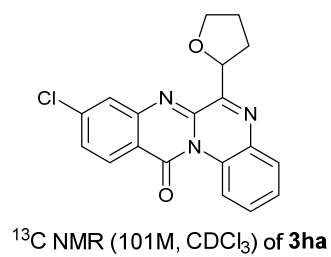
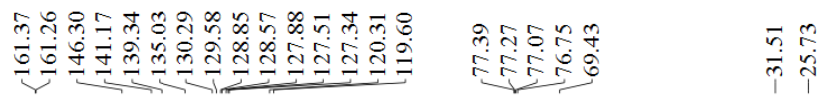
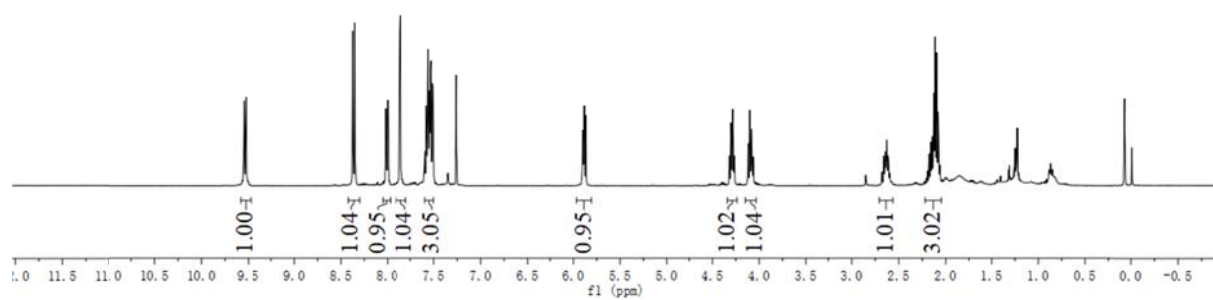
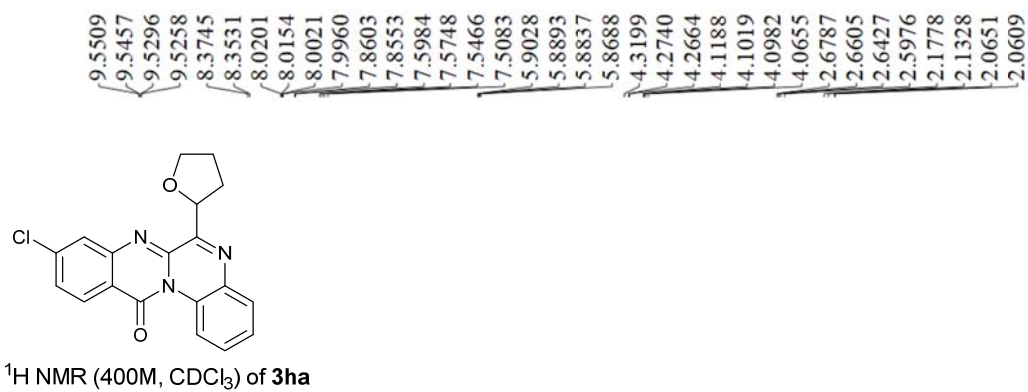


¹H NMR (400M, CDCl₃) of **3ga**

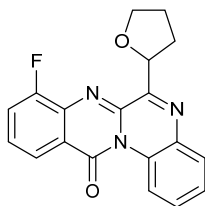


¹³C NMR (101M, CDCl₃) of **3ga**

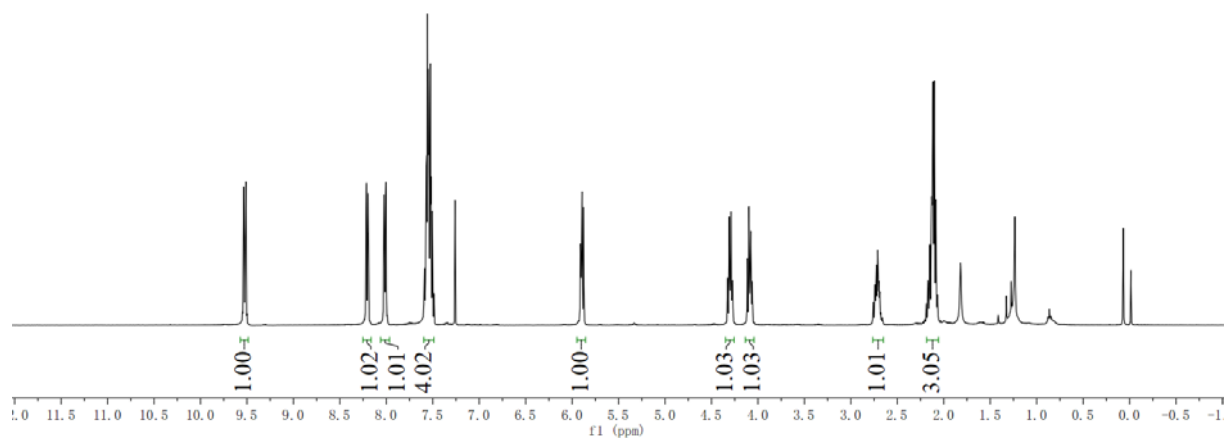




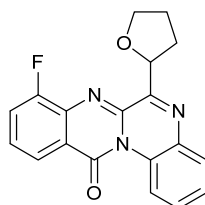
9.5356
9.5297
9.5105
8.2180
8.2127
8.1966
8.1933
8.0265
8.0217
8.0181
8.0026
7.5940
7.5884
7.5191
7.4871
5.9114
5.9051
5.8922
5.8767
4.3263
4.2932
4.2892
4.2722
4.1142
4.0819
4.0772
4.0615
2.7587
2.7300
2.6981
2.6910
2.1718
2.1311
2.1026
2.0650



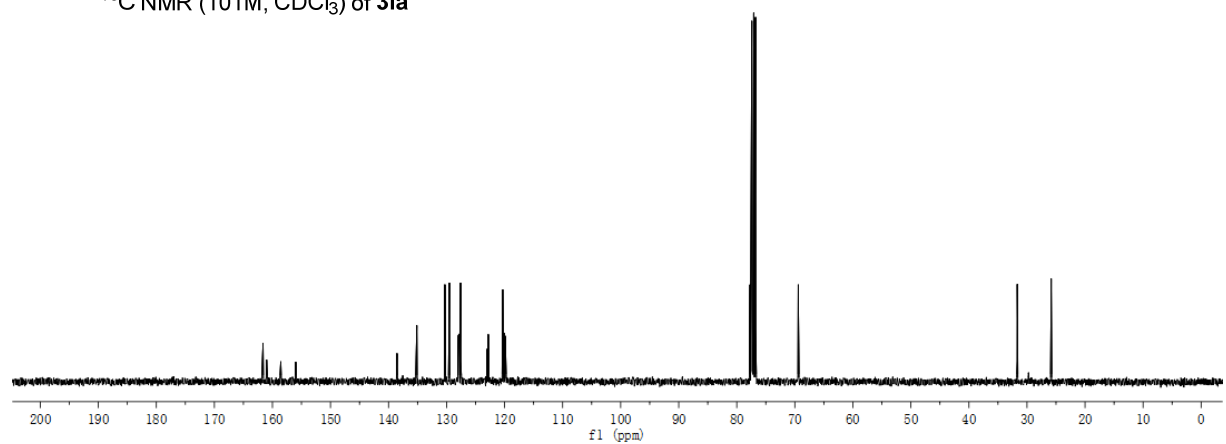
¹H NMR (400M, CDCl₃) of **3ia**



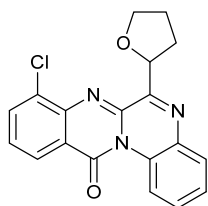
161.613
161.036
161.004
158.560
155.986
135.126
130.289
129.515
128.008
127.933
127.822
127.575
122.994
122.814
122.768
120.328
120.068
119.886
77.708
77.404
77.086
76.768
69.413
-31.663
-25.828



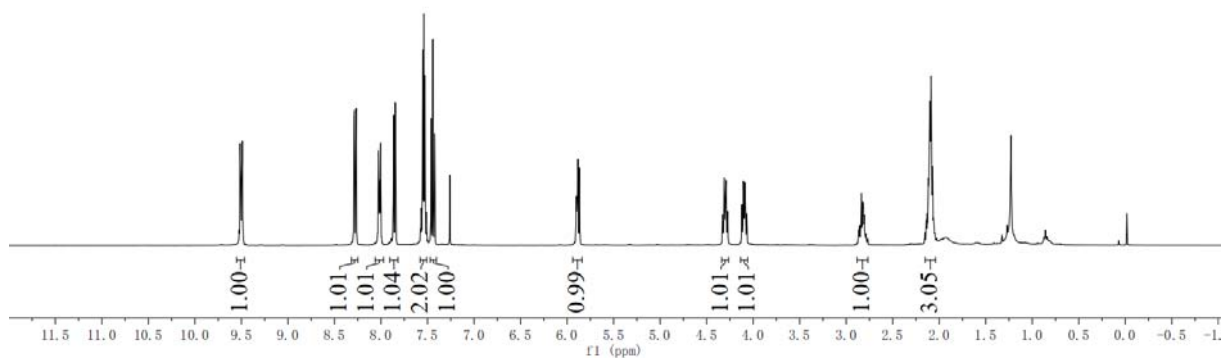
¹³C NMR (101M, CDCl₃) of **3ia**



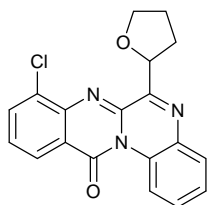
9.5237
9.5142
9.4993
9.4807
8.2899
8.2864
8.2697
8.2662
8.0273
8.0167
8.0098
8.0032
7.8661
7.8626
7.8468
7.8433
7.5492
7.5304
7.5128
7.4624
7.4427
7.4230
5.9020
5.8870
5.8826
5.8673
4.3286
4.3110
4.2900
4.2739
4.1215
4.1009
4.0861
4.0688
2.8195
2.1387
2.1033
0.0744



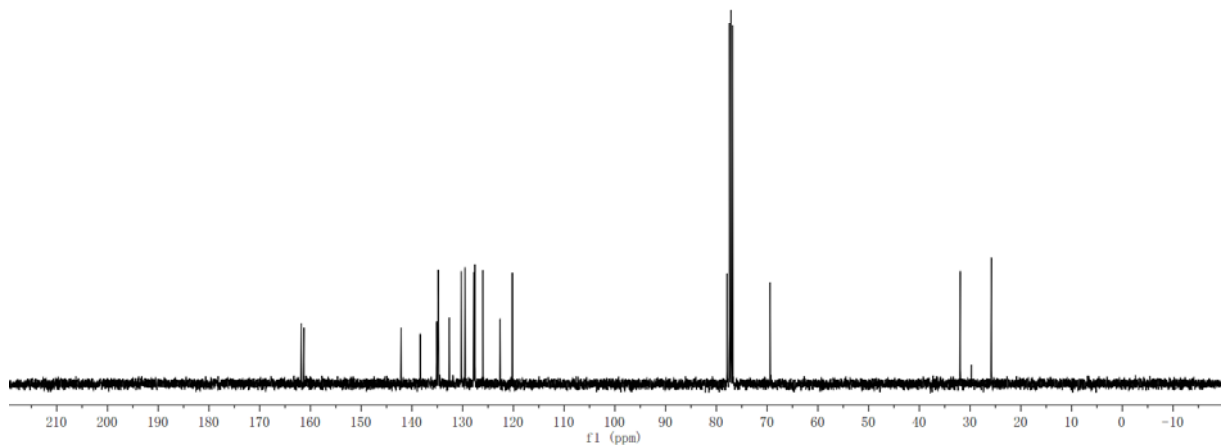
¹H NMR (400M, CDCl₃) of **3ja**



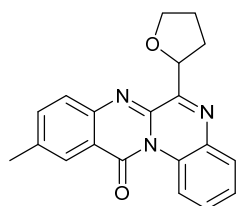
161.81
161.29
142.12
138.36
135.12
134.82
132.62
130.28
129.53
127.82
127.71
127.61
126.01
122.62
120.21
77.88
77.42
77.10
76.78
69.42
-31.95
-25.80



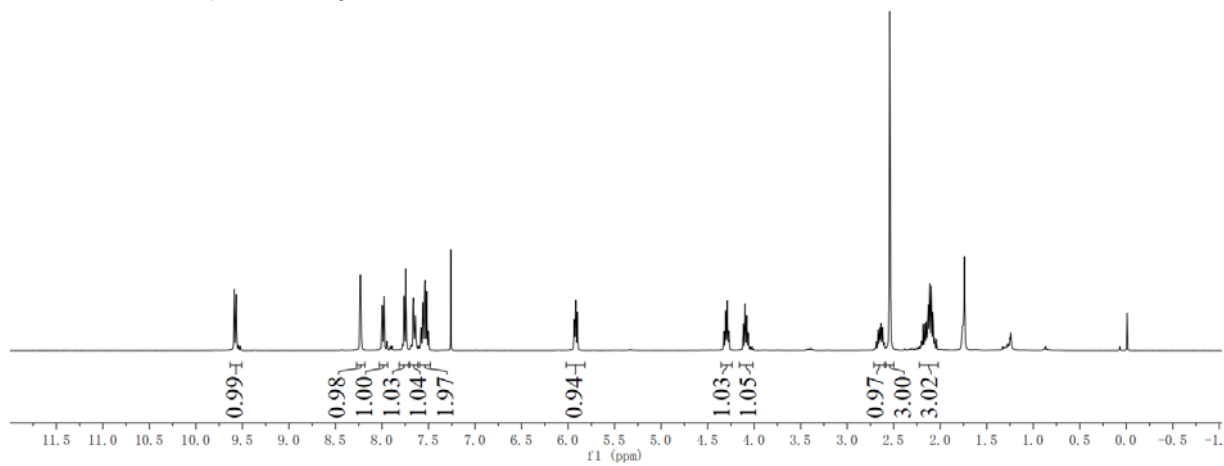
¹³C NMR (101M, CDCl₃) of **3ja**



9.5916
9.5829
9.5710
9.5620
8.2366
8.2335
8.2301
8.2240
8.0006
7.9944
7.9820
7.9767
7.7644
7.7587
7.7436
7.7374
7.6667
7.6550
7.6460
7.6338
7.5828
7.5598
7.5356
7.4993
5.9358
5.9217
5.9166
5.9014
4.3250
4.3051
4.2883
4.2709
4.1168
4.0961
4.0790
4.0629
2.6560
2.6410
2.6160
2.5422
2.2010
2.1340
2.0911
2.0392

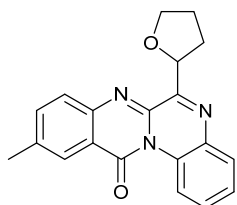


¹H NMR (400M, CDCl₃) of **3ka**

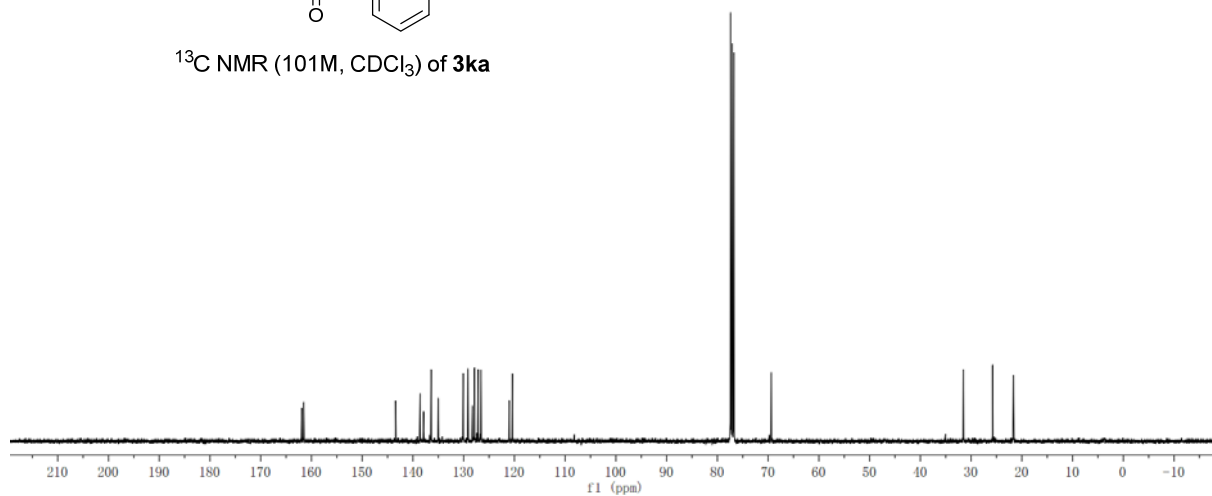


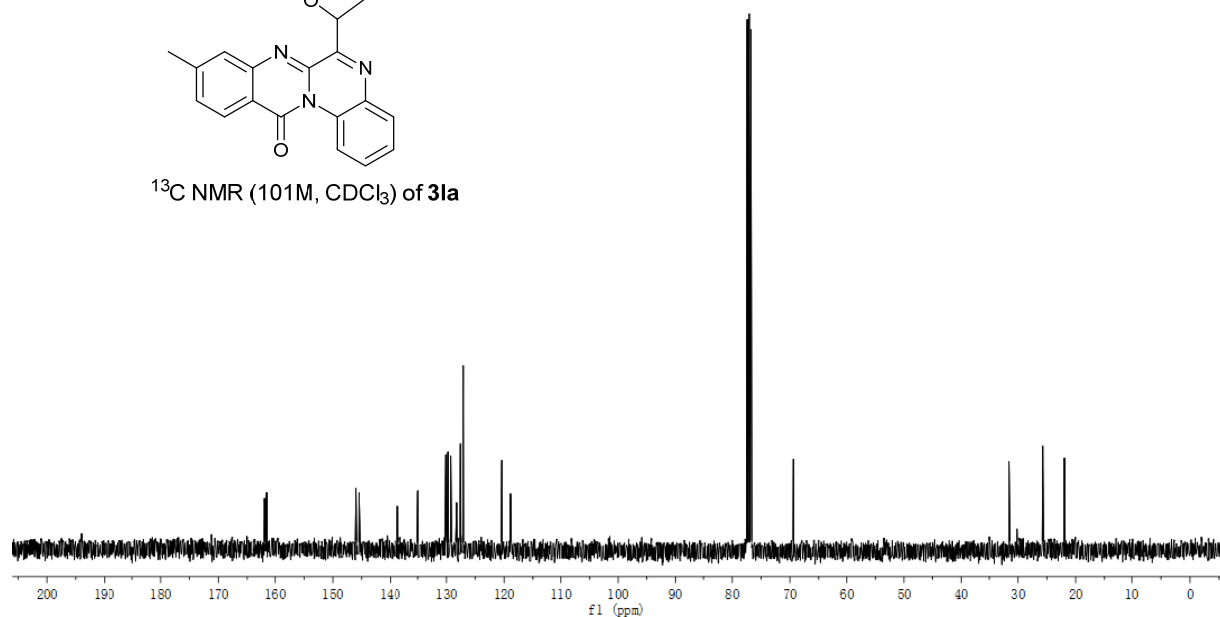
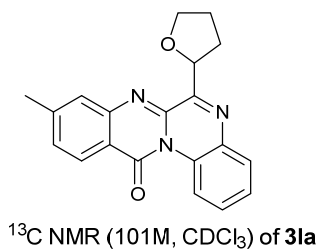
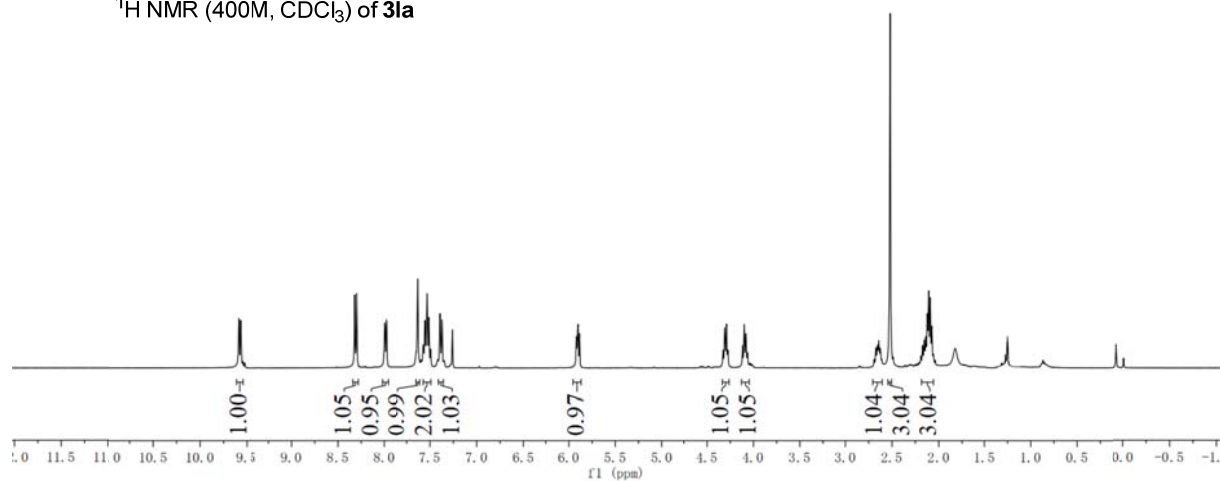
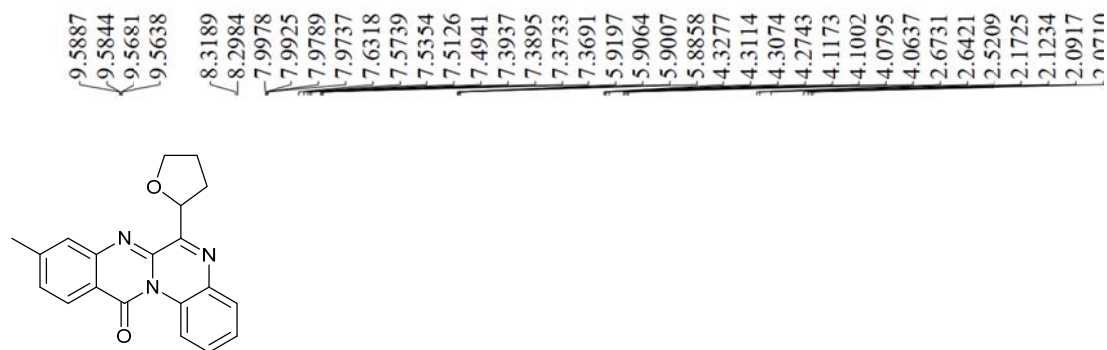
161.92
161.53
143.40
138.58
137.90
136.40
135.03
130.09
129.19
128.27
127.87
127.15
126.59
121.02
120.40
77.38
77.27
77.07
76.75
69.37

-31.53
-25.74
-21.68

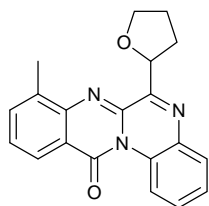


¹³C NMR (101M, CDCl₃) of **3ka**

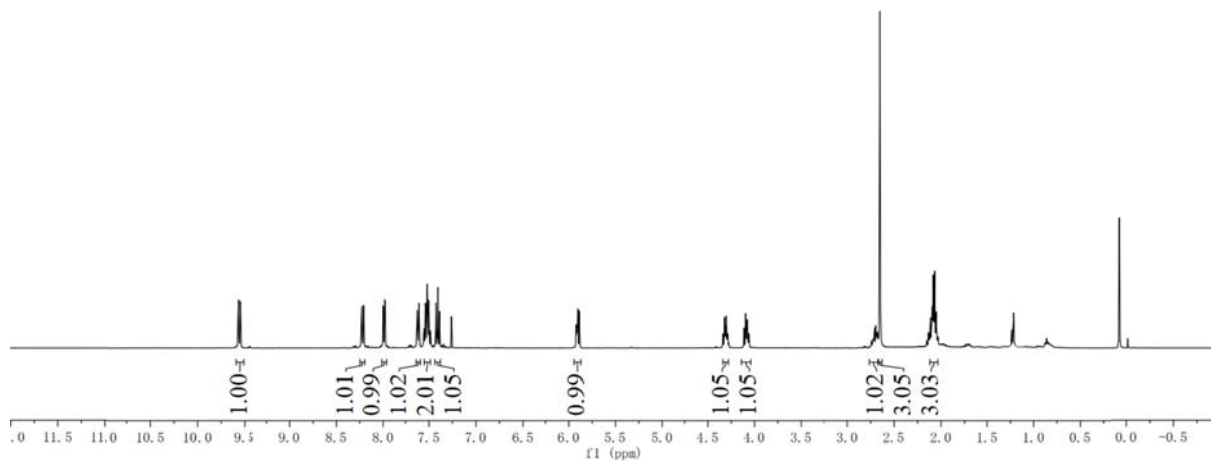




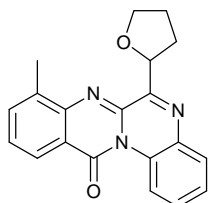
9.5709
9.5659
9.5497
9.5460
8.2311
8.2273
8.2083
8.2060
8.0000
7.9927
7.9820
7.9760
7.6280
7.6249
7.6072
7.6040
7.5377
7.5297
7.5155
7.4982
7.4256
7.4063
7.3874
5.9217
5.9083
5.9022
5.8876
4.2930
4.1133
4.0971
4.0768
4.0601
2.7068
2.6923
2.6511
2.1352
2.1132
0.0684



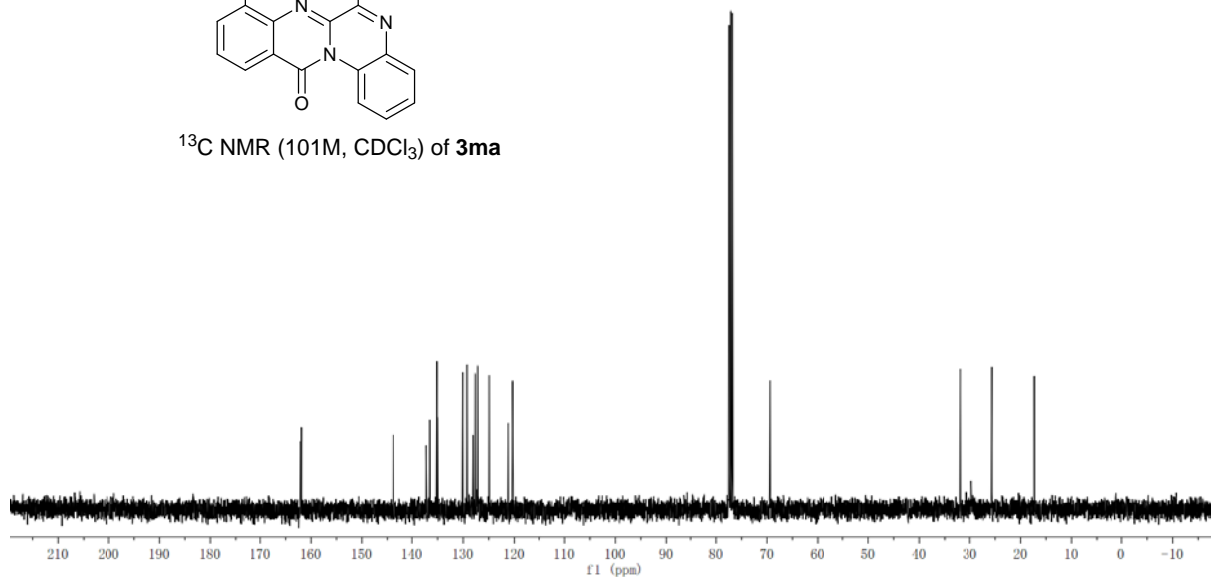
¹H NMR (400M, CDCl₃) of 3ma



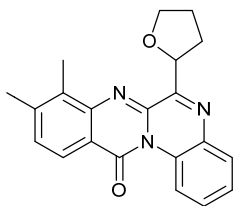
162.10
161.90
143.80
137.23
136.54
135.13
135.03
130.10
129.23
128.09
127.65
127.18
124.91
121.21
120.35
77.55
77.43
77.11
76.79
69.38
32.00
25.64
17.29



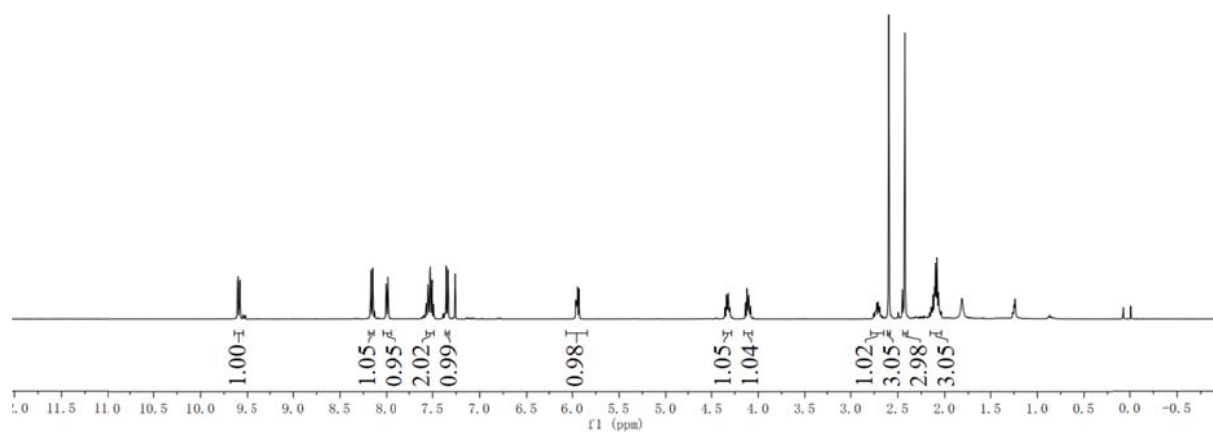
¹³C NMR (101M, CDCl₃) of 3ma



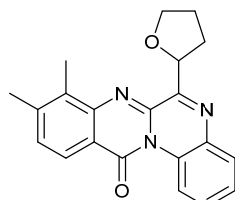
9.6063
9.6019
9.5847
9.5812
8.1697
8.1493
8.0061
7.9998
7.9874
7.9821
7.5697
7.5435
7.5099
7.4874
7.3564
7.3359
5.9638
5.9510
5.9444
5.9302
4.3574
4.3402
4.3101
4.3034
4.1354
4.1193
4.0992
4.0823
2.7420
2.7218
2.7099
2.6902
2.5952
2.4246
2.1473
2.0967
2.0672
2.0377



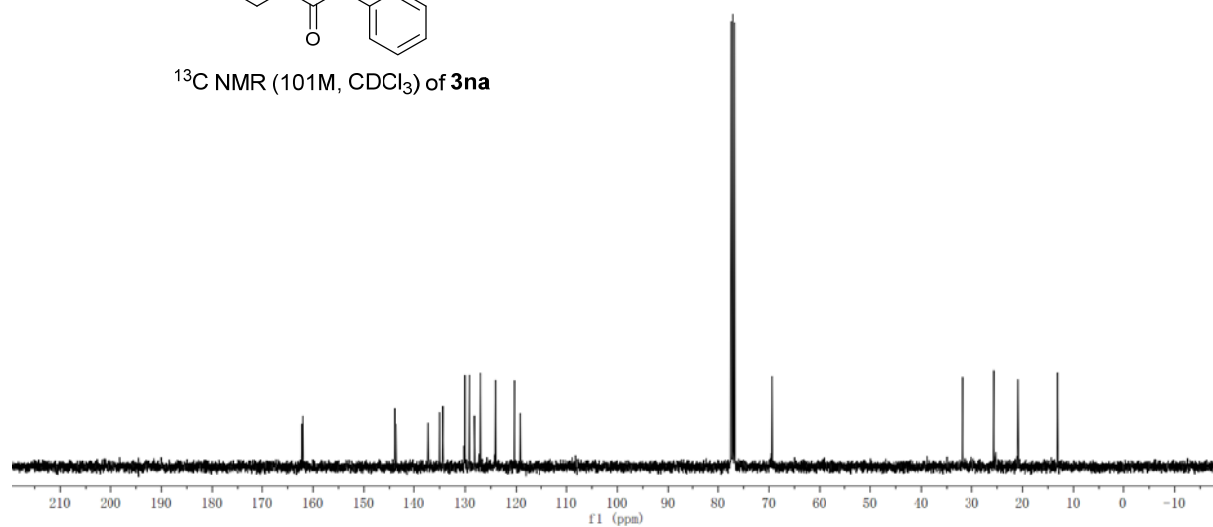
¹H NMR (400M, CDCl₃) of 3na



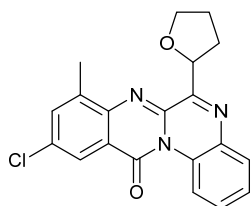
162.19
161.98
143.90
143.52
137.23
135.02
134.36
130.19
130.07
129.18
128.20
127.05
124.09
120.40
119.23
77.56
77.40
77.08
76.77
69.39
31.95
25.63
20.92
13.13



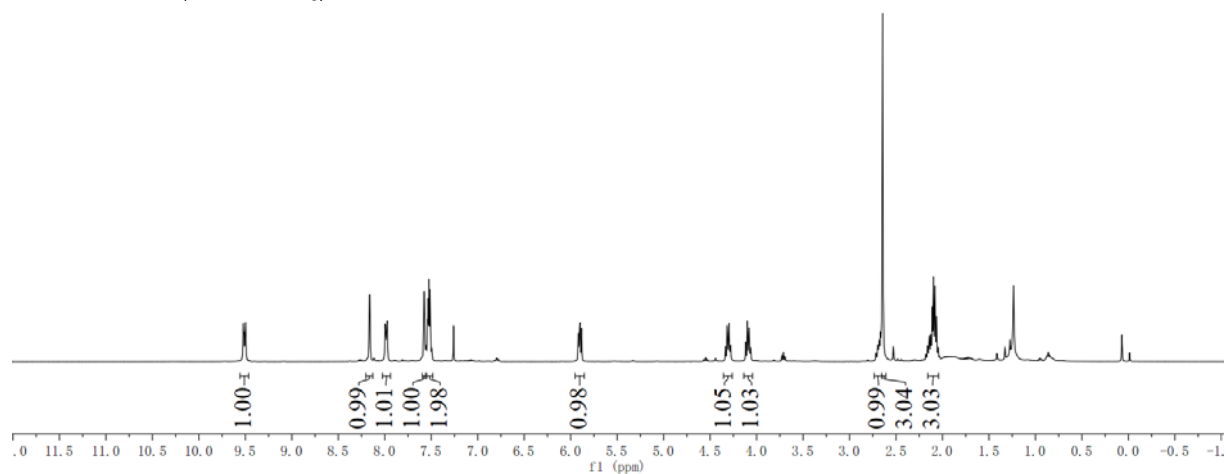
¹³C NMR (101M, CDCl₃) of 3na



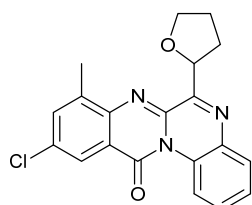
9.5217
9.5151
9.5058
9.4968
8.1657
8.1599
7.9966
7.9914
7.9799
7.9726
7.5785
7.5726
7.5406
7.5333
7.5239
7.5089
5.9174
5.9044
5.8981
5.8835
4.3337
4.3155
4.2974
4.2801
4.1169
4.0963
4.0799
4.0636
2.7156
2.6954
2.6800
2.6668
2.6443
2.1414
2.1110
2.0820
2.0612



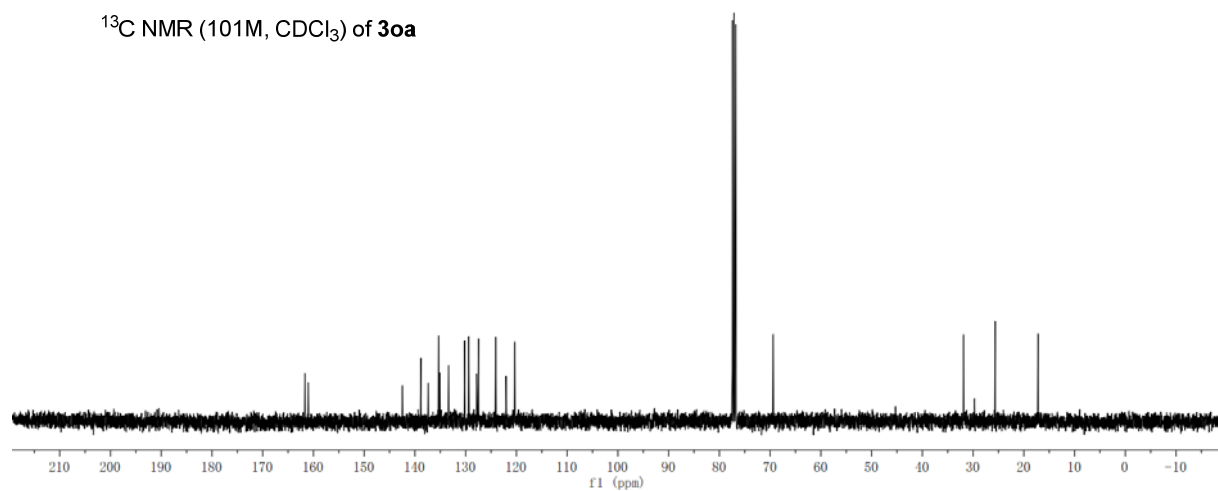
$^1\text{H NMR}$ (400M, CDCl_3) of 30a



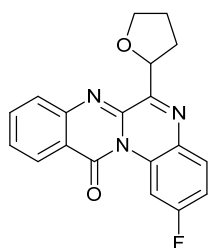
161.66
161.03
142.46
138.83
137.37
135.34
135.10
133.36
130.20
129.40
127.84
127.47
124.10
122.04
120.31
77.44
77.40
77.08
76.77
69.39
31.87
25.65
17.20



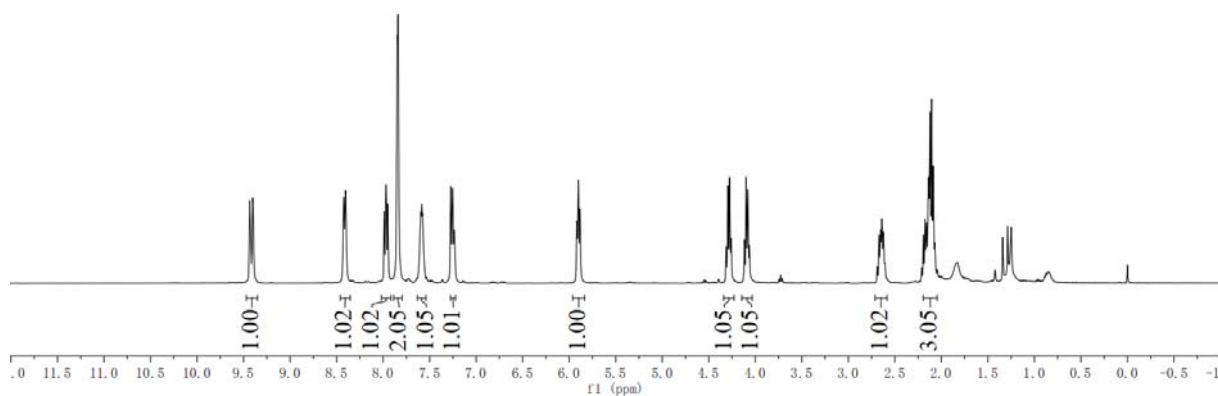
$^{13}\text{C NMR}$ (101M, CDCl_3) of 30a



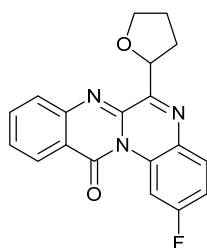
9.4401
9.4267
9.4094
9.3957
8.4293
8.4229
8.4092
8.4017
7.9877
7.9712
7.9654
7.9498
7.8487
7.8389
7.6118
7.5956
7.5855
7.5651
7.2746
7.2579
7.2476
7.2291
5.9183
5.9040
5.8990
5.8842
4.3127
4.2945
4.2765
4.2593
4.1163
4.0984
4.0804
4.0627
2.6702
2.6237
2.1591
2.1056



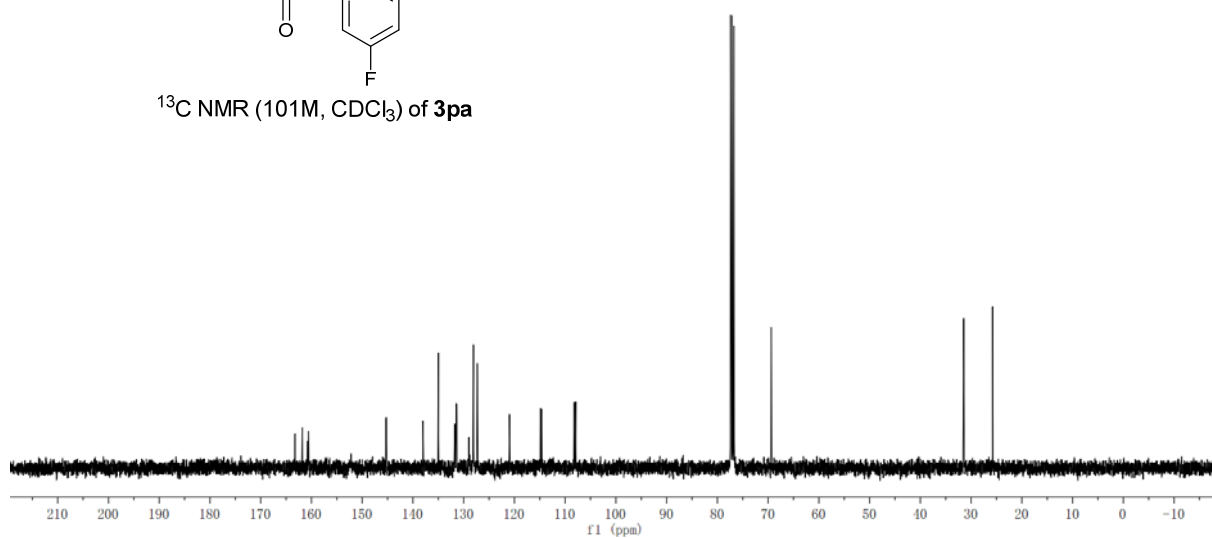
¹H NMR (400M, CDCl₃) of **3pa**

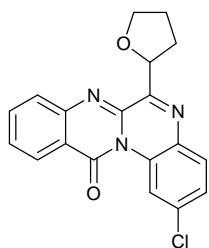


163.228
161.801
160.763
160.585
145.281
138.023
134.994
131.749
131.463
131.365
128.954
128.830
128.154
128.081
127.330
120.963
114.875
114.645
108.240
107.923
77.390
77.271
77.072
76.754
69.378
-31.456
-25.748

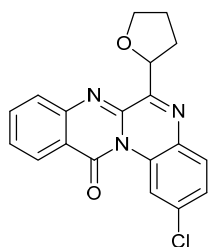
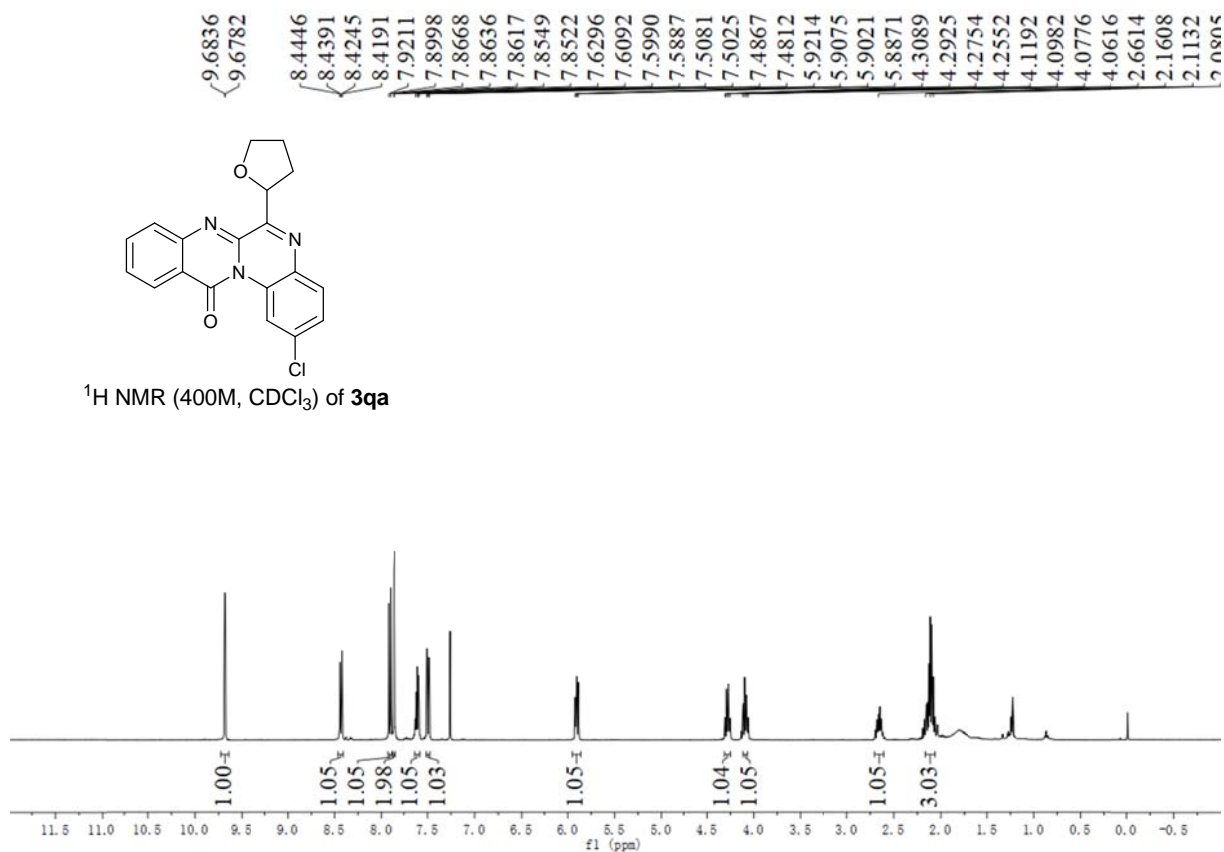


¹³C NMR (101M, CDCl₃) of **3pa**

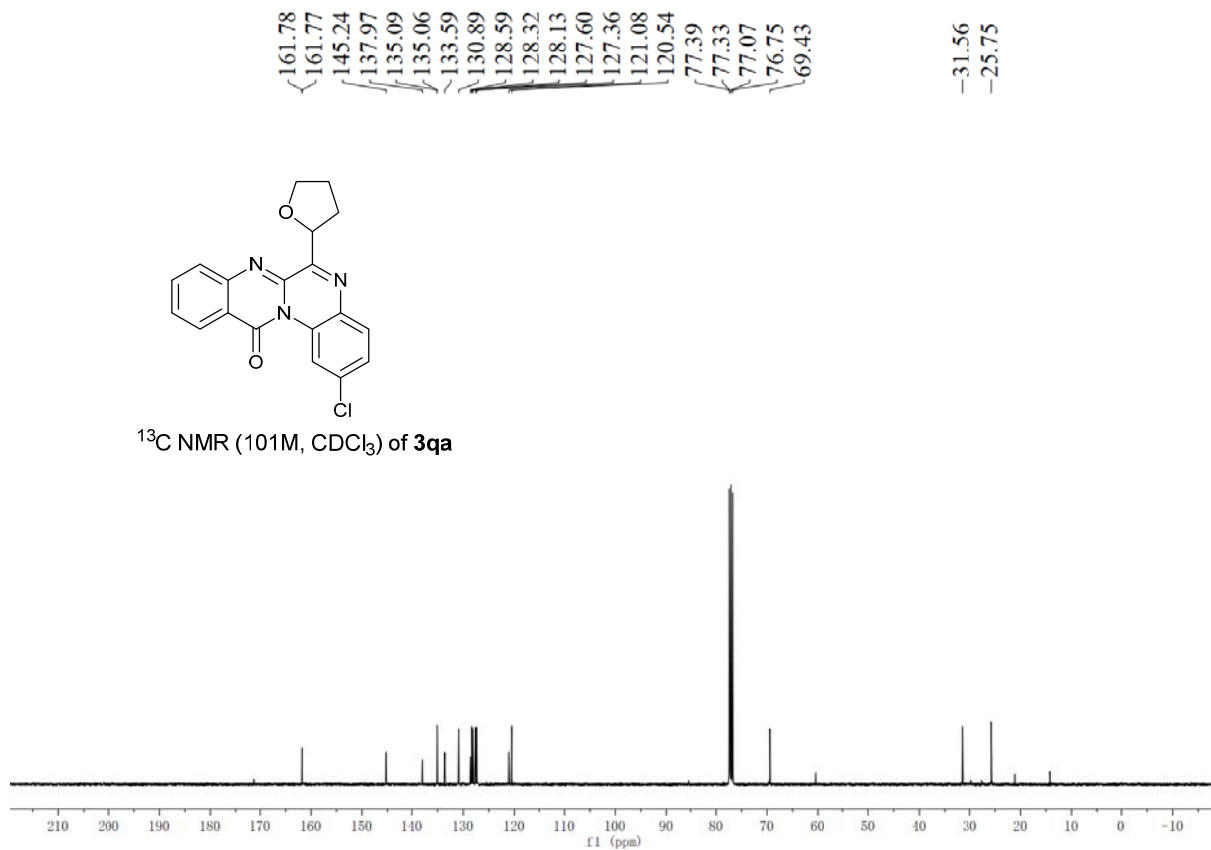




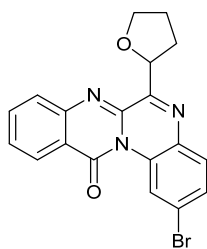
¹H NMR (400M, CDCl₃) of **3qa**



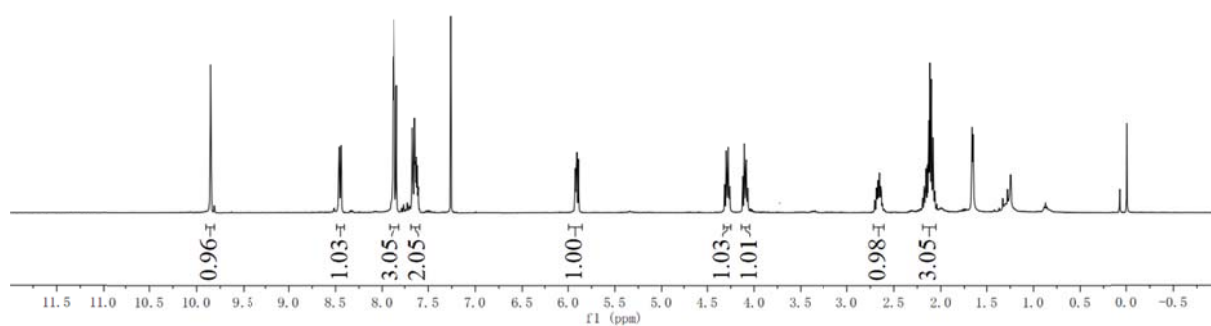
¹³C NMR (101M, CDCl₃) of **3qa**



9.8574
9.8526
9.8475
8.4654
8.4565
8.4450
8.4362
7.8809
7.8692
7.8613
7.8402
7.6725
7.6474
7.6260
7.6055
5.9249
5.9107
5.9055
5.8911
4.3144
4.2978
4.2810
4.2610
4.1210
4.1043
4.0880
4.0677
2.7020
2.6819
2.6571
2.6330
2.1947
2.1506
2.1168
2.0638

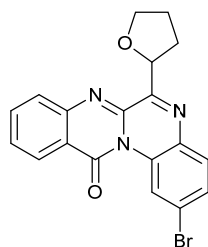


$^1\text{H NMR}$ (400M, CDCl_3) of **3ra**

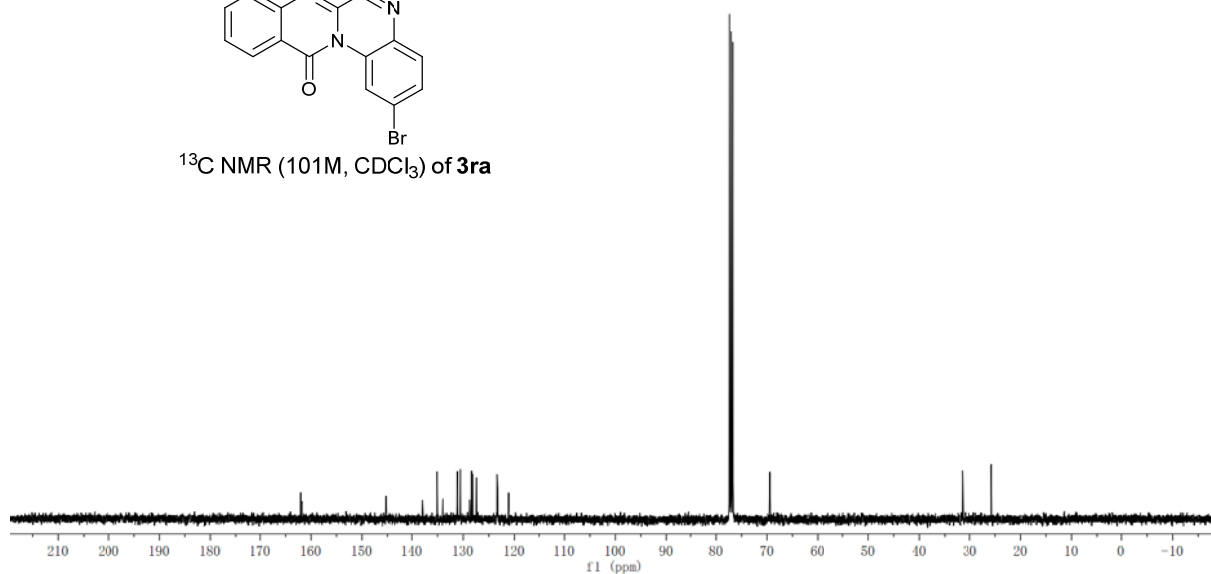


162.02
161.78
145.26
137.97
135.09
133.96
131.14
130.57
128.75
128.37
128.16
127.39
123.39
123.27
121.12
77.37
77.26
77.06
76.74
69.45

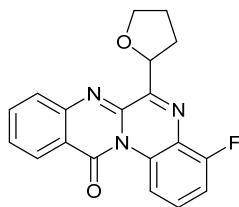
-31.55
-25.75



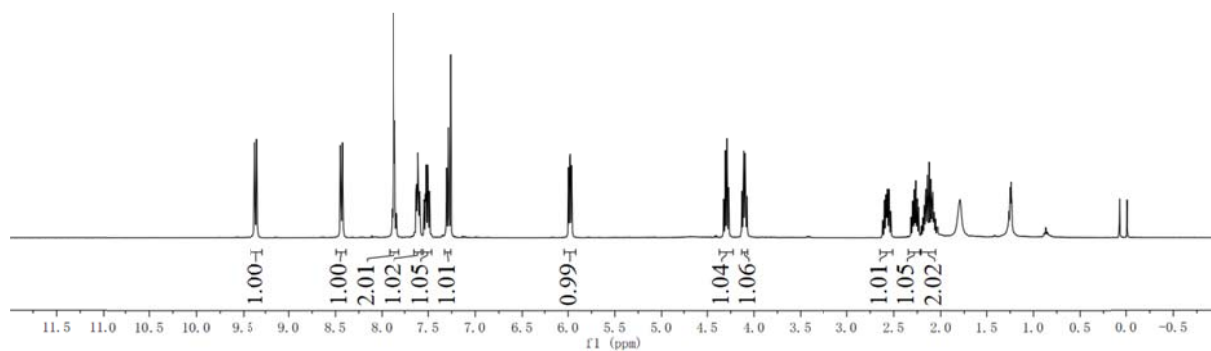
$^{13}\text{C NMR}$ (101M, CDCl_3) of **3ra**



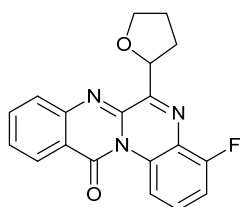
9.3707
9.3639
9.3484
9.3415
8.4506
8.4419
8.4302
8.4242
7.8897
7.8697
7.8588
7.8384
7.6304
7.6045
7.5954
7.5436
7.5284
7.4854
7.4826
7.3072
7.2867
7.2842
7.2816
5.9962
5.9828
5.9767
5.9625
4.3260
4.3090
4.3063
4.2711
4.1293
4.1100
4.0953
4.0759
2.5981
2.5513
2.5310
2.3168
2.2965
2.2659
2.2352
2.1405
2.1010



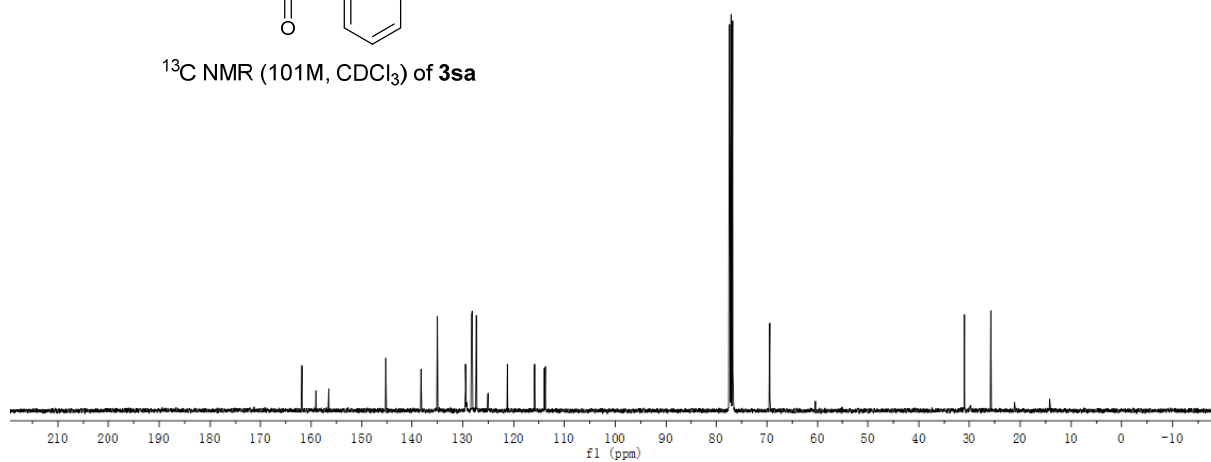
$^1\text{H NMR}$ (400M, CDCl_3) of **3sa**



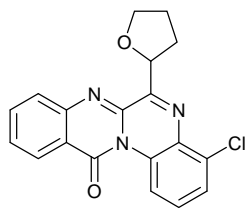
161.890
161.870
161.813
159.061
156.517
145.295
138.206
135.008
129.492
129.403
129.315
128.299
128.183
127.368
125.145
125.017
121.289
115.977
115.934
113.865
113.674
77.392
77.253
77.075
76.756
69.439
-31.080
-25.751



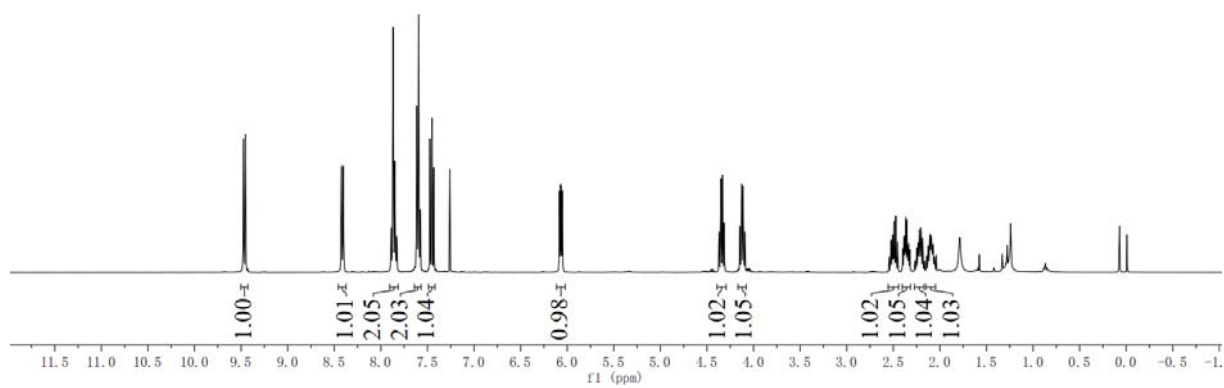
$^{13}\text{C NMR}$ (101M, CDCl_3) of **3sa**



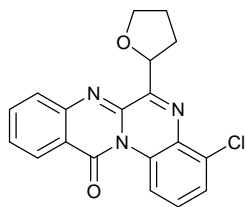
9.4764
9.4733
9.4545
9.4513
8.4262
8.4209
8.4059
8.4006
7.8938
7.8732
7.8515
7.8274
7.6175
7.5998
7.5976
7.5747
7.4729
7.4530
7.4508
7.4310
6.0831
6.0721
6.0630
6.0519
4.3698
4.3540
4.3344
4.3149
4.1465
4.1273
4.1124
4.0929
2.5265
2.4949
2.4533
2.3990
2.3788
2.3542
2.3227
2.2232
2.1994
2.1421
2.0963
2.0799



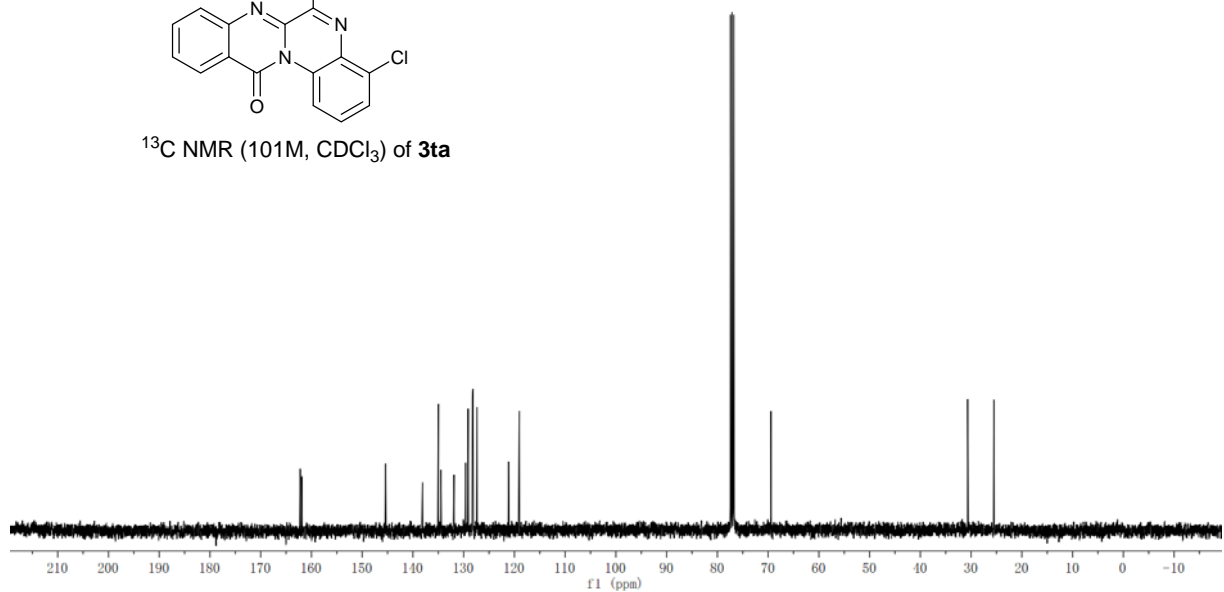
^1H NMR (400M, CDCl_3) of **3ta**

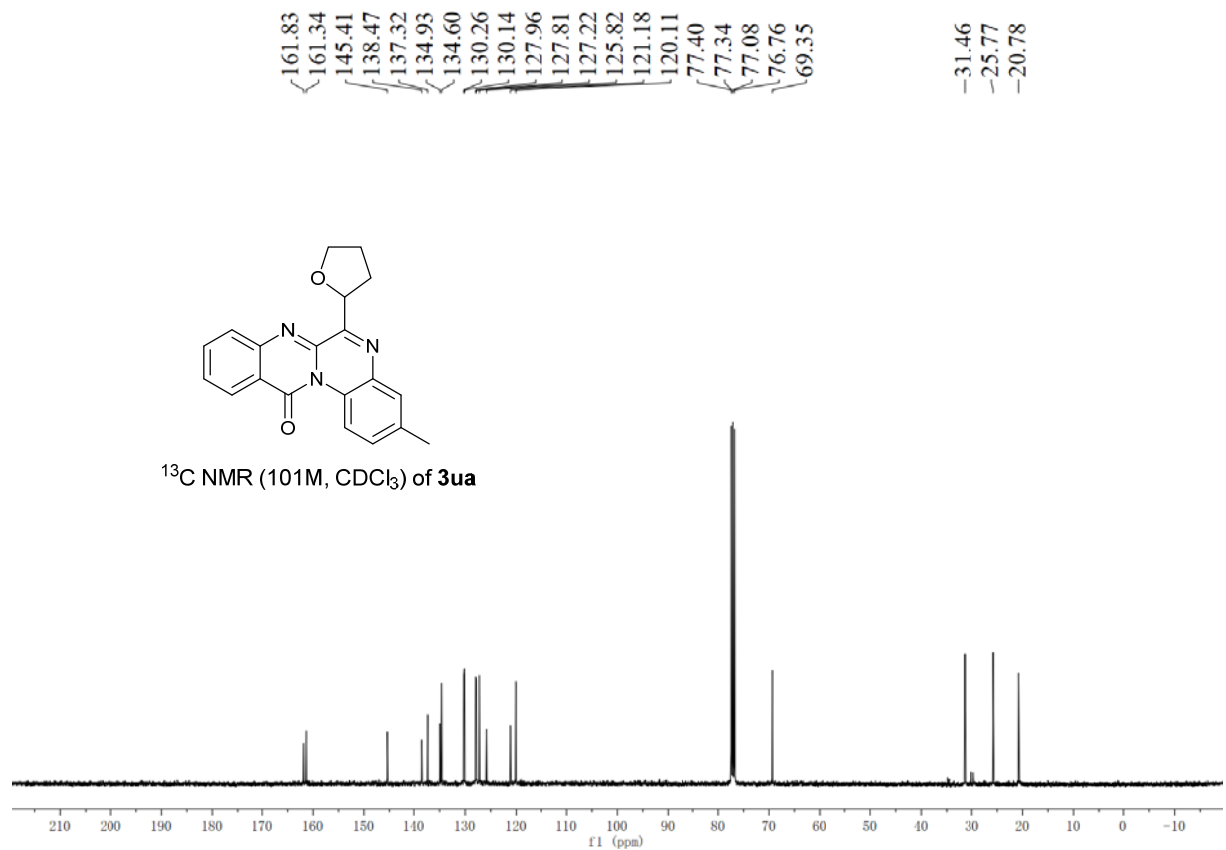
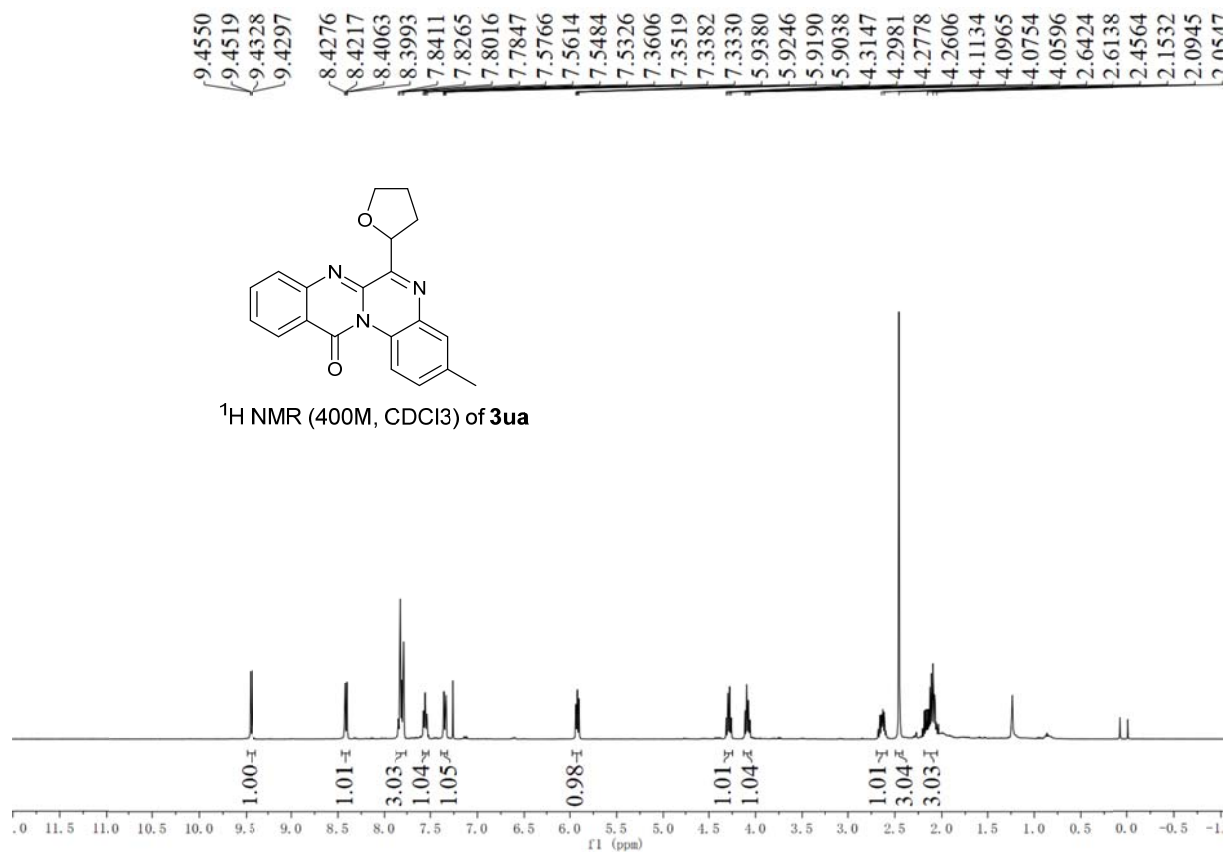


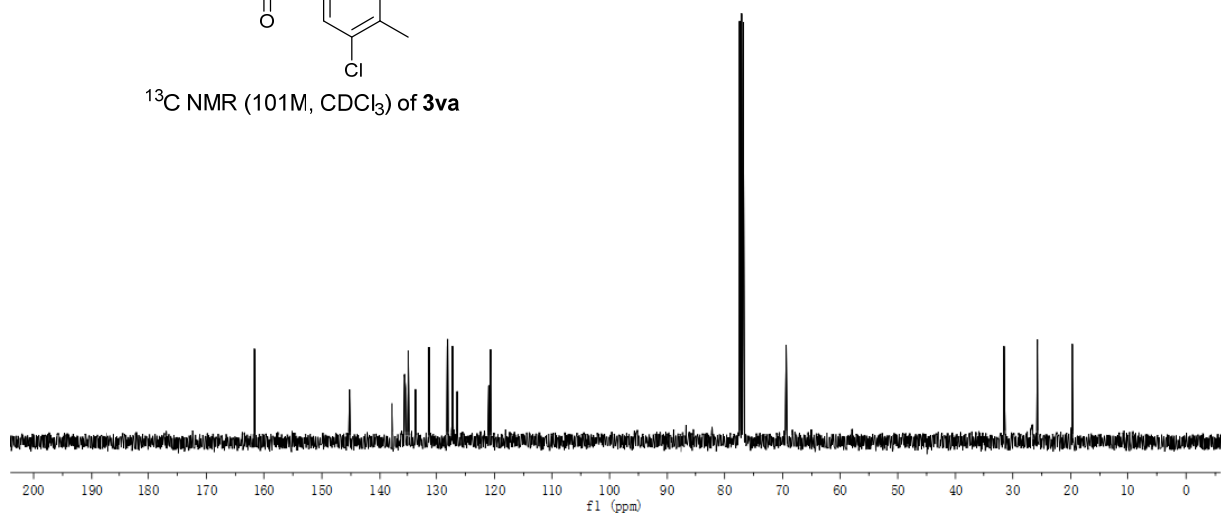
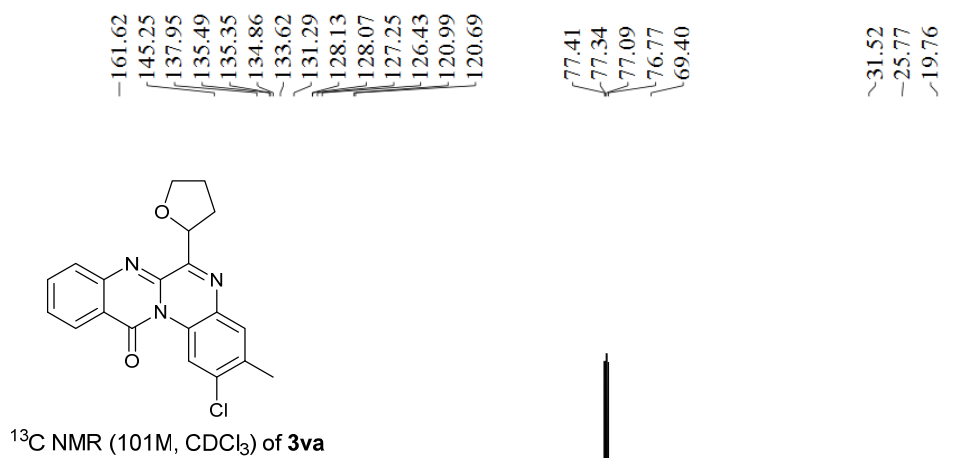
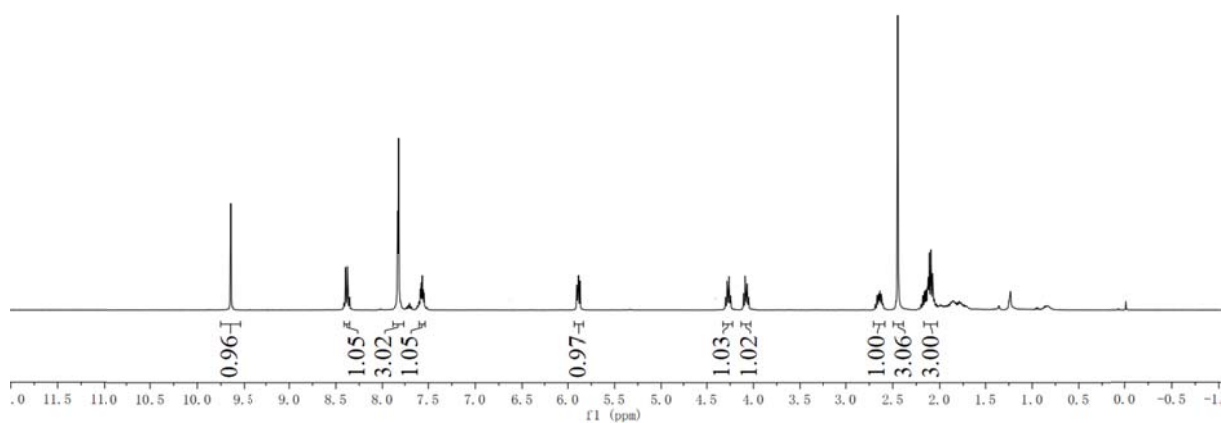
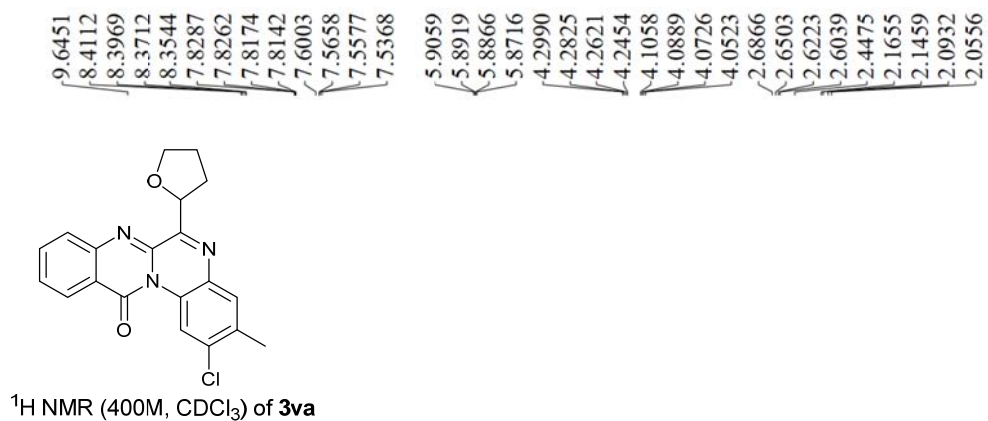
162.22
161.87
145.38
138.10
135.00
134.48
131.92
129.62
129.13
128.28
128.21
128.16
127.36
121.16
119.04
77.40
77.08
76.82
76.76
69.43
-30.67
-25.51



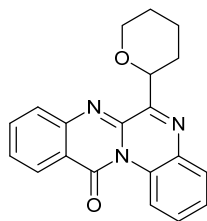
^{13}C NMR (101M, CDCl_3) of **3ta**



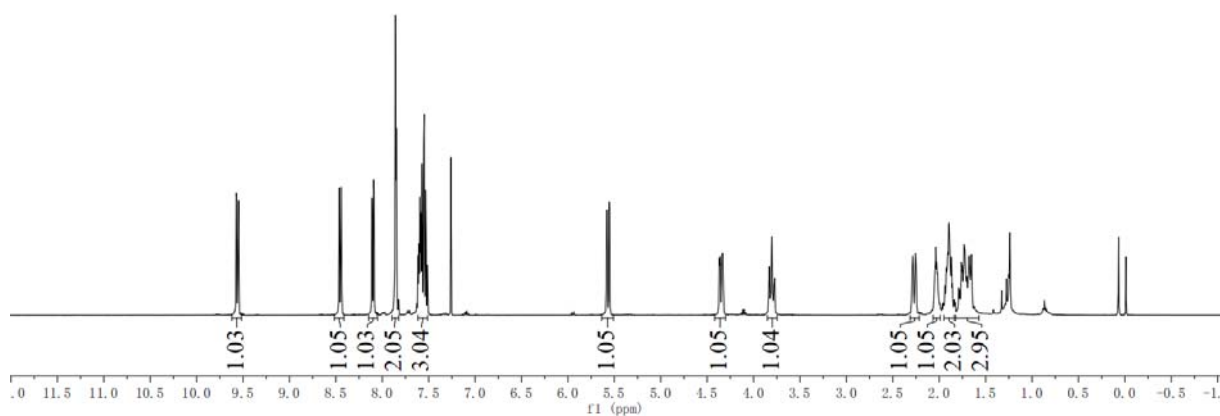




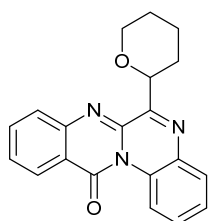
9.5722
9.5679
9.5519
9.5476
8.4636
8.4580
8.4432
8.4384
8.1121
8.1057
8.0934
8.0880
7.8712
7.8594
7.8507
7.6151
7.5742
7.5478
7.5112
5.5825
5.5773
5.5555
5.5505
4.3688
4.3579
4.3408
4.3251
3.8365
3.8070
3.8011
3.7720
2.2910
2.2809
2.2598
2.2492
2.0368
2.0224
1.9368
1.9089
1.8934
1.8584
1.7911
1.7599
1.7329



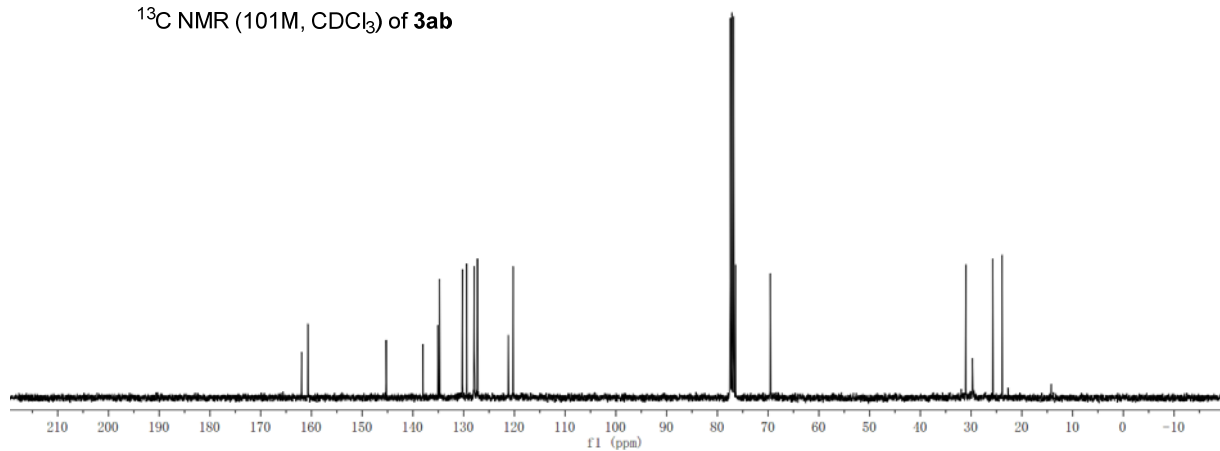
¹H NMR (400M, CDCl₃) of **3ab**



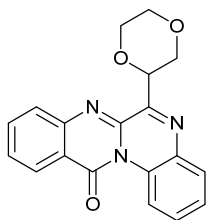
161.93
160.70
145.27
138.02
135.08
134.76
130.24
129.41
127.98
127.93
127.90
127.32
127.27
121.20
120.26
77.43
77.11
76.79
76.42
69.56
31.04
25.72
23.88



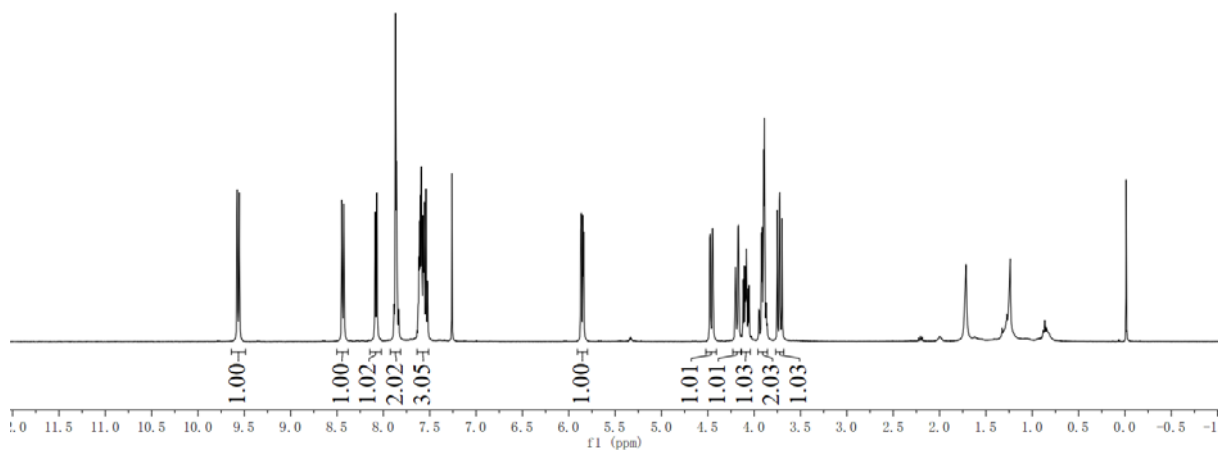
¹³C NMR (101M, CDCl₃) of **3ab**



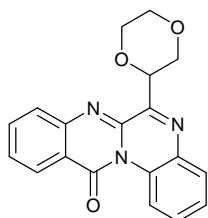
9.5797
9.5757
9.5586
9.5545
8.4516
8.4454
8.4311
8.4260
8.0927
8.0878
8.0735
8.0685
7.8693
7.8583
7.6236
7.5873
7.5406
7.5222
5.8710
5.8644
5.8472
5.8407
4.4795
4.4730
4.4518
4.4452
4.1964
4.1747
4.1681
4.1196
4.1082
4.0551
3.9208
3.8871
3.7506
3.7270
3.7229
2.6001



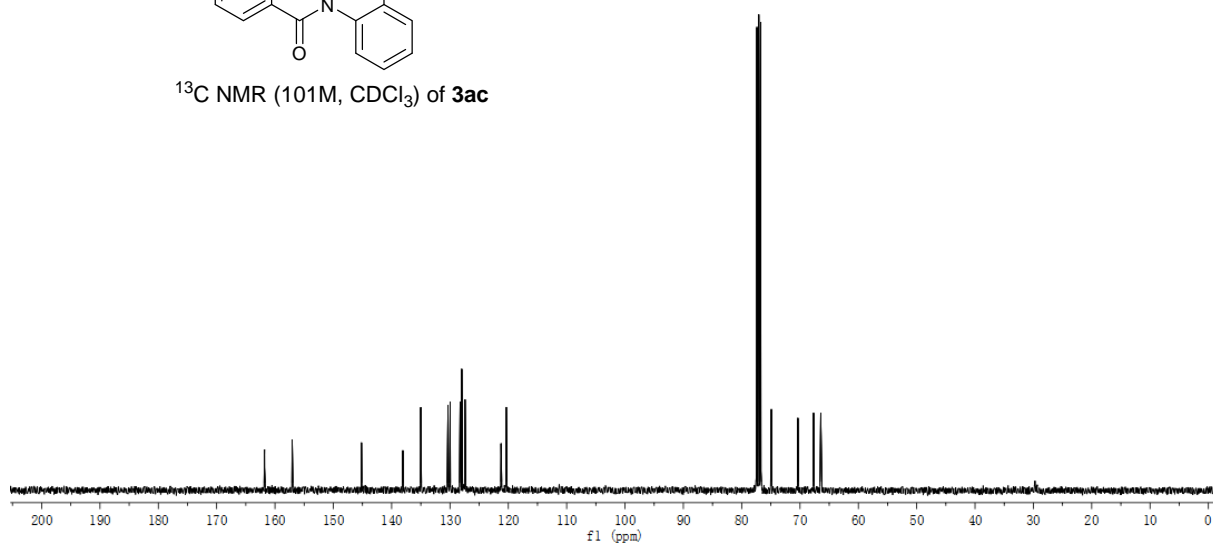
^1H NMR (400M, CDCl_3) of 3ac



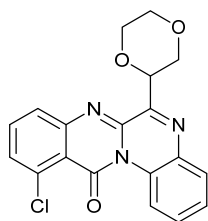
161.79
157.05
145.18
138.09
135.00
134.92
130.34
129.97
128.26
127.99
127.43
127.37
121.24
120.36
77.39
77.07
76.75
74.91
70.37
67.68
66.45



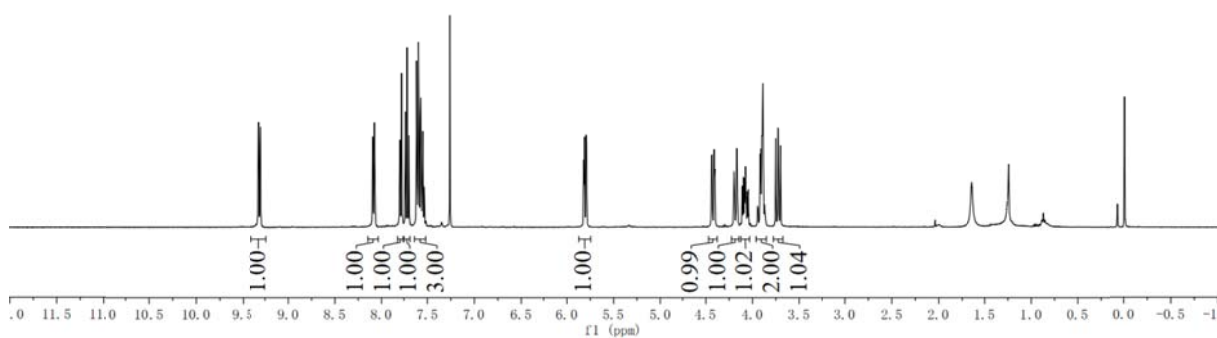
^{13}C NMR (101M, CDCl_3) of 3ac



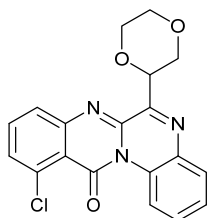
9.3226
9.3183
9.3023
9.2980
8.0954
8.0902
8.0765
8.0713
7.7962
7.7927
7.7755
7.7722
7.7352
7.7157
7.6955
7.6147
7.5919
7.5684
7.5312
5.8205
5.8139
5.7967
5.7901
4.4394
4.4328
4.4116
4.4051
4.2024
4.1925
4.1705
4.1642
4.1096
4.0866
4.0690
4.0451
3.9463
3.9101
3.8869
3.8595
3.7517
3.7281
3.7239
3.7002



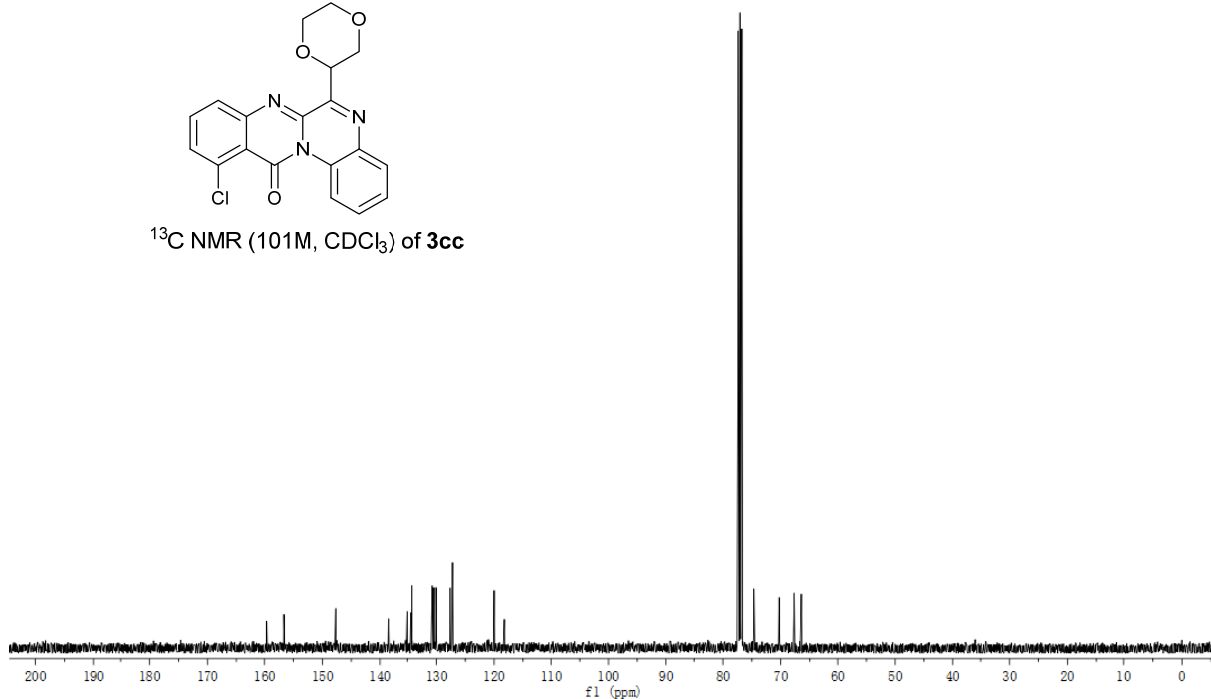
^1H NMR (400M, CDCl_3) of **3cc**



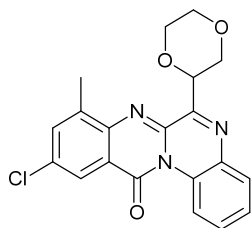
159.64
156.65
147.67
138.53
135.03
134.43
134.26
130.71
130.45
130.06
127.61
127.19
119.99
118.23
77.37
77.06
76.74
74.66
70.27
67.68
66.44



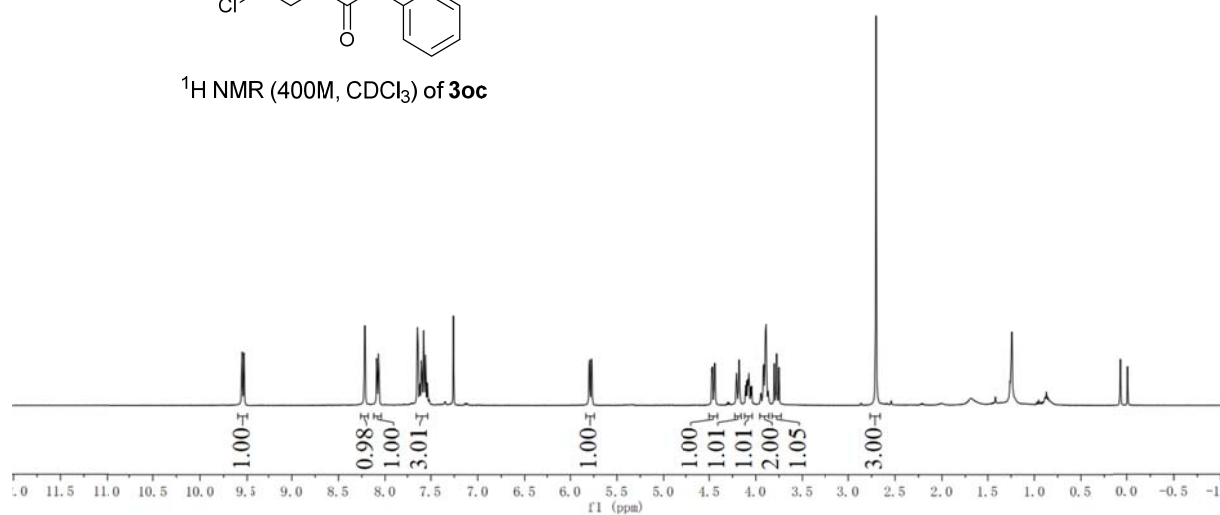
^{13}C NMR (101M, CDCl_3) of **3cc**



9.5567
9.5526
9.5358
9.5318
8.2198
8.2138
8.0899
8.0847
8.0710
8.0658
7.6439
7.6379
7.5765
7.5355
5.7996
5.7931
5.7760
5.7695
4.4711
4.4646
4.4433
4.4369
4.2080
4.2024
4.1807
4.1744
4.1093
4.0979
4.0743
4.0449
3.9488
3.8993
3.8885
3.8695
3.8021
3.7784
3.7743
3.7505
2.7033

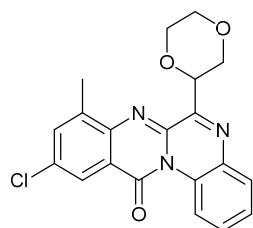


^1H NMR (400M, CDCl_3) of **3oc**

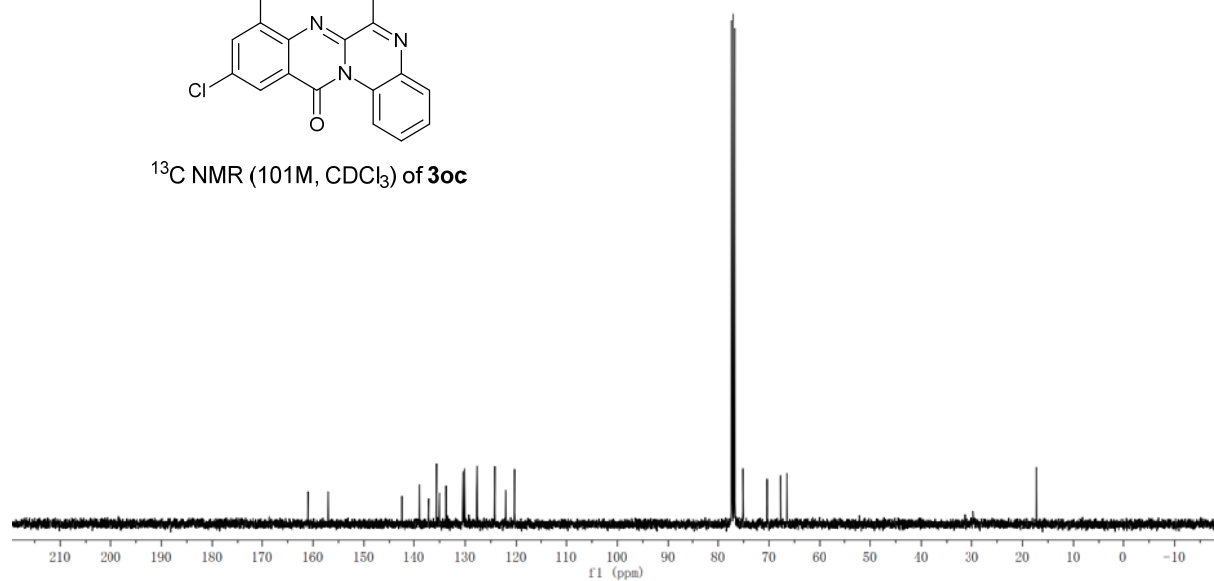


160.98
157.04
142.33
138.92
137.14
135.60
135.04
133.74
130.42
130.13
127.77
127.67
124.22
122.10
120.38
77.38
77.06
76.74
75.12
70.36
67.73
66.46

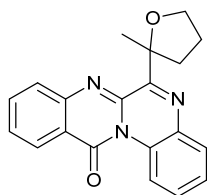
-17.26



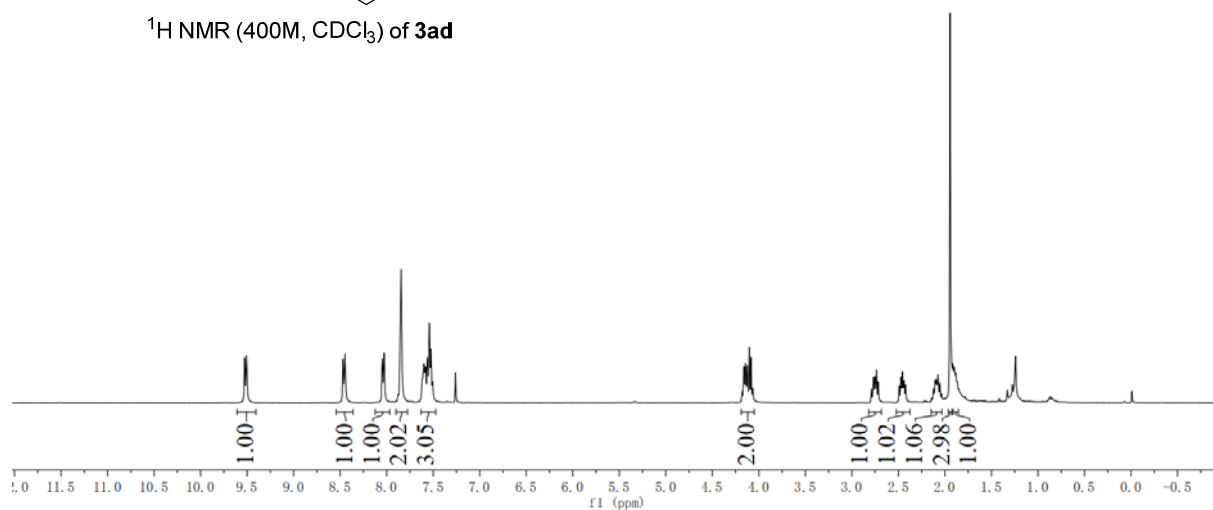
^{13}C NMR (101M, CDCl_3) of **3oc**



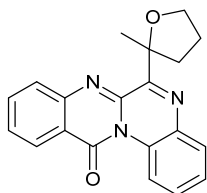
9.5289
9.5245
9.5076
9.5038
8.4711
8.4667
8.4490
8.0499
8.0447
8.0323
8.0268
7.8791
7.8514
7.8458
7.8430
7.6251
7.5791
7.5391
7.5047
4.1801
4.1031
4.0839
4.0645
2.7884
2.7690
2.7360
2.7172
2.4919
2.4716
2.4567
2.4228
2.0937
2.0743
1.9445
1.9162
1.9067
1.8827
1.8657



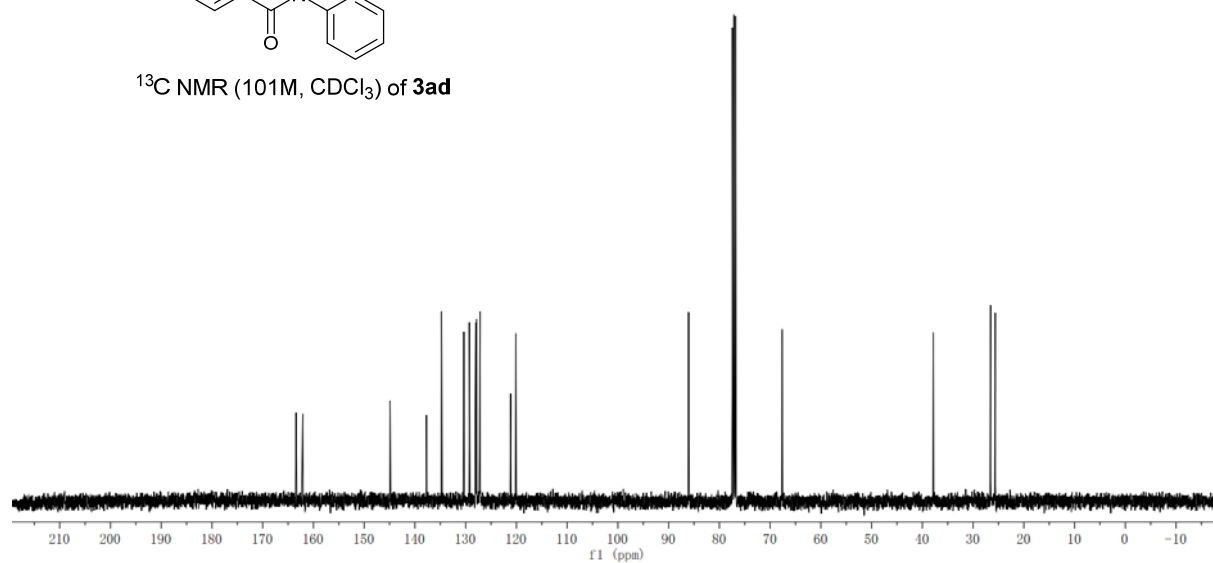
¹H NMR (400M, CDCl₃) of **3ad**



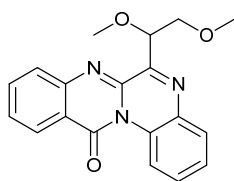
163.42
162.10
144.90
137.73
134.76
134.74
130.36
129.27
128.13
127.99
127.84
127.27
127.18
121.14
120.12
86.06
77.43
77.11
76.79
67.65
-37.85
26.56
25.64



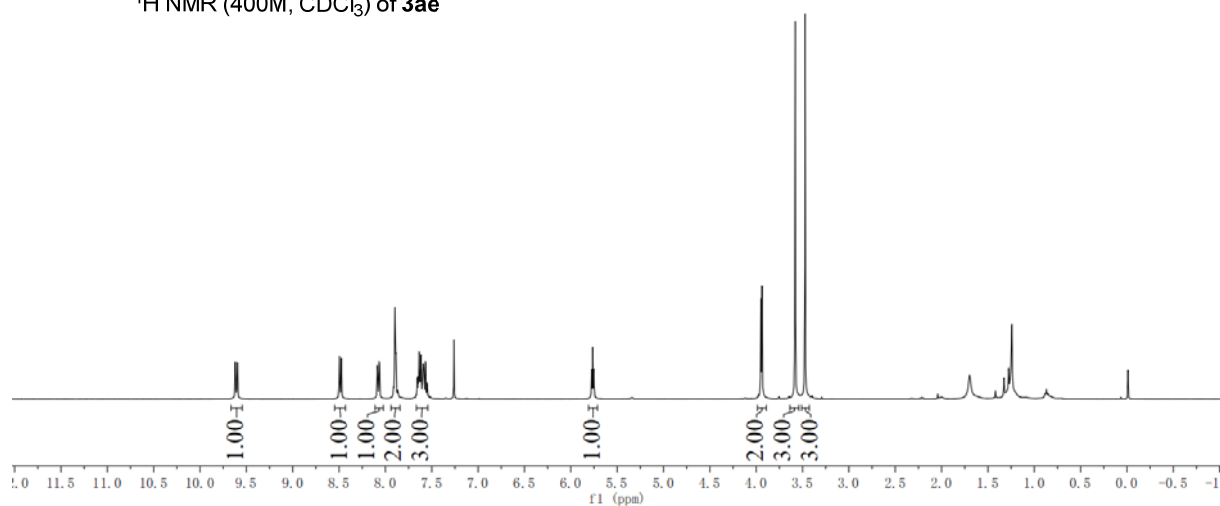
¹³C NMR (101M, CDCl₃) of **3ad**



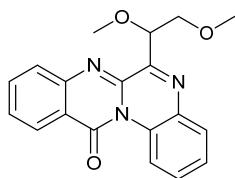
9.6202
 9.6163
 9.5991
 9.5952
 8.4993
 8.4937
 8.4788
 8.4737
 8.0870
 8.0820
 8.0680
 8.0630
 7.9123
 7.9004
 7.8977
 7.8633
 7.6567
 7.6364
 7.6147
 7.5474
 5.7755
 5.7633
 5.7506
 3.9493
 3.9368
 3.5791
 3.4720



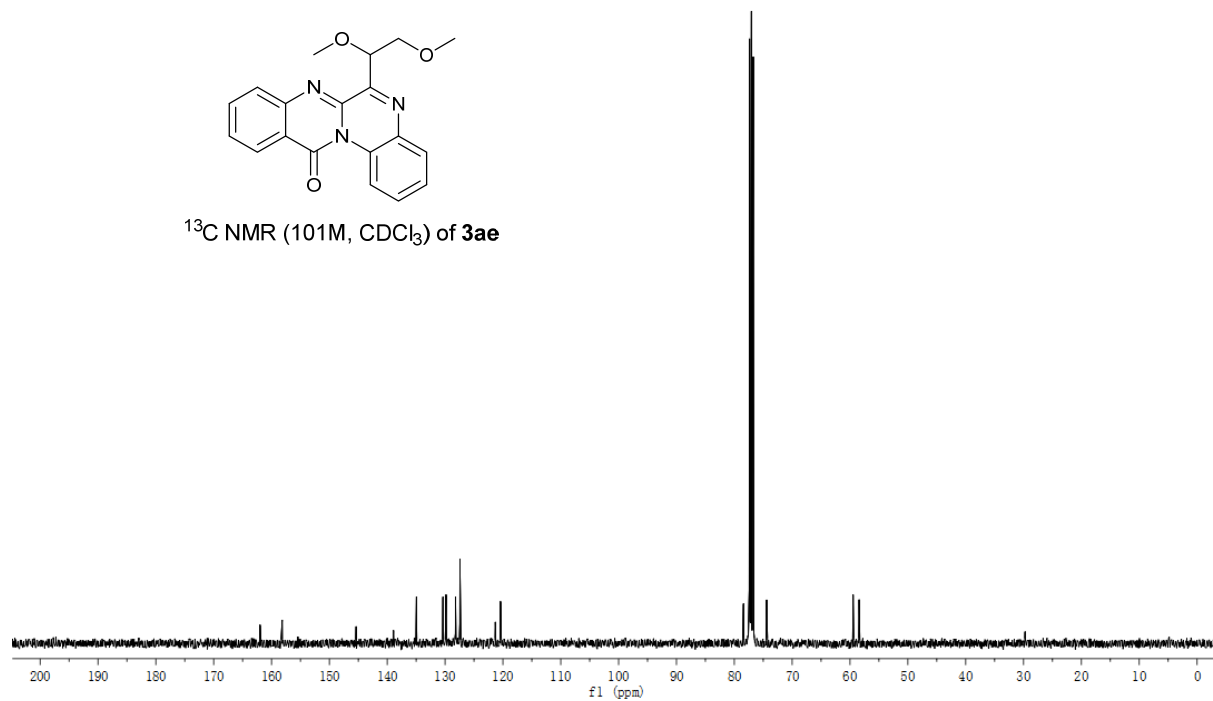
¹H NMR (400M, CDCl₃) of **3ae**



161.99
 158.17
 145.36
 138.92
 135.09
 134.95
 130.36
 129.83
 128.19
 128.14
 128.05
 127.43
 121.30
 120.42
 78.41
 77.36
 77.04
 76.72
 74.41
 59.47
 58.42

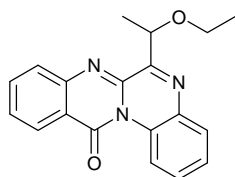


¹³C NMR (101M, CDCl₃) of **3ae**

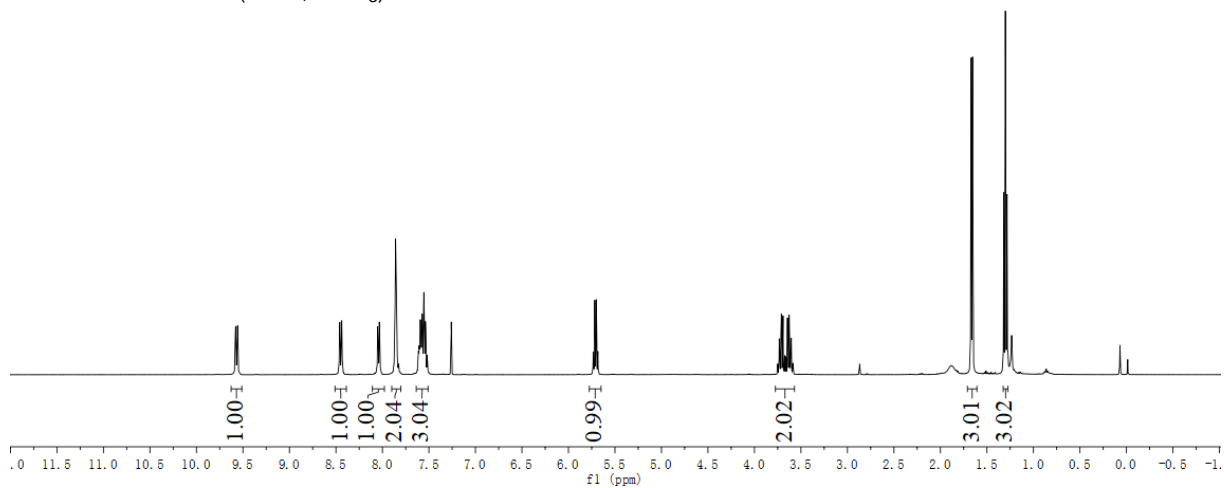


9.5799
9.5754
9.5585
9.5550
8.4617
8.4519
8.4395
8.4359
8.0515
8.0443
8.0333
8.0274
7.8743
7.8612
7.8447
7.8242
7.6130
7.5744
7.5481
7.5155
5.7327
5.7164
5.7001
5.6838
3.7507
3.6980
3.6275
3.5870

1.6715
1.6552
1.3192
1.3017
1.2843

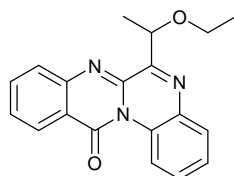


¹H NMR (400M, CDCl₃) of 3af

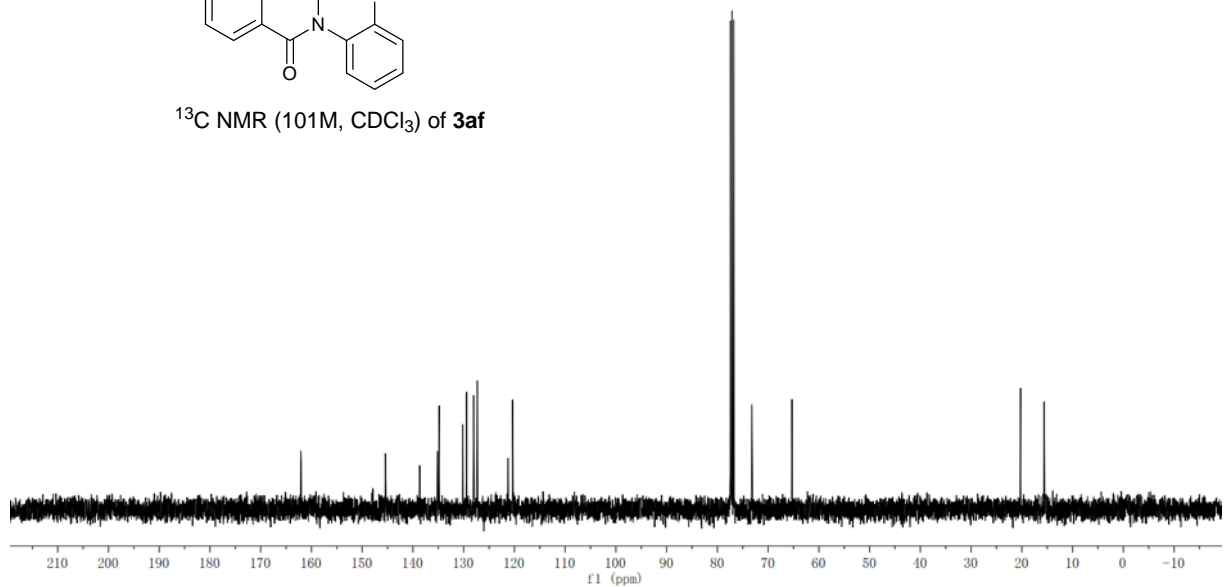


162.12
162.02
145.40
138.66
135.18
134.83
130.15
129.42
128.05
128.02
127.97
127.35
127.33
121.24
120.35
77.40
77.08
76.77
73.22
65.29

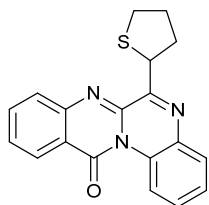
-20.25
-15.59



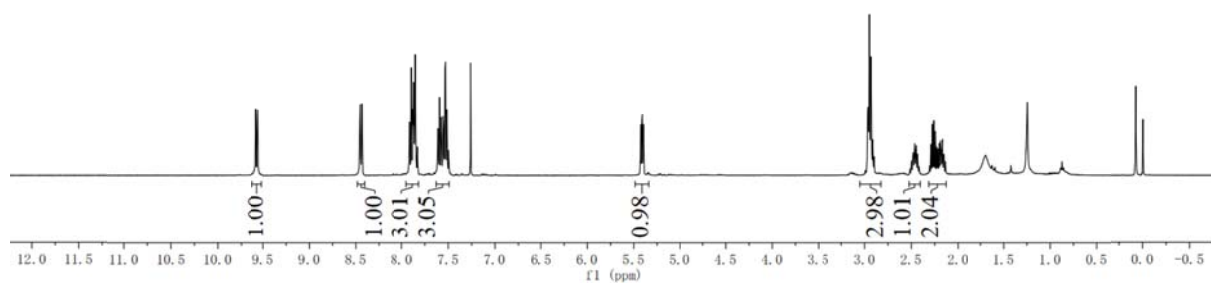
¹³C NMR (101M, CDCl₃) of 3af



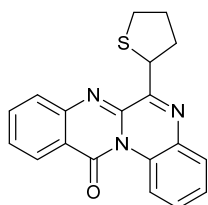
9.5804
9.5760
9.5600
9.5556
8.4571
8.4536
8.4369
8.4334
7.9162
7.8923
7.8493
7.8289
7.6136
7.5346
7.5289
7.4926
5.4260
5.4139
5.4081
5.3963
2.9920
2.9469
2.9312
2.8986
2.5150
2.4836
2.4634
2.4173
2.3056
2.2751
2.2599
2.1361



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



162.09
161.62
145.30
139.15
135.02
134.80
129.76
129.12
128.16
128.08
127.91
127.28
127.17
121.16
120.46
77.38
77.06
76.75
-47.80
33.19
32.12
31.33



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

