

*N,N*-Dimethylformamide as Carbon Synthons for the Synthesis of *N*-Heterocycles: Pyrrolo/Indolo[1,2-*a*]quinoxalines and Quinazolin-4-ones

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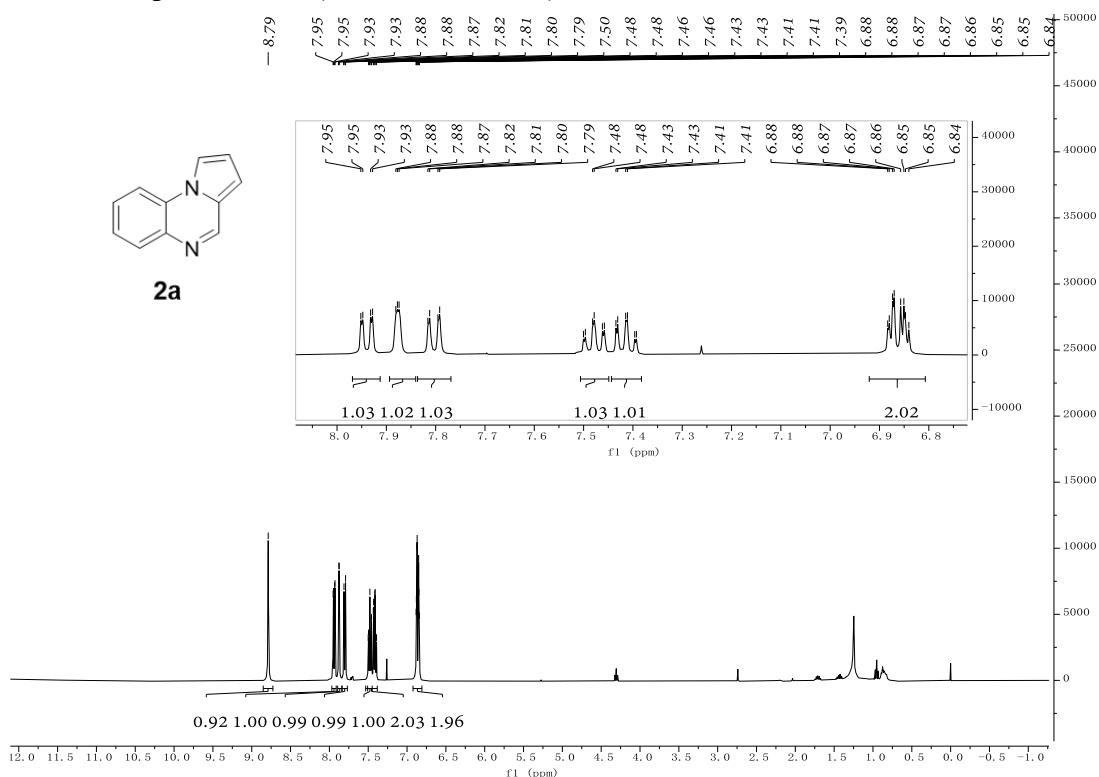
E-mail: [chenma@sdu.edu.cn](mailto:chenma@sdu.edu.cn)

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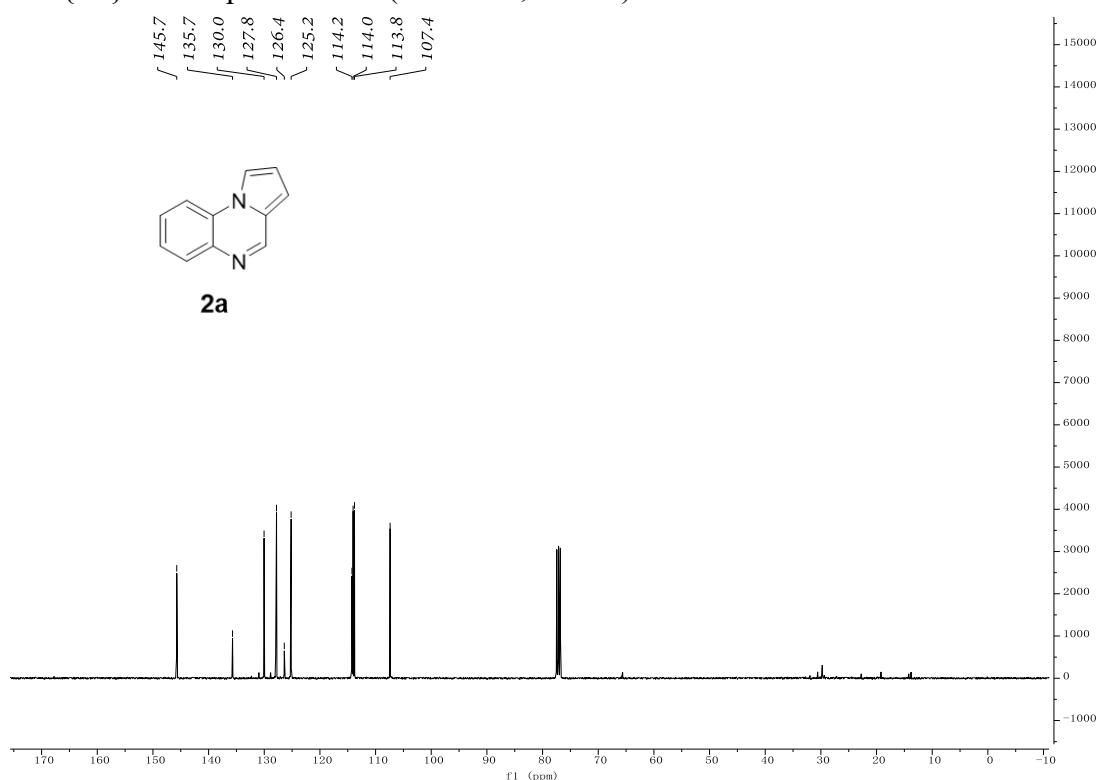
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## 1. NMR spectra

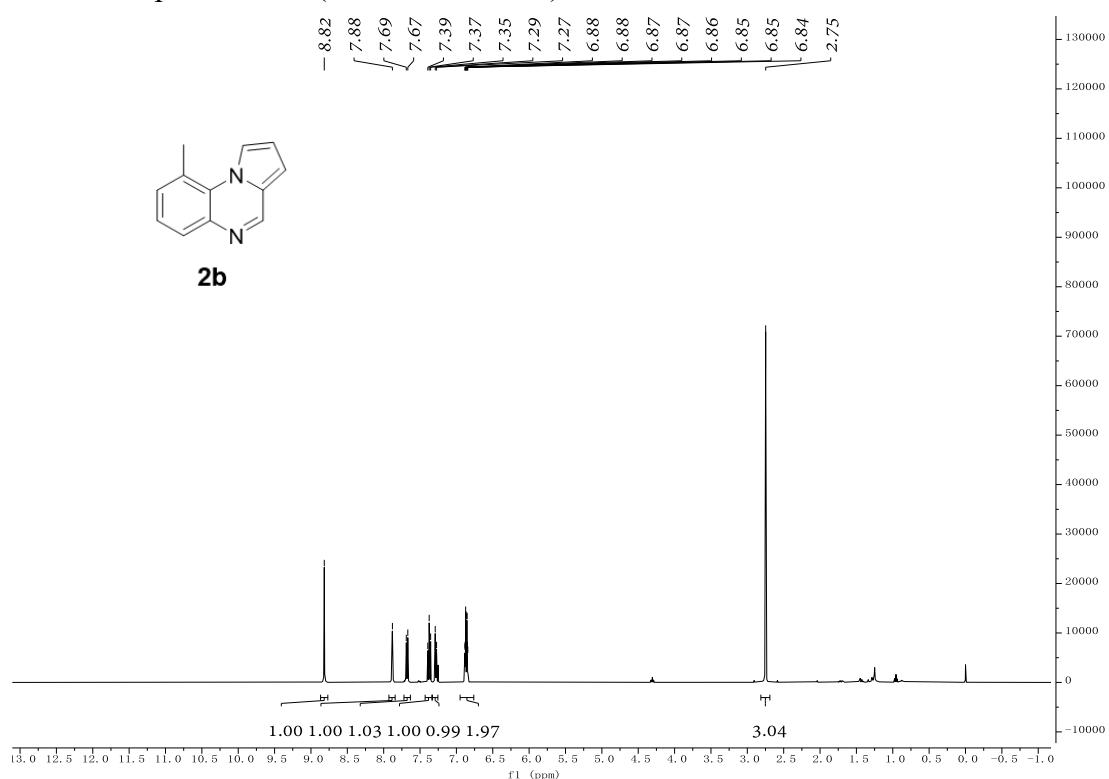
$^1\text{H}$  NMR spectra of **2a** (400 MHz,  $\text{CDCl}_3$ )



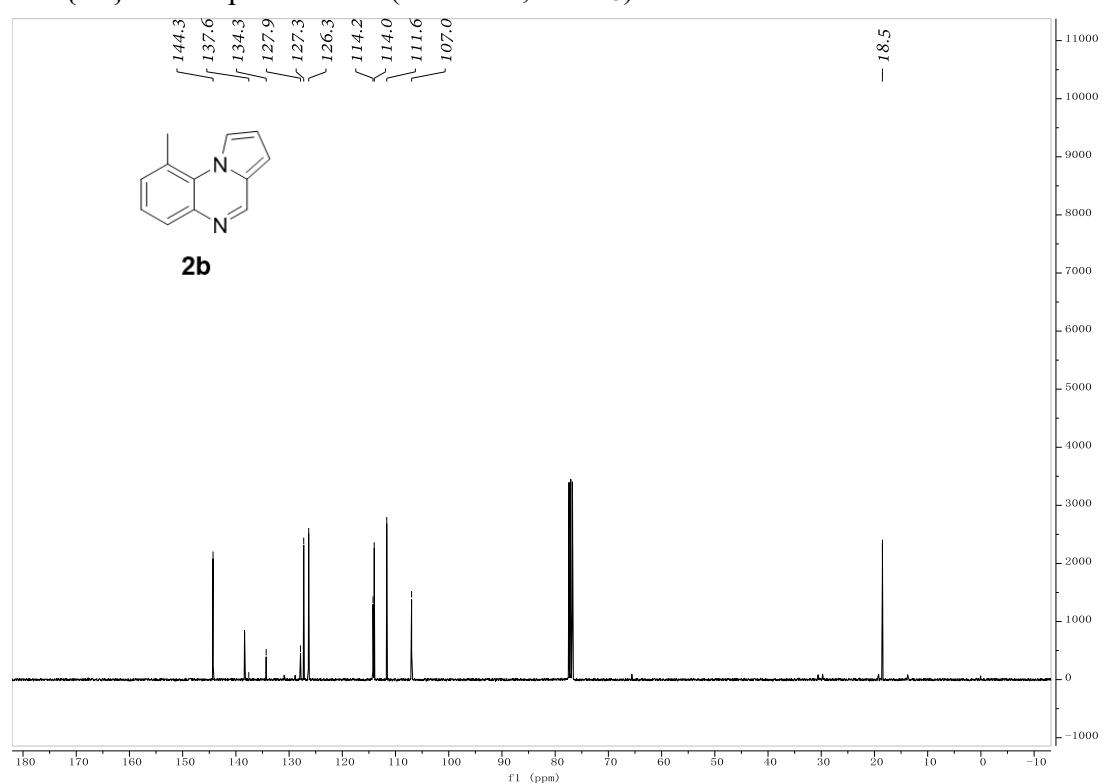
$^{13}\text{C}\{^1\text{H}\}$  NMR spectra of **2a** (100 MHz,  $\text{CDCl}_3$ )



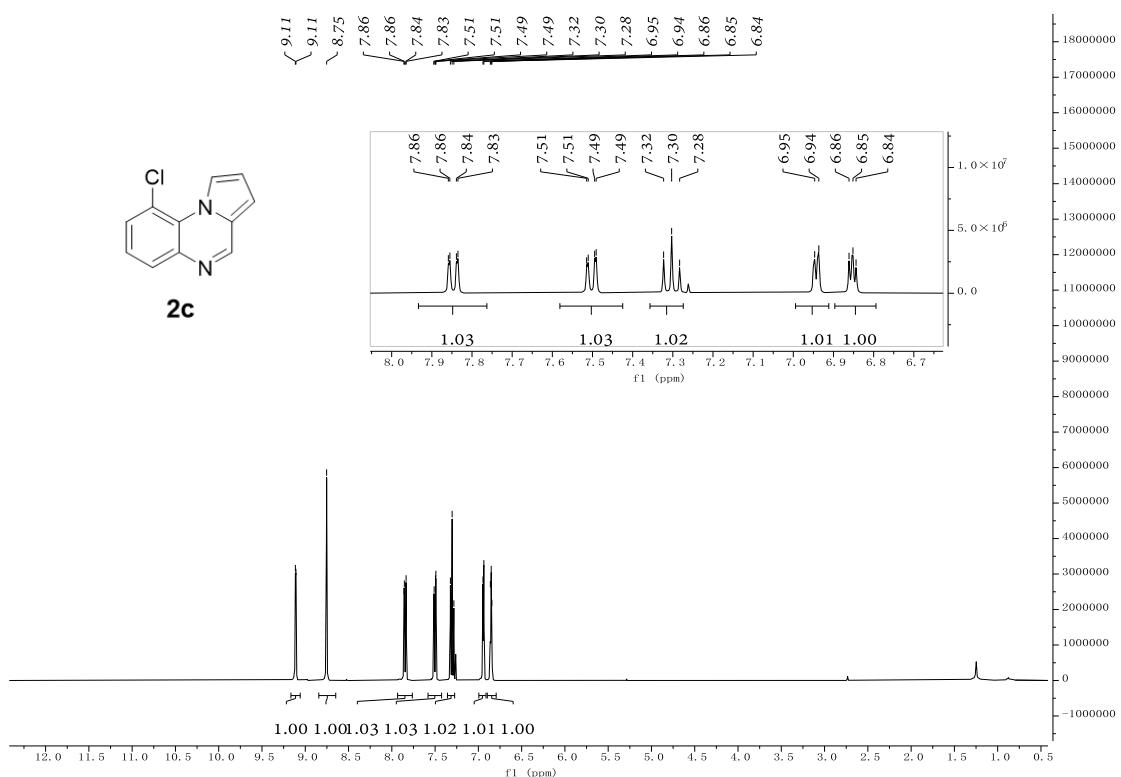
<sup>1</sup> H NMR spectra of **2b** (400 MHz, CDCl<sub>3</sub>)



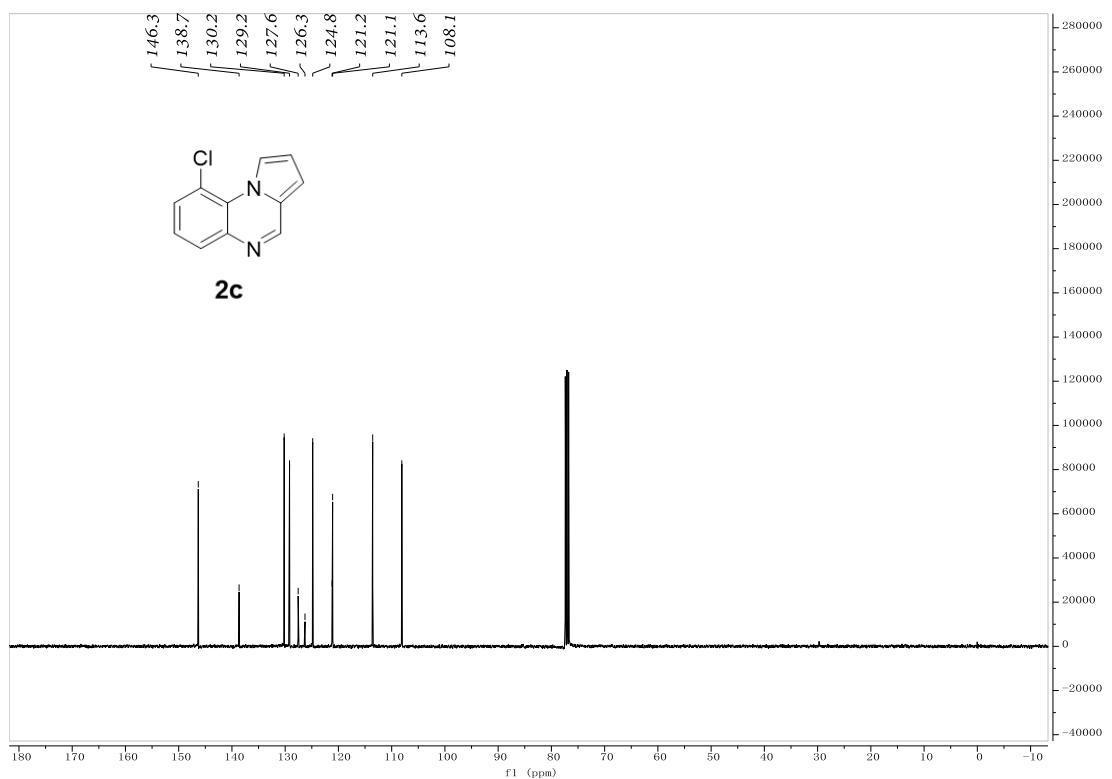
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2b** (100 MHz, CDCl<sub>3</sub>)



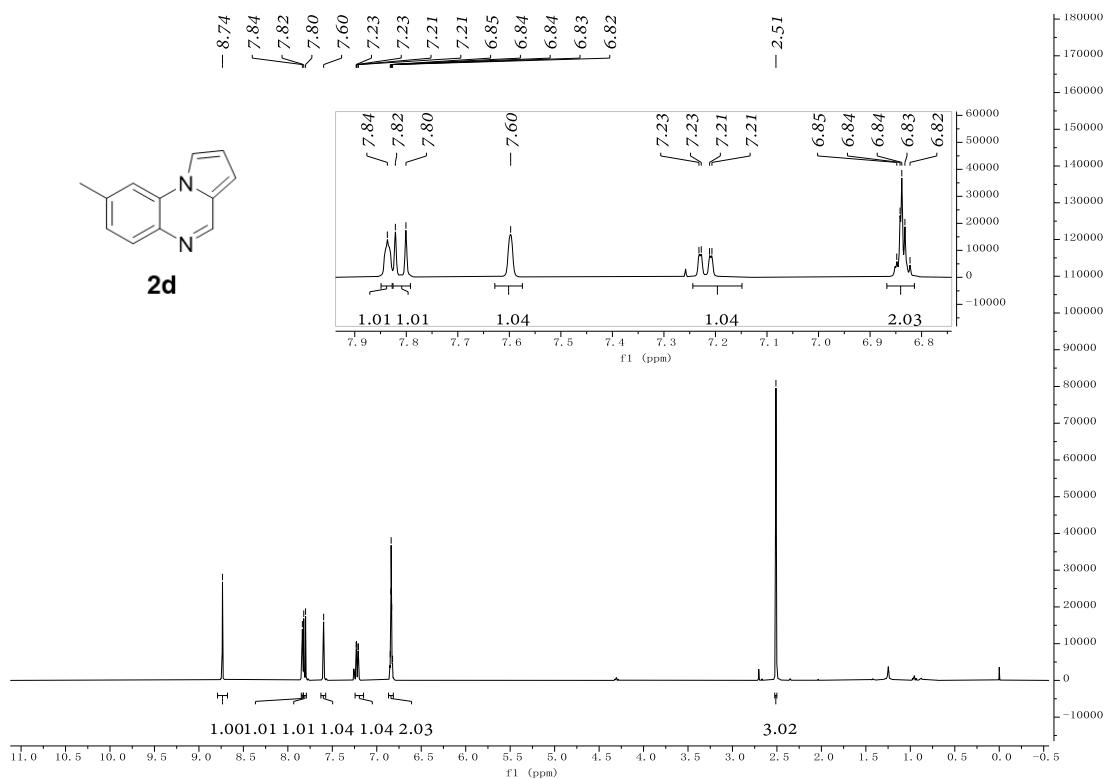
<sup>1</sup> H NMR spectra of **2c** (400 MHz, CDCl<sub>3</sub>)



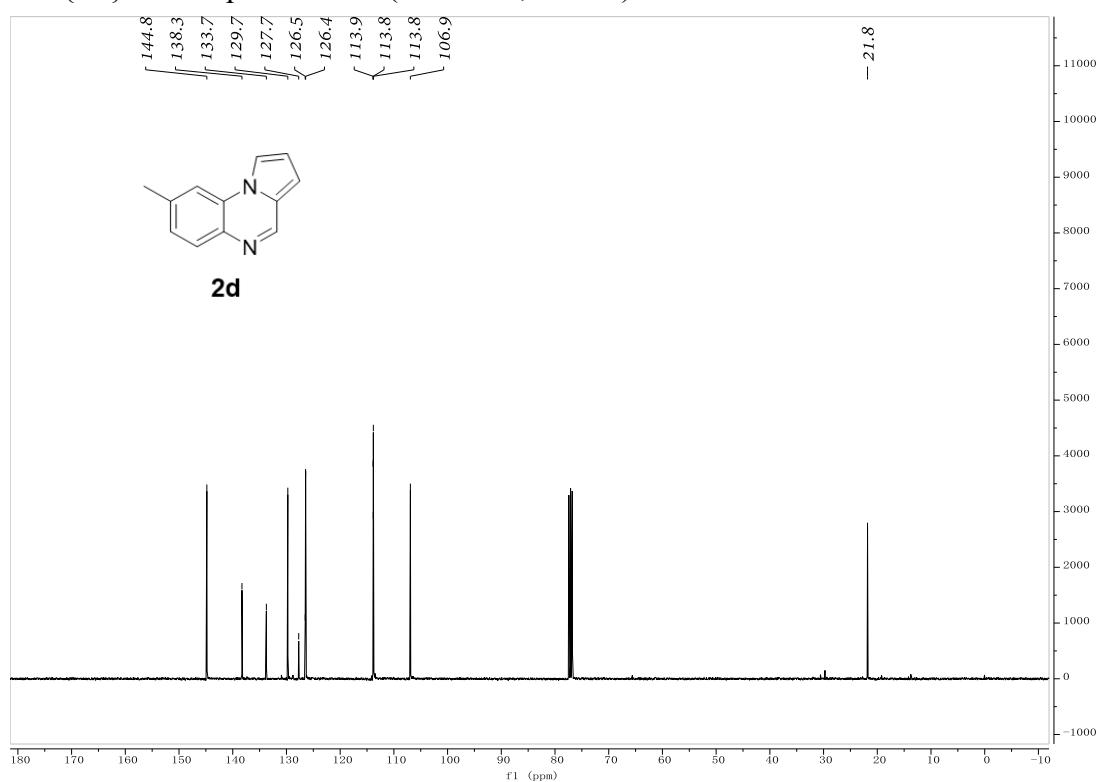
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2c** (100 MHz, CDCl<sub>3</sub>)



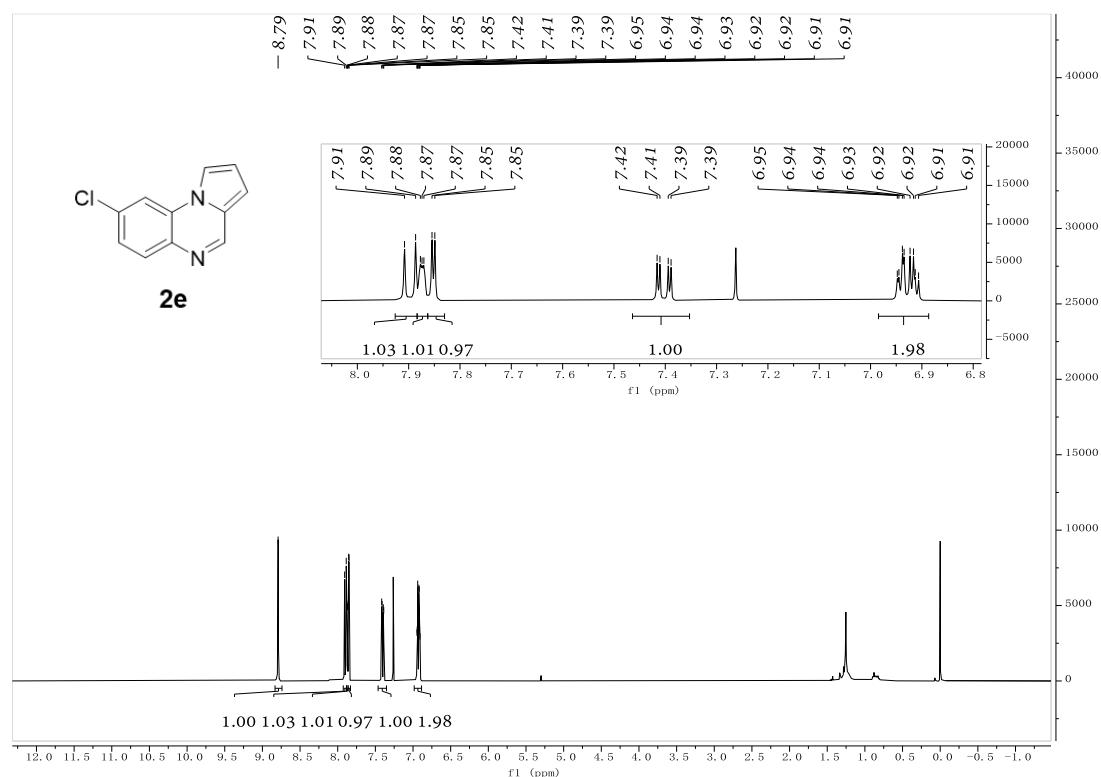
<sup>1</sup> H NMR spectra of **2d** (400 MHz, CDCl<sub>3</sub>)



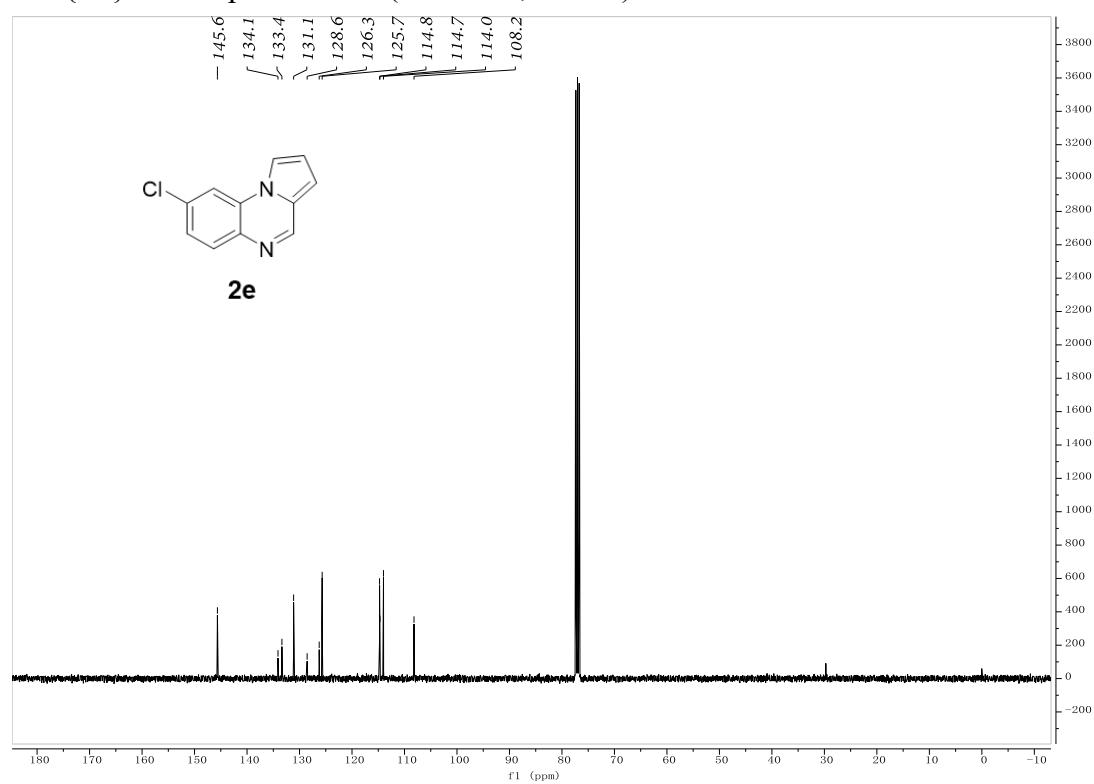
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **2d** (100 MHz, CDCl<sub>3</sub>)



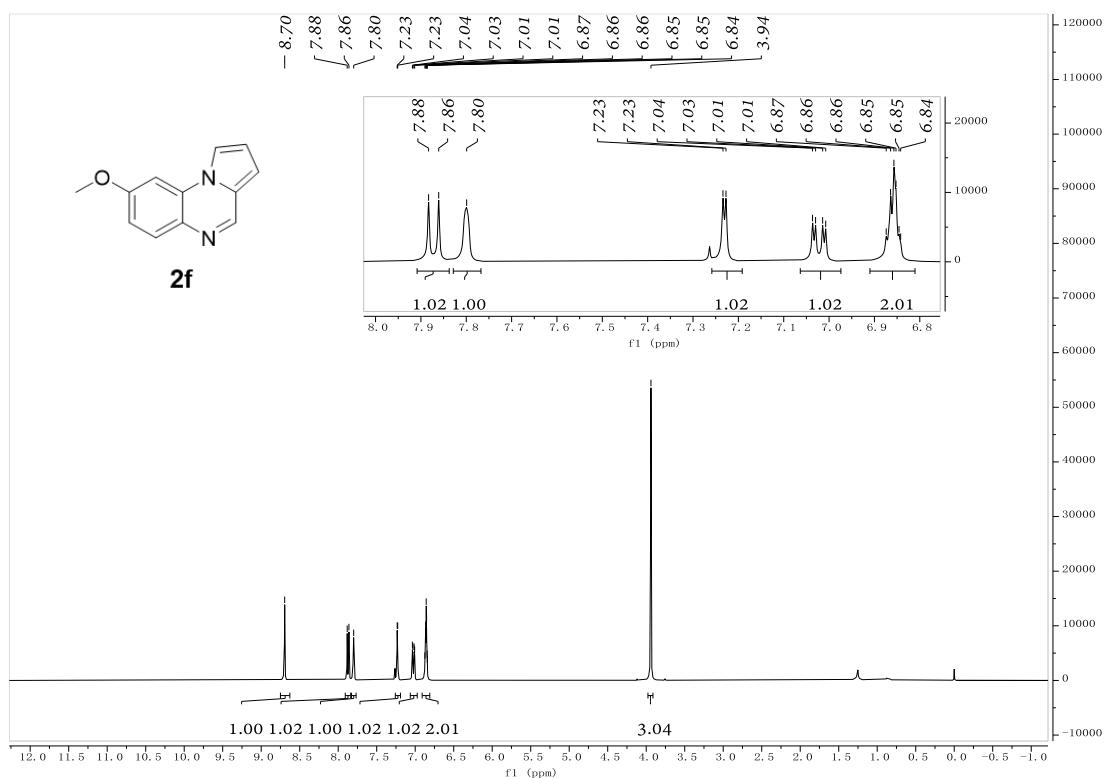
<sup>1</sup> H NMR spectra of **2e** (400 MHz, CDCl<sub>3</sub>)



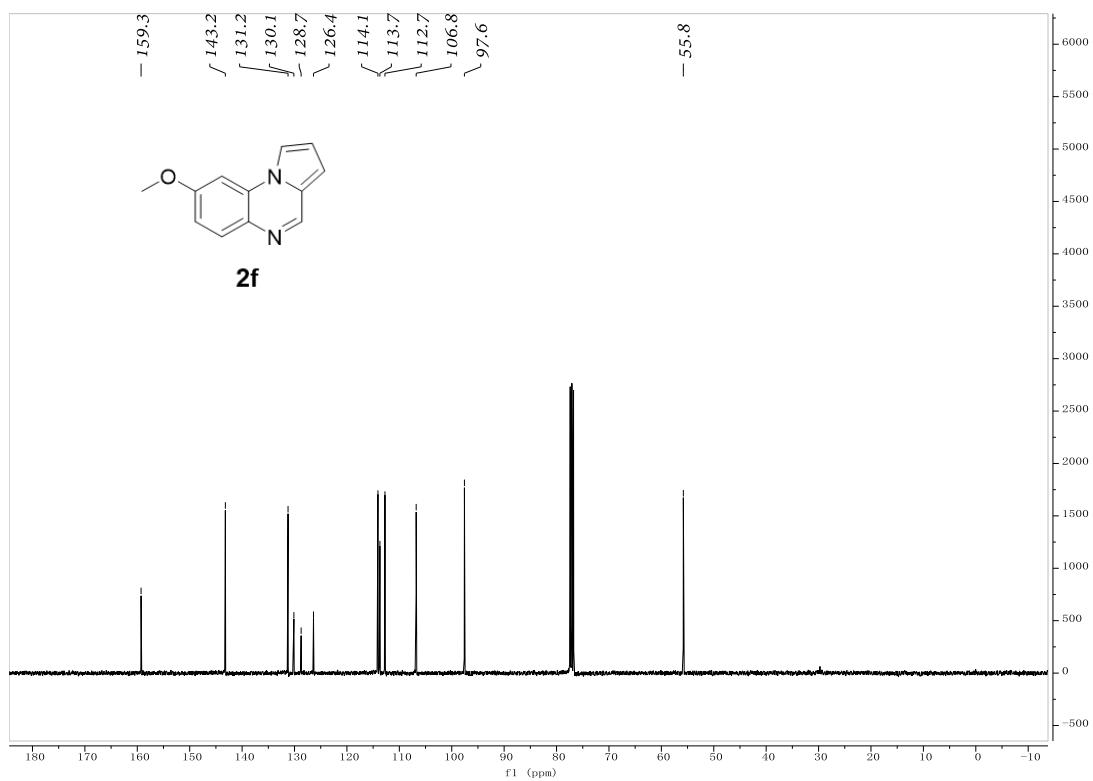
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2e** (100 MHz, CDCl<sub>3</sub>)



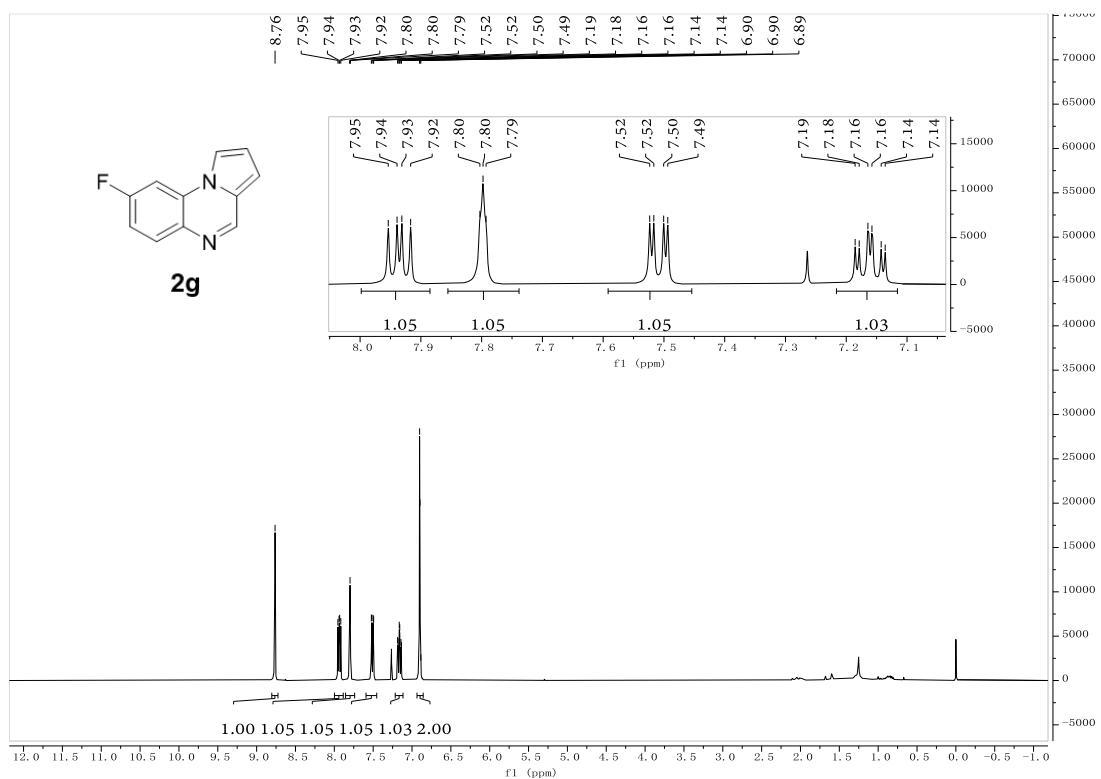
<sup>1</sup> H NMR spectra of **2f** (400 MHz, CDCl<sub>3</sub>)



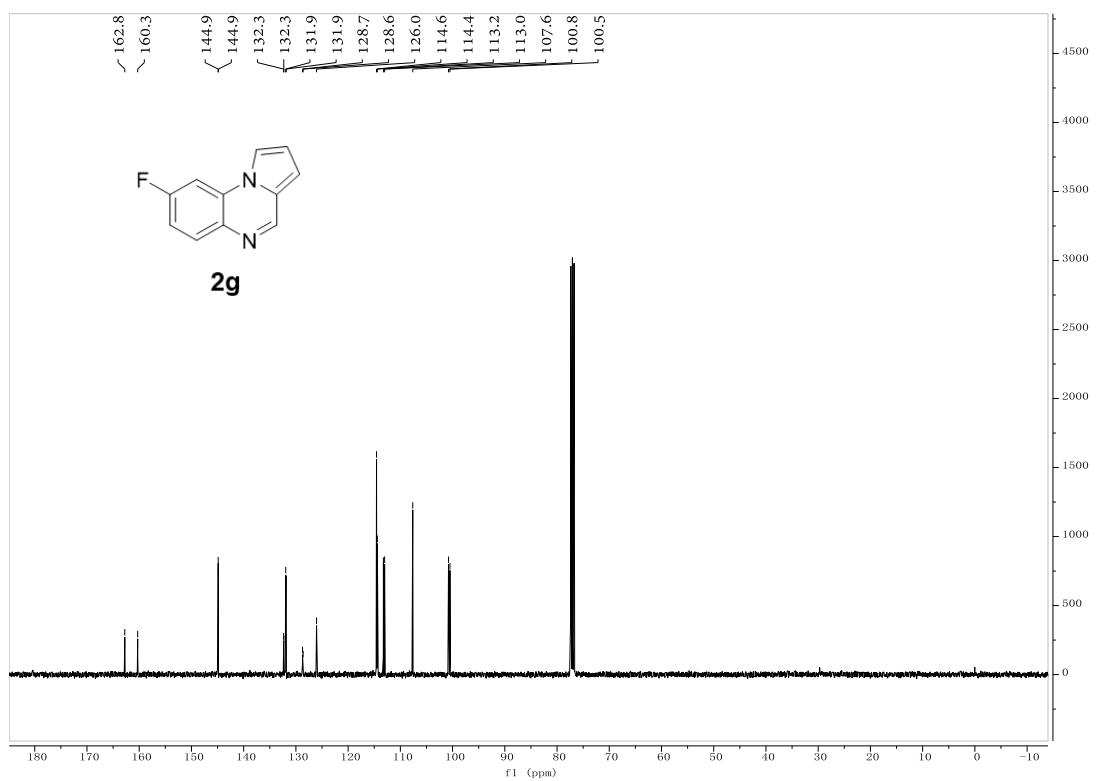
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **2f** (100 MHz, CDCl<sub>3</sub>)



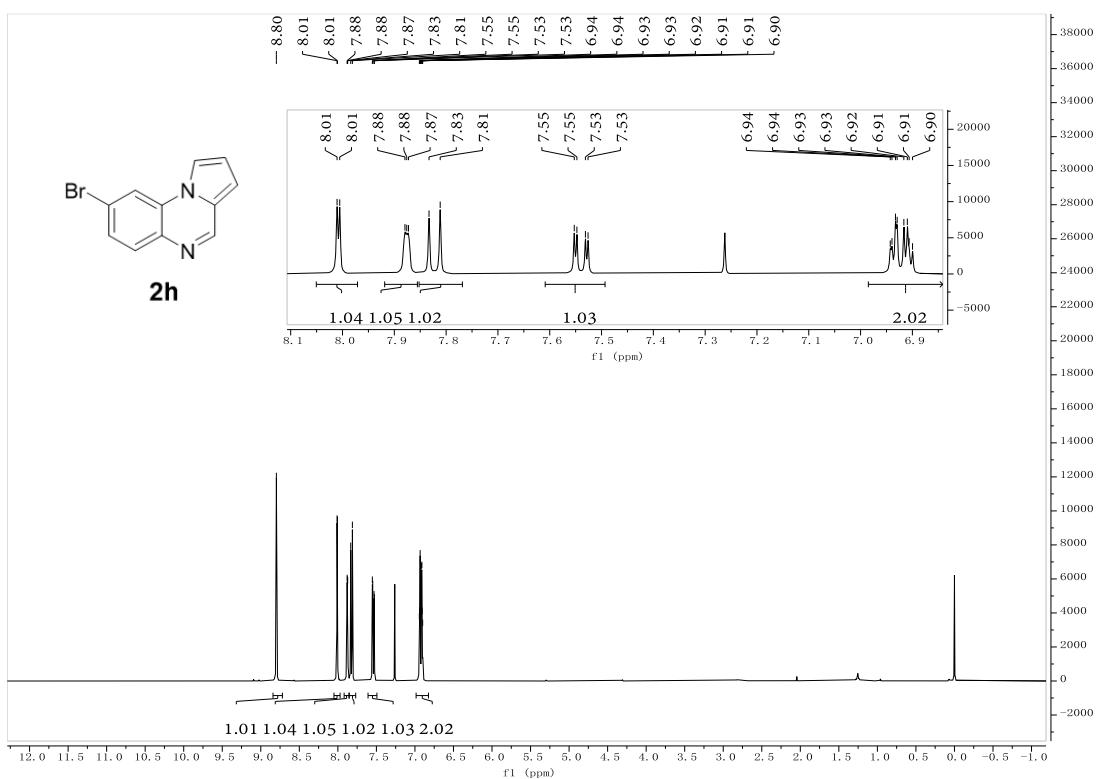
<sup>1</sup> H NMR spectra of **2g** (400 MHz, CDCl<sub>3</sub>)



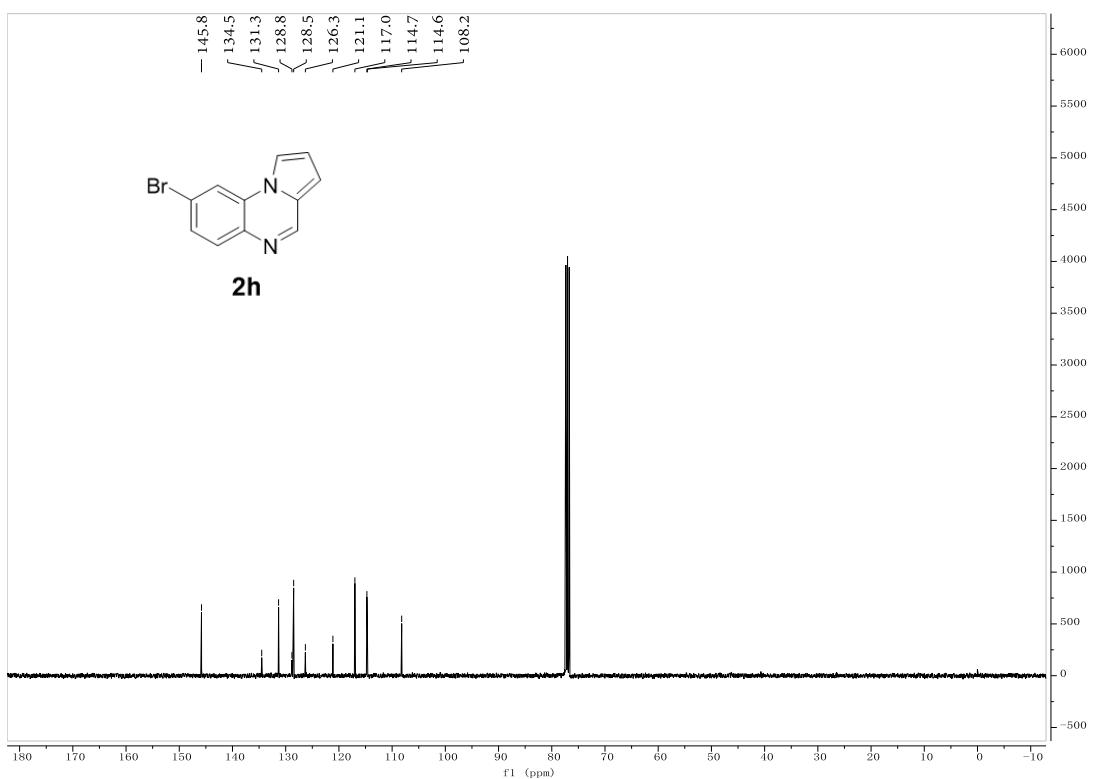
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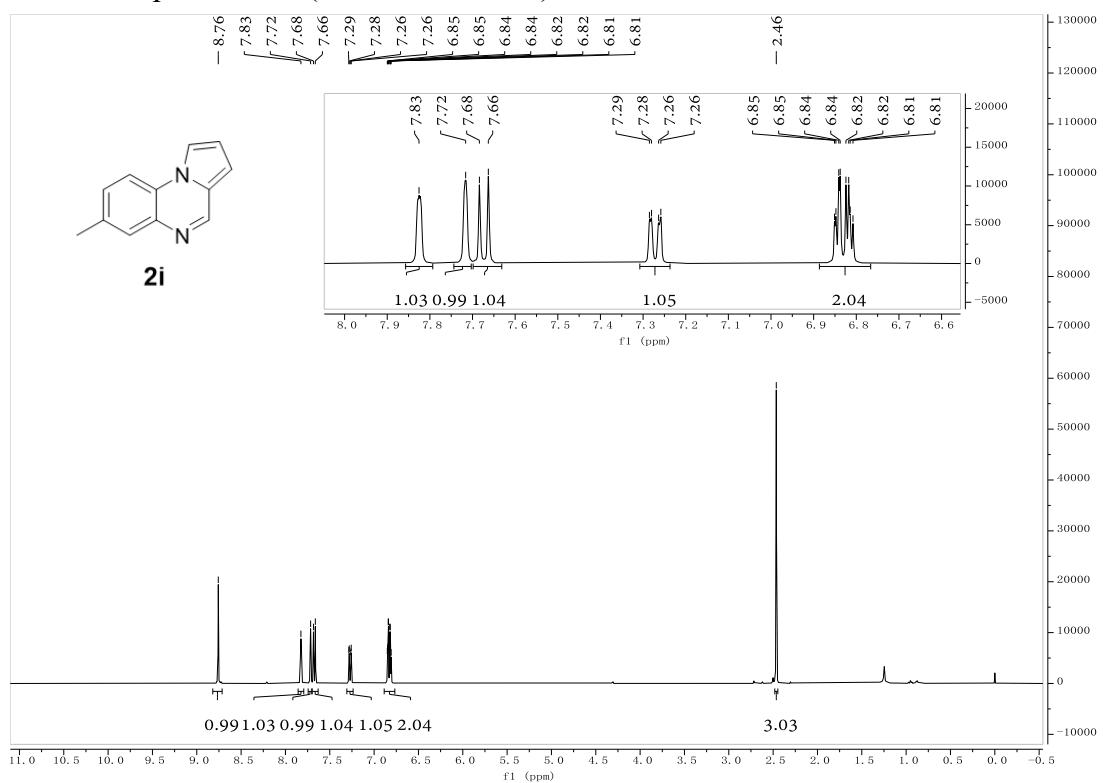
<sup>1</sup> H NMR spectra of **2h** (400 MHz, CDCl<sub>3</sub>)



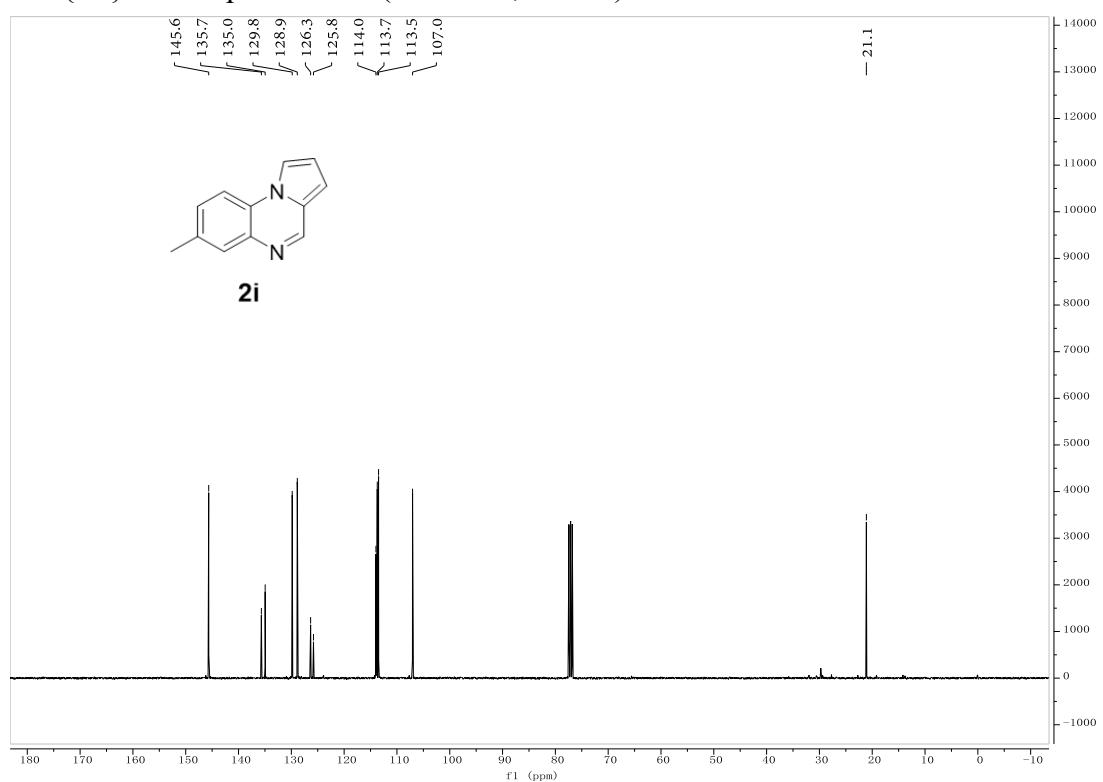
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2h** (100 MHz, CDCl<sub>3</sub>)



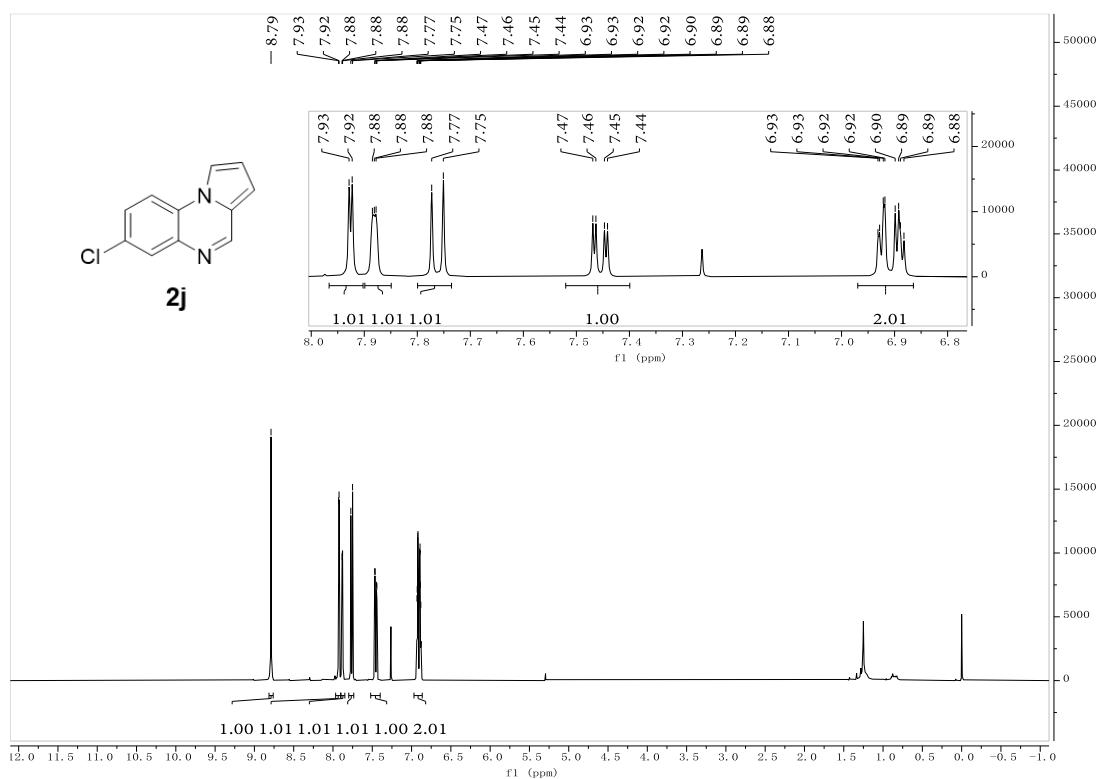
<sup>1</sup> H NMR spectra of **2i** (400 MHz, CDCl<sub>3</sub>)



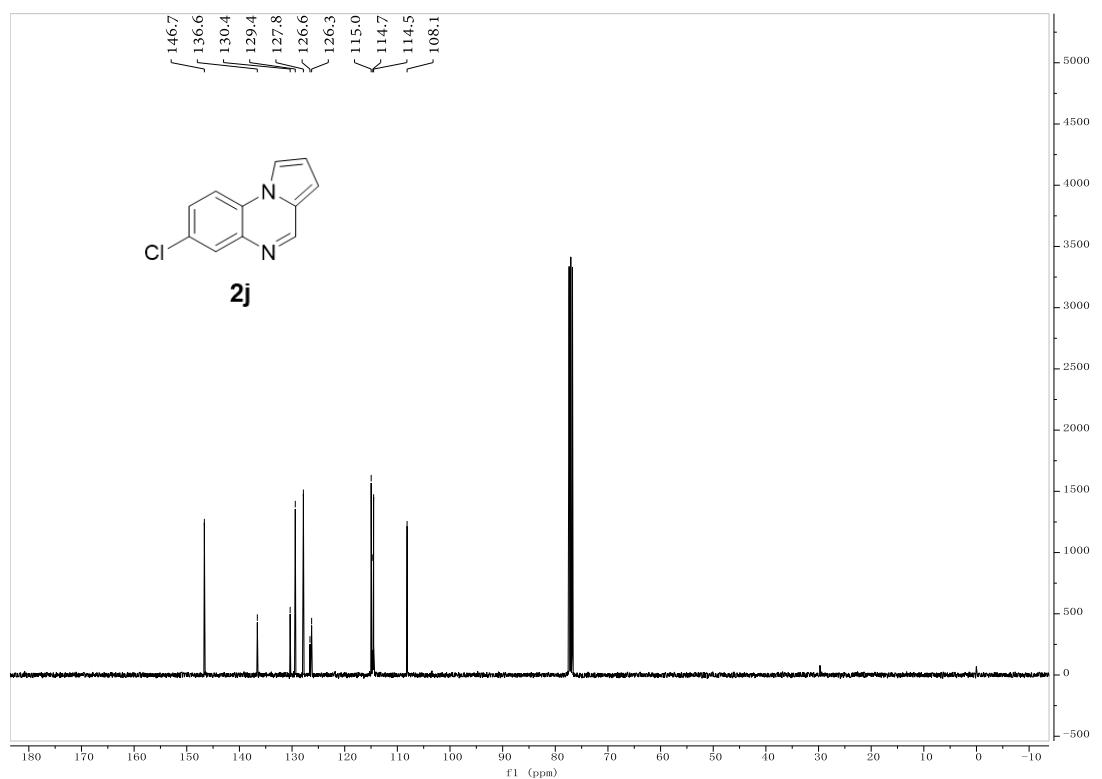
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **2i** (100 MHz, CDCl<sub>3</sub>)



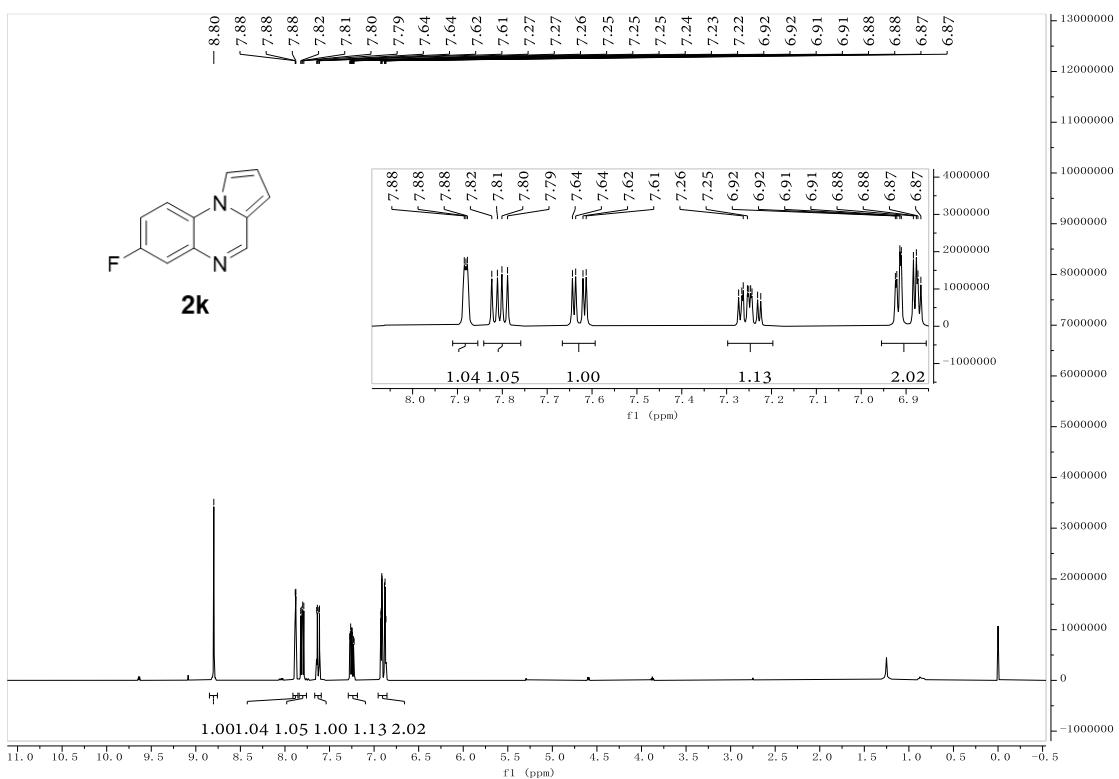
<sup>1</sup> H NMR spectra of **2j** (400 MHz, CDCl<sub>3</sub>)



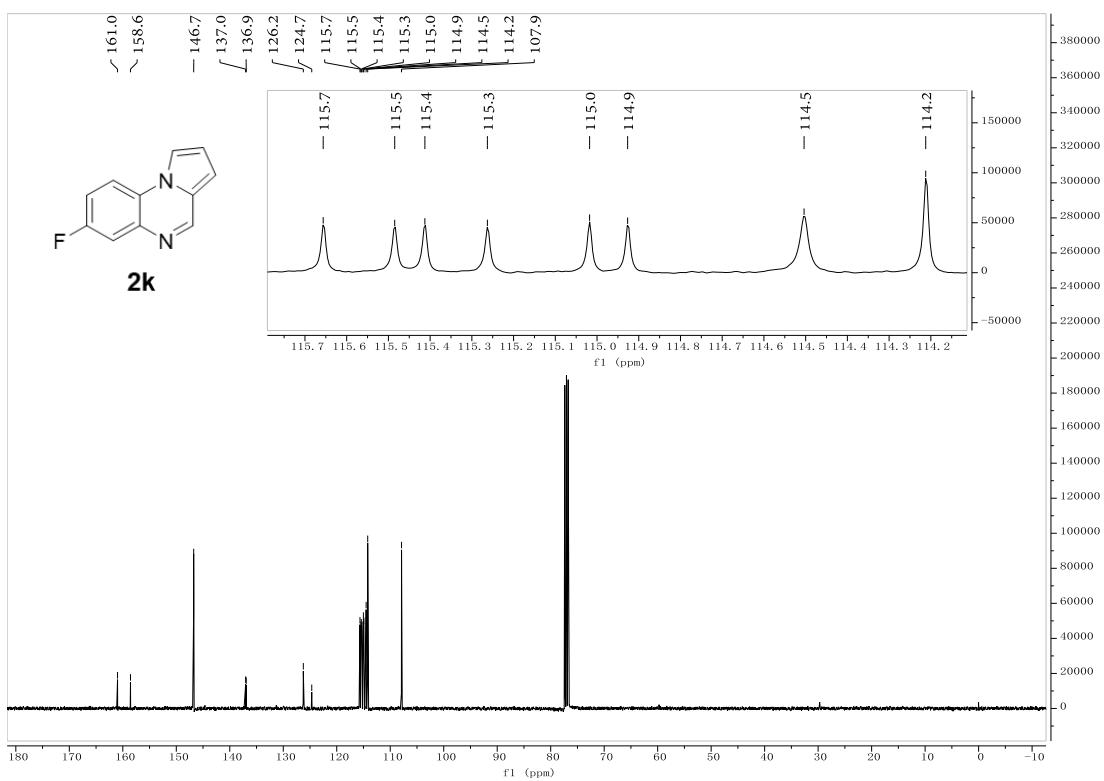
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2j** (100 MHz, CDCl<sub>3</sub>)



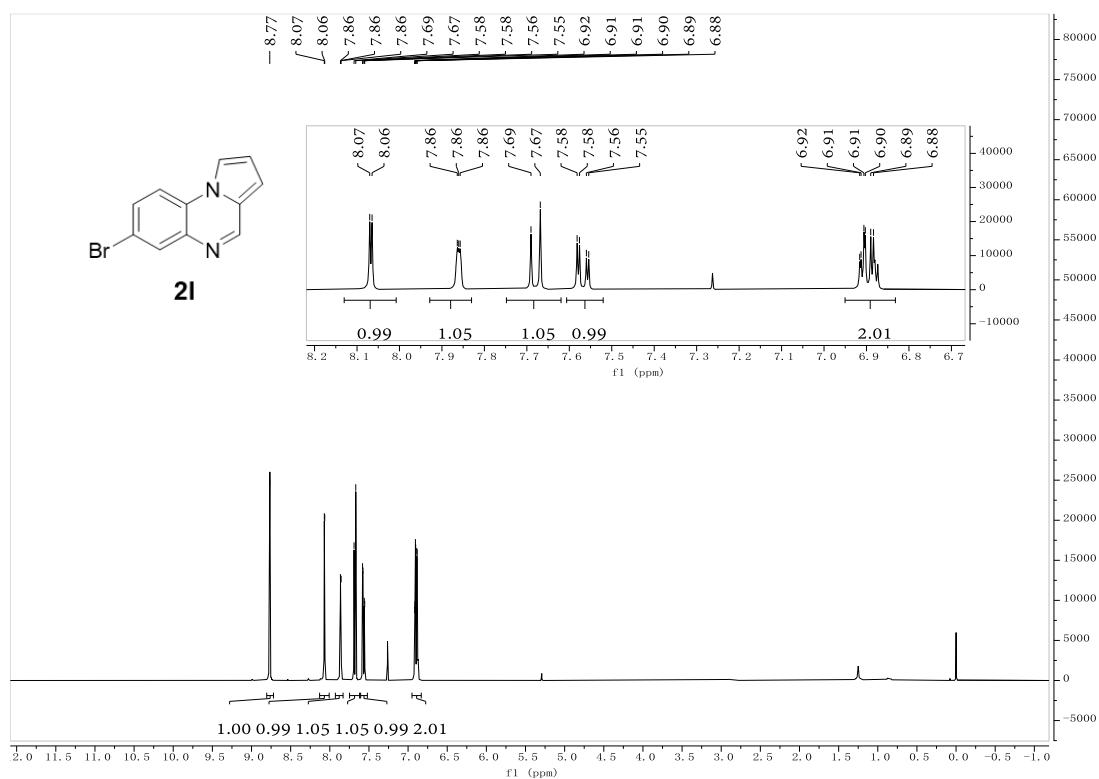
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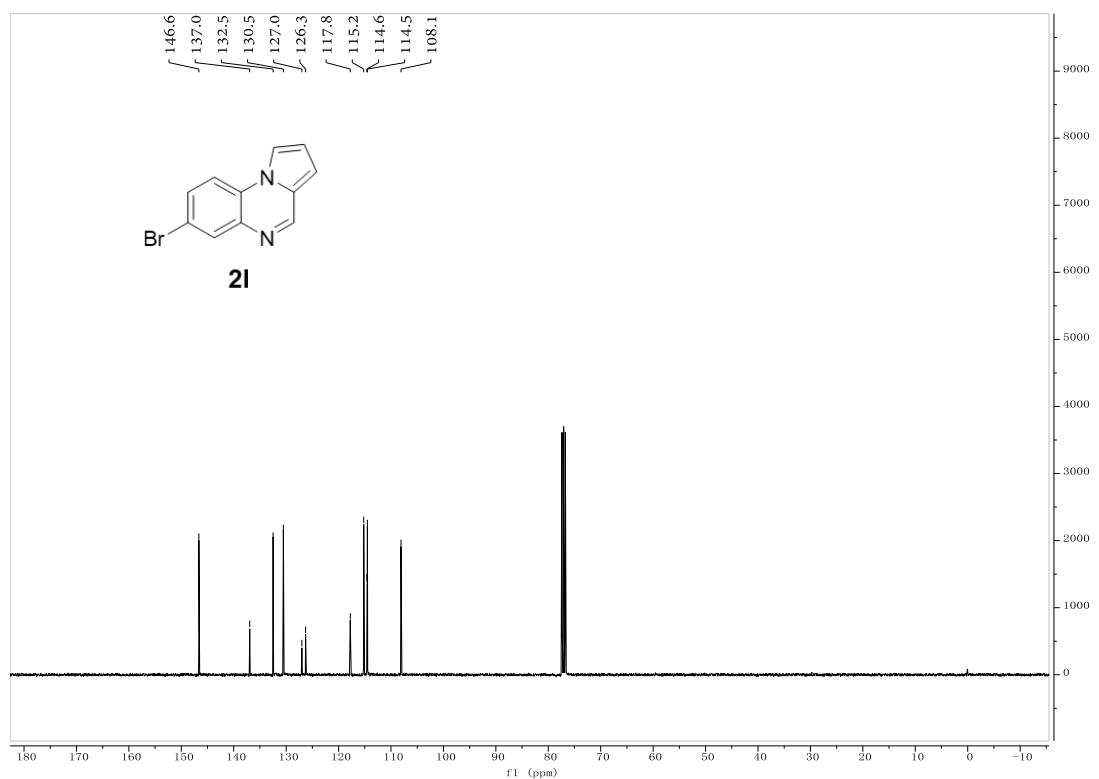
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2k** (100 MHz, CDCl<sub>3</sub>)



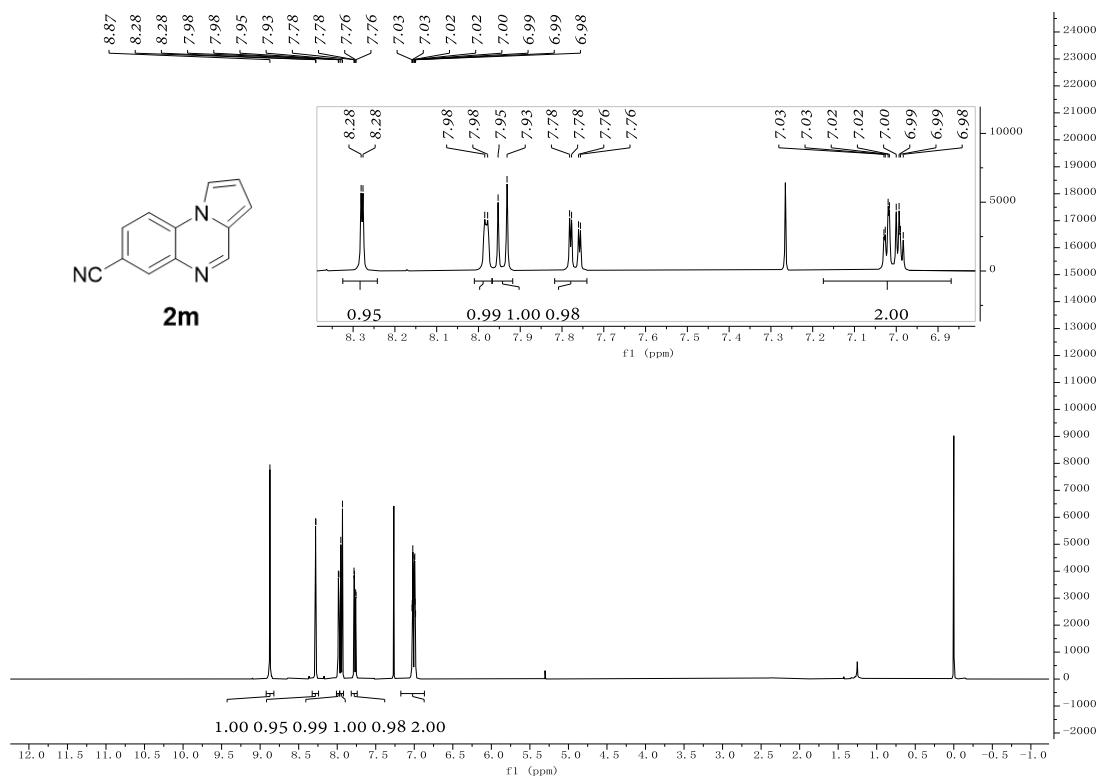
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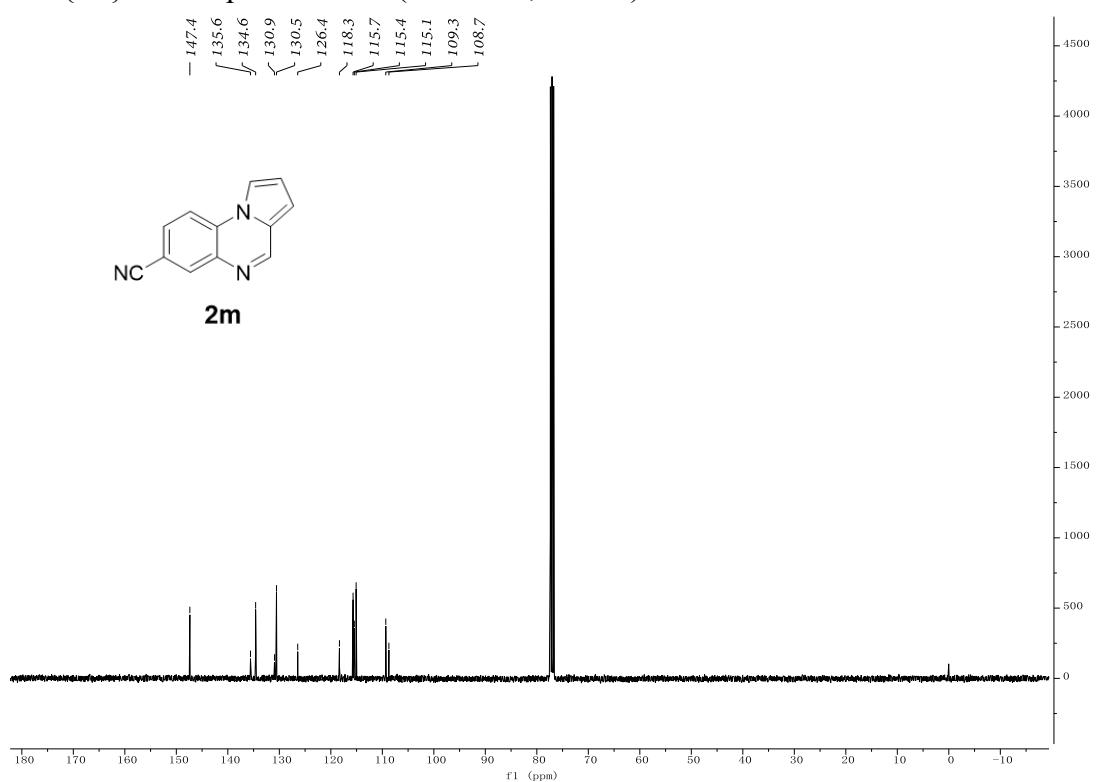
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2I** (100 MHz, CDCl<sub>3</sub>)



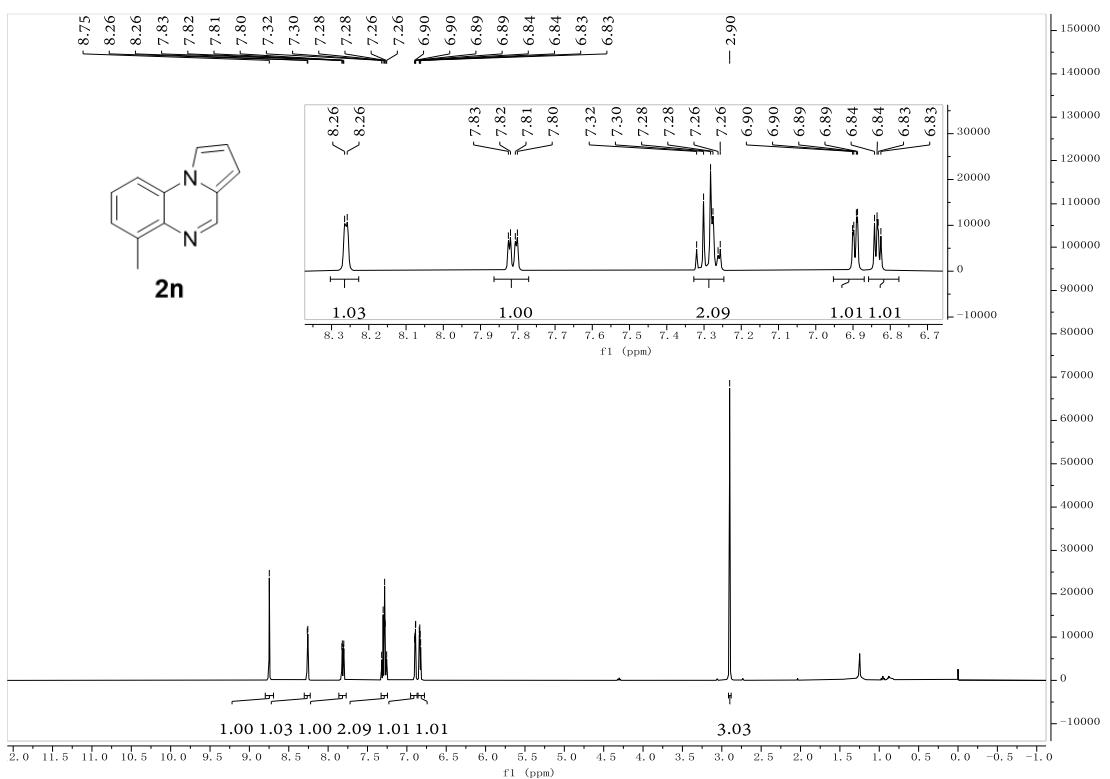
<sup>1</sup> H NMR spectra of **2m** (400 MHz, CDCl<sub>3</sub>)



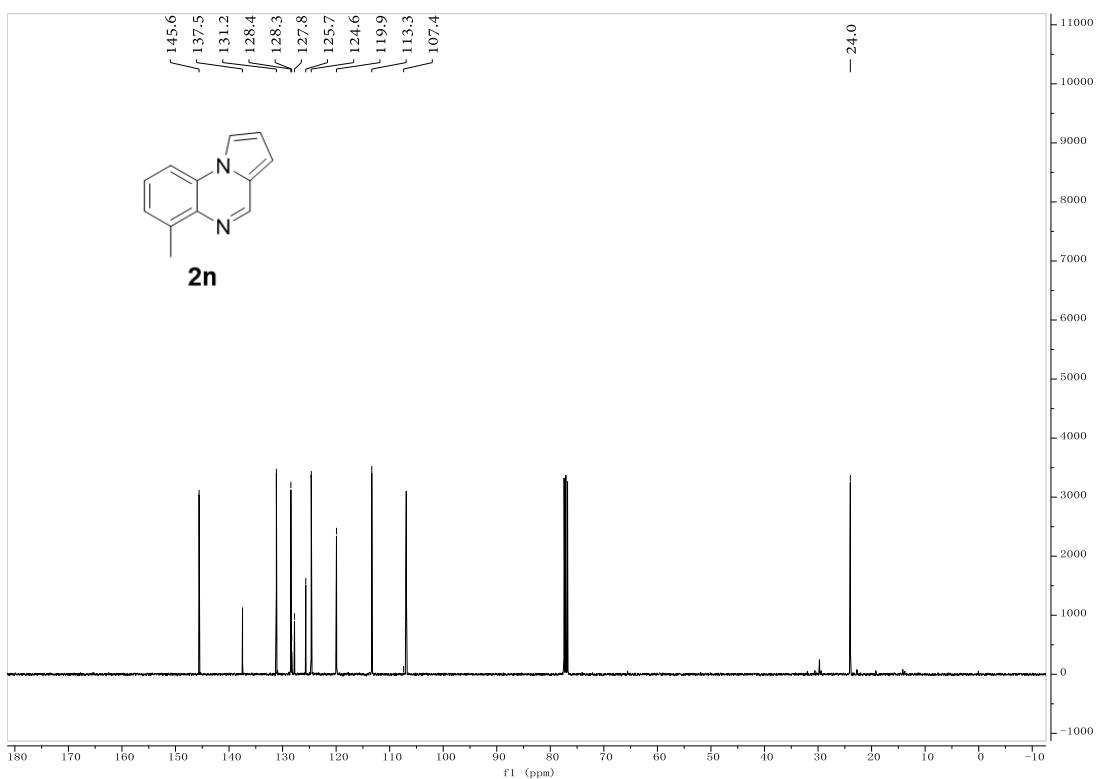
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2m** (100 MHz, CDCl<sub>3</sub>)



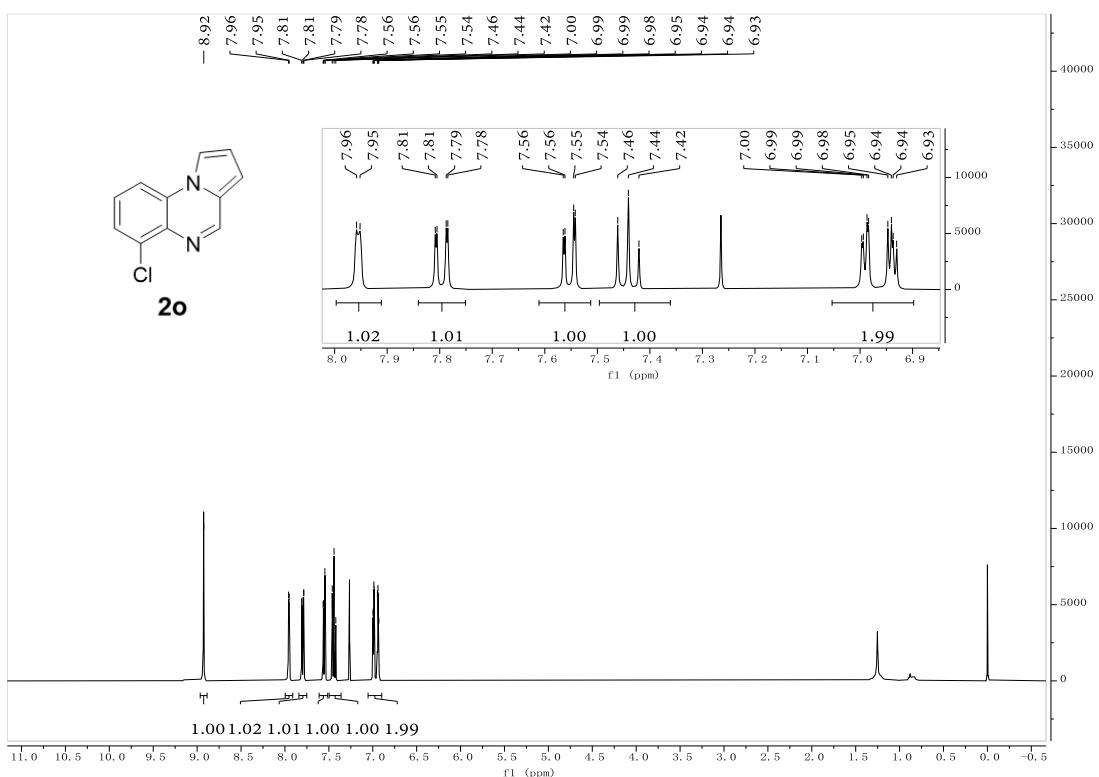
<sup>1</sup> H NMR spectra of **2n** (400 MHz, CDCl<sub>3</sub>)



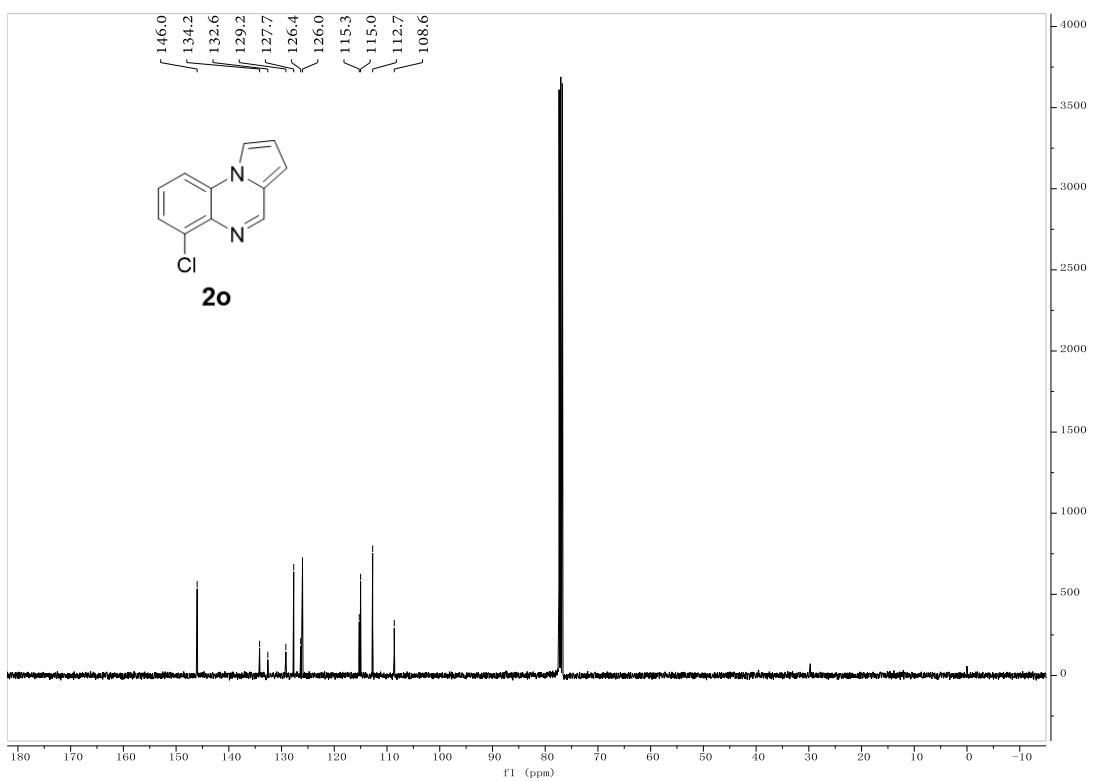
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2n** (100 MHz, CDCl<sub>3</sub>)



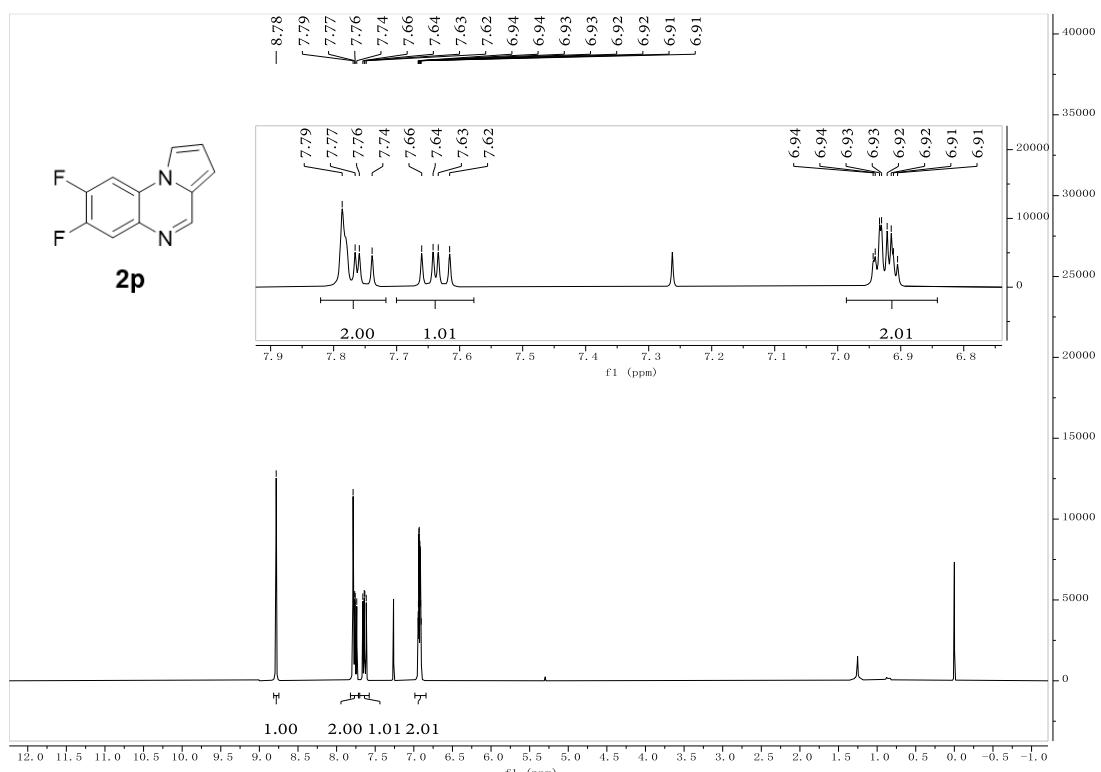
<sup>1</sup> H NMR spectra of **2o** (400 MHz, CDCl<sub>3</sub>)



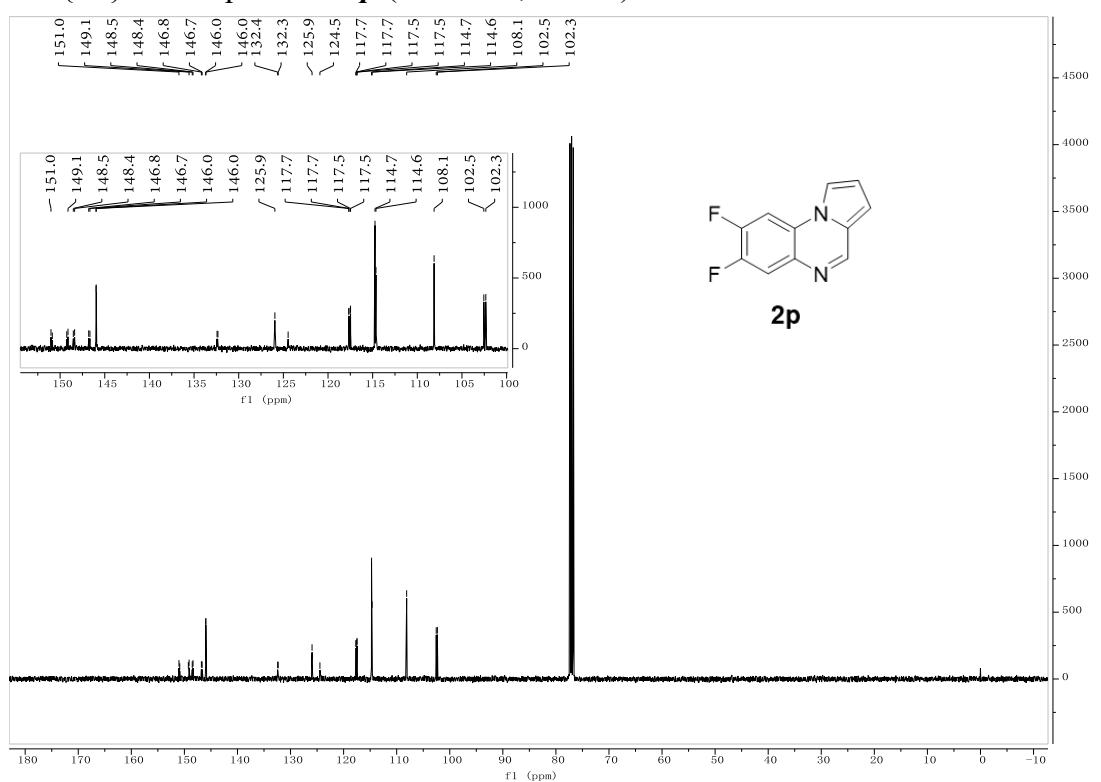
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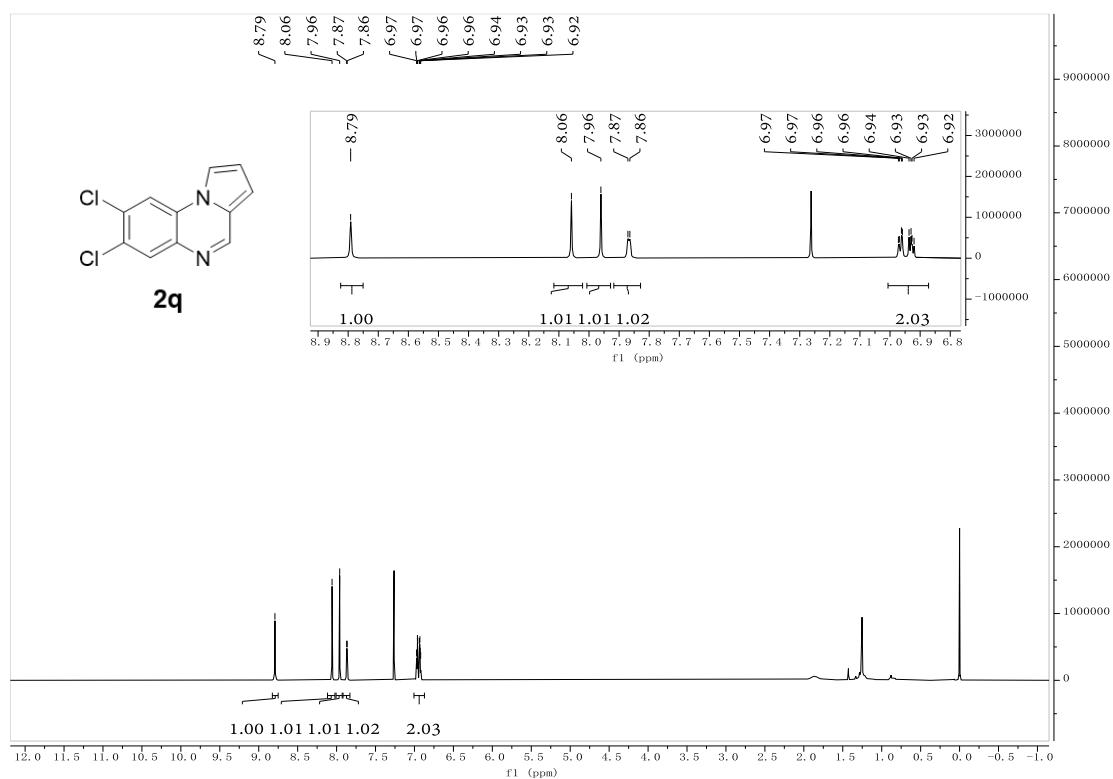
<sup>1</sup> H NMR spectra of **2p** (400 MHz, CDCl<sub>3</sub>)



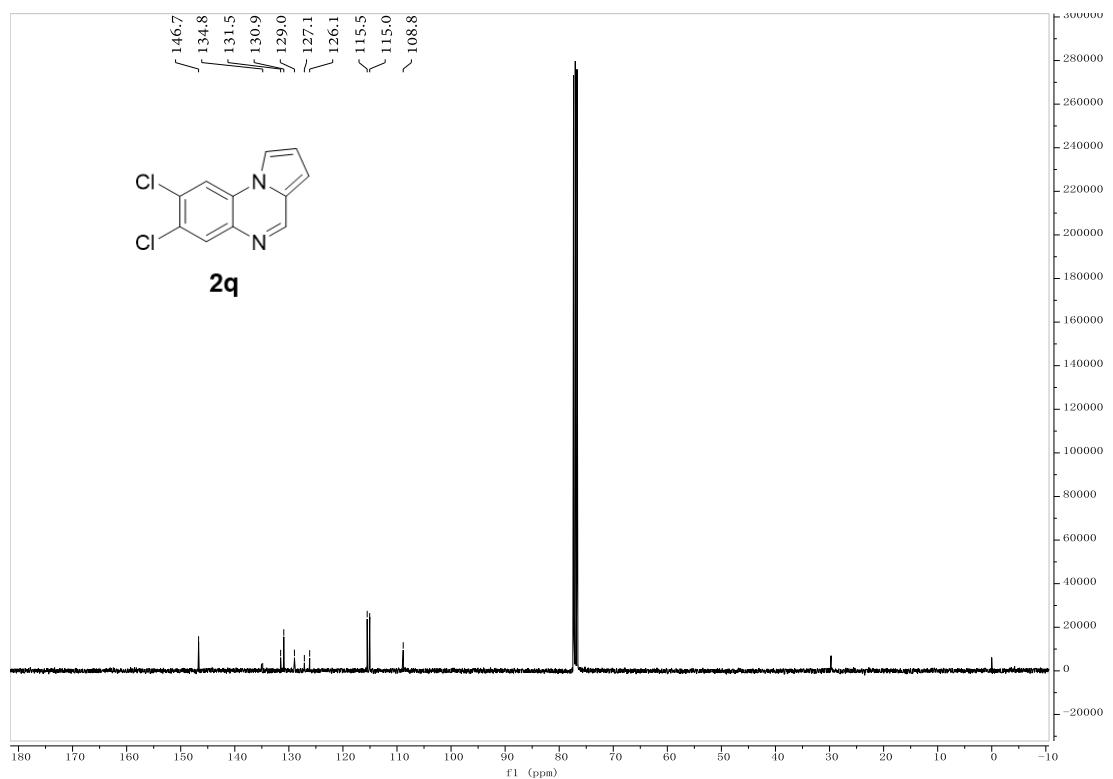
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2p** (100 MHz, CDCl<sub>3</sub>)



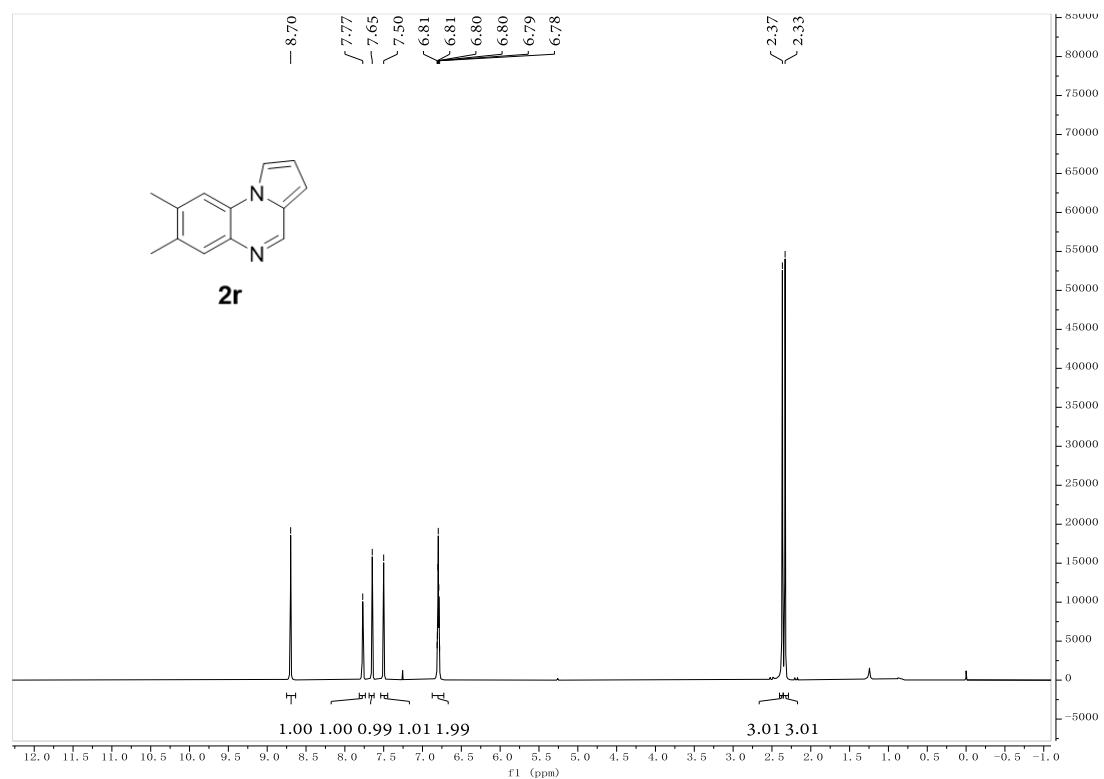
<sup>1</sup> H NMR spectra of **2q** (400 MHz, CDCl<sub>3</sub>)



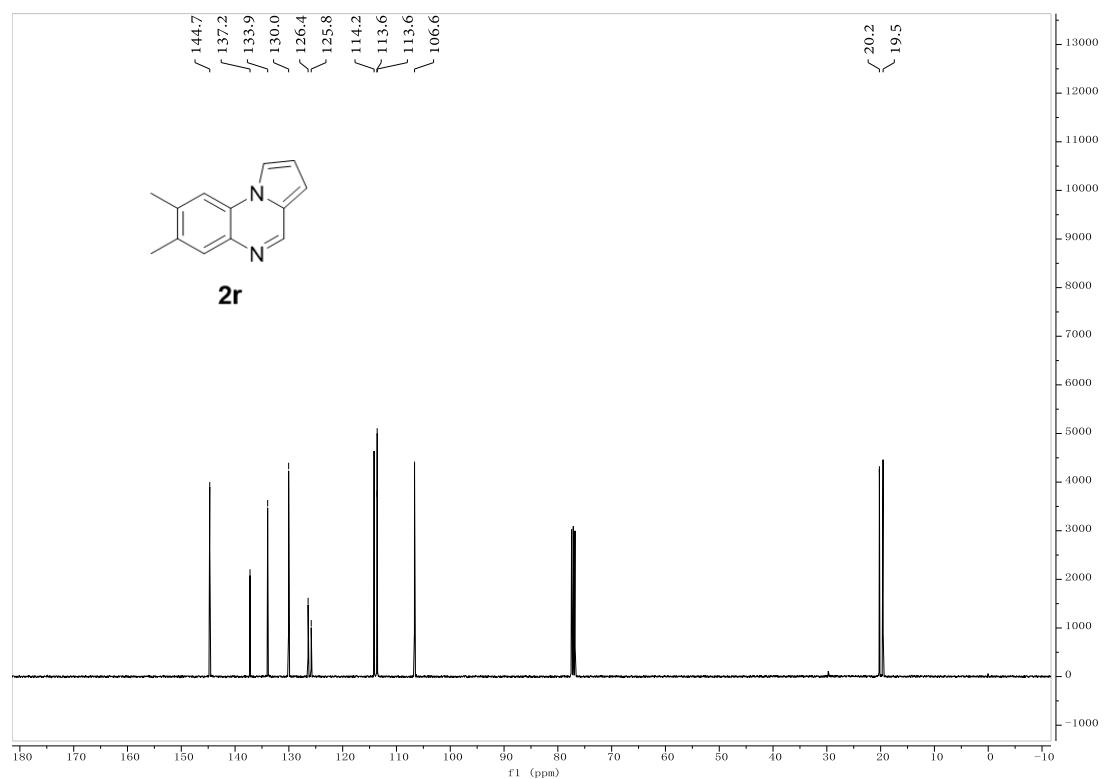
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2q** (100 MHz, CDCl<sub>3</sub>)



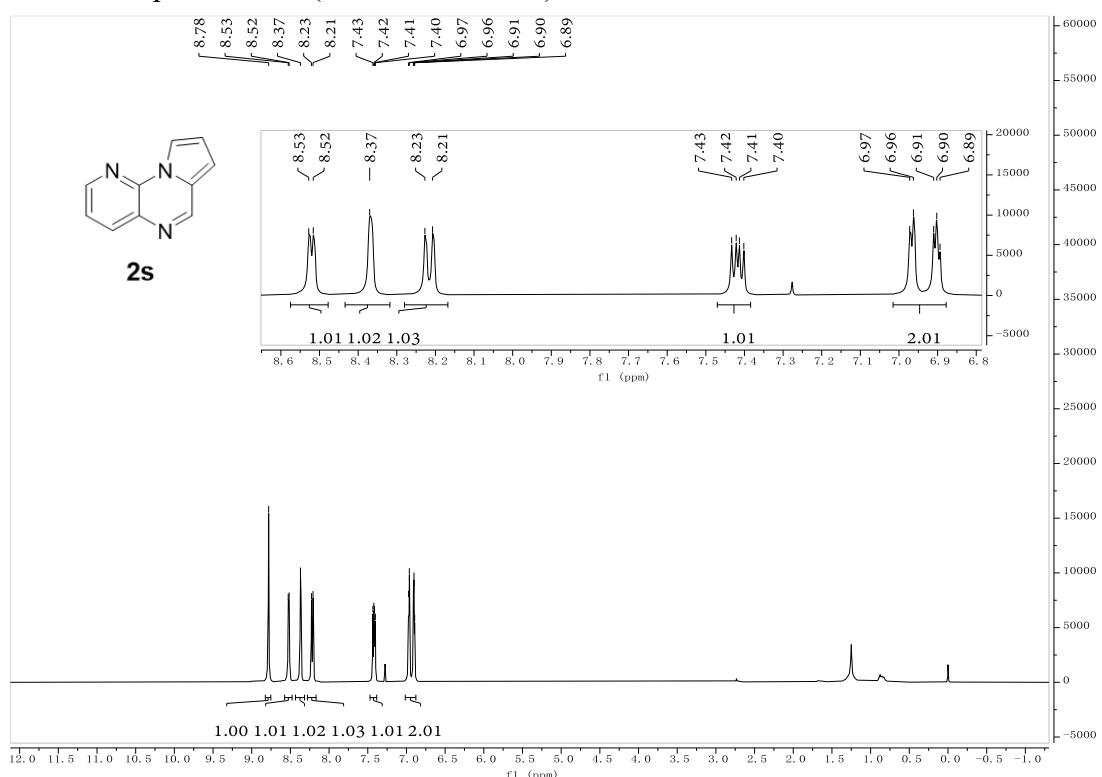
<sup>1</sup> H NMR spectra of **2r** (400 MHz, CDCl<sub>3</sub>)



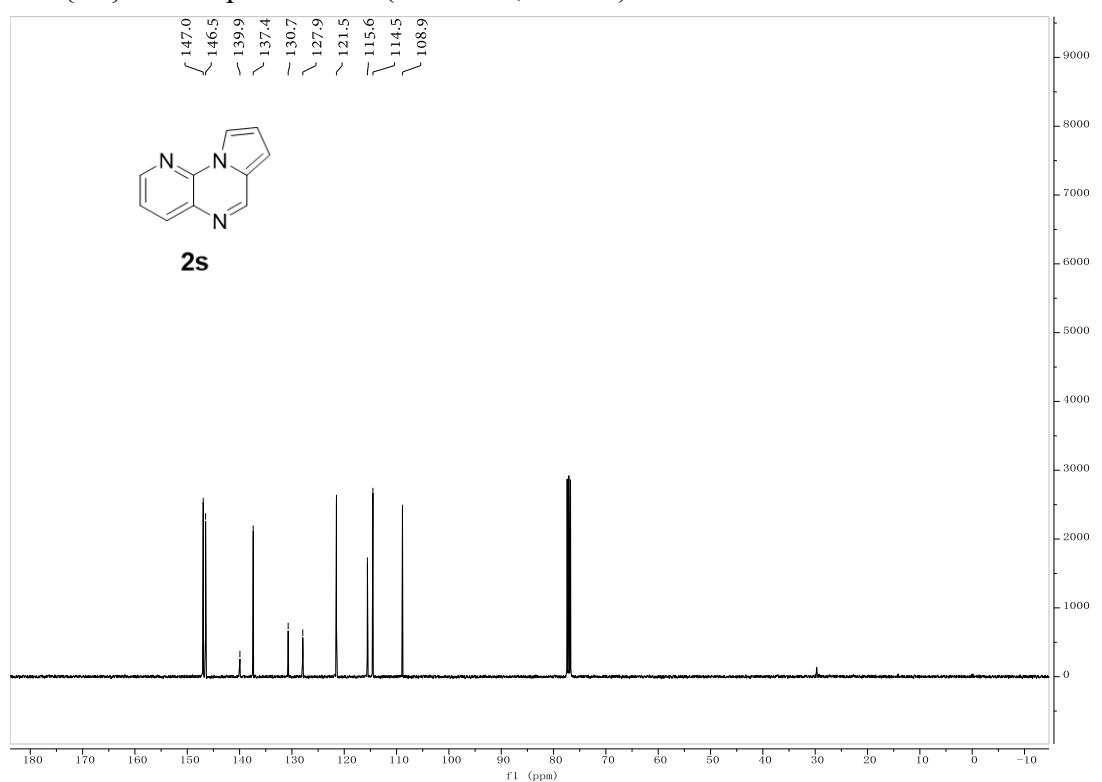
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2r** (100 MHz, CDCl<sub>3</sub>)



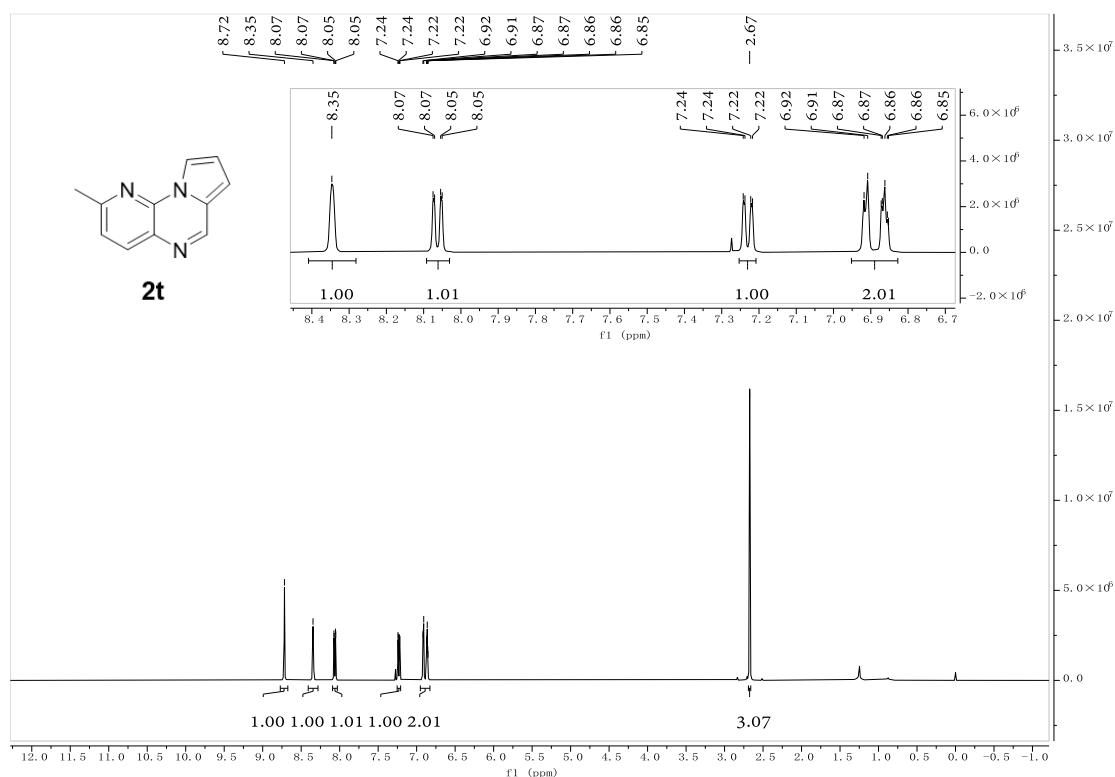
<sup>1</sup> H NMR spectra of **2s** (400 MHz, CDCl<sub>3</sub>)



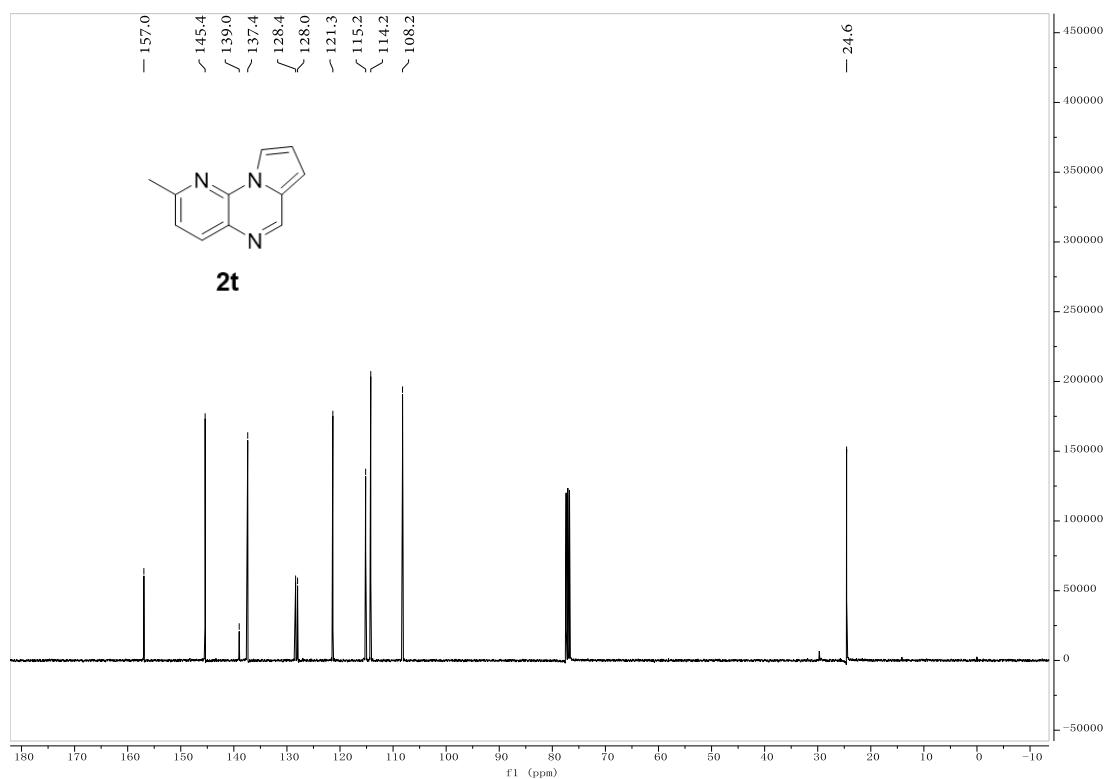
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **2s** (100 MHz, CDCl<sub>3</sub>)



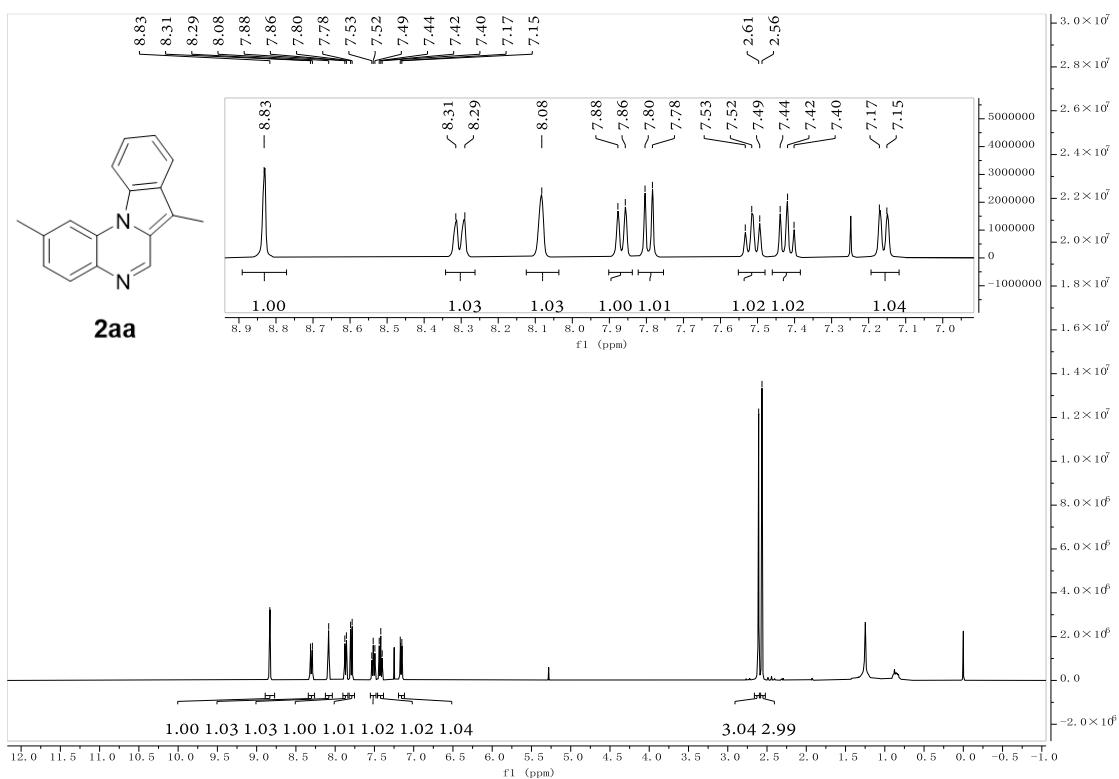
<sup>1</sup> H NMR spectra of **2t** (400 MHz, CDCl<sub>3</sub>)



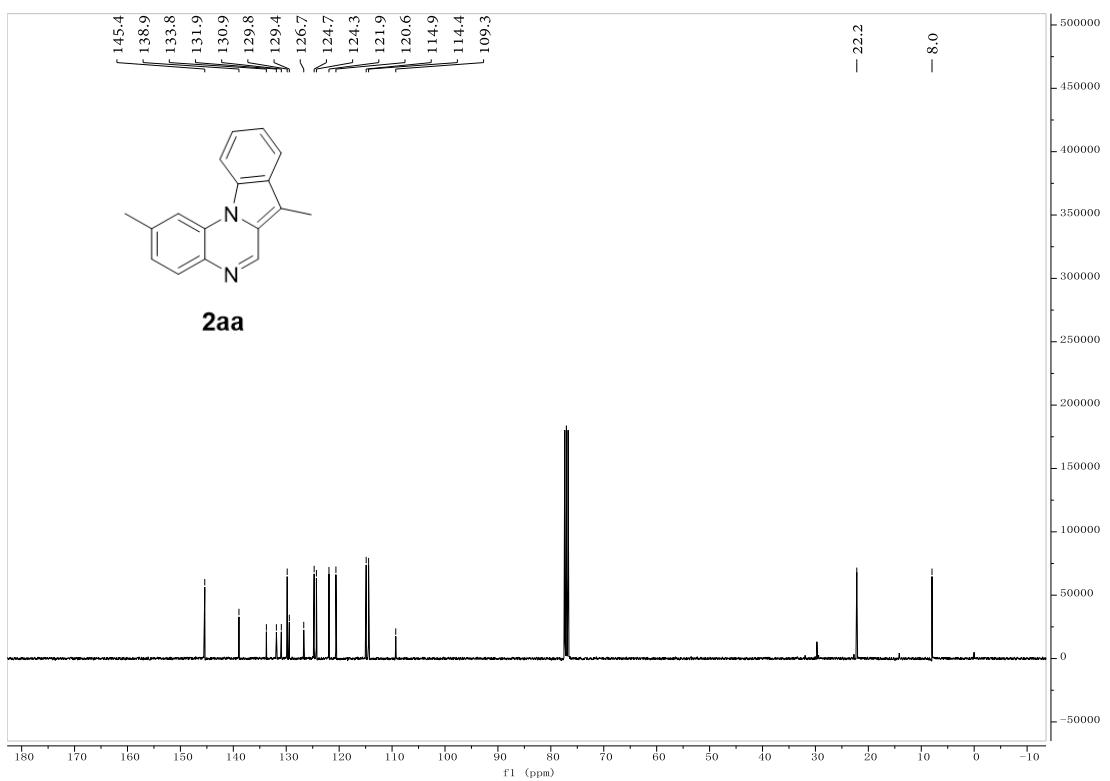
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **2t** (100 MHz, CDCl<sub>3</sub>)



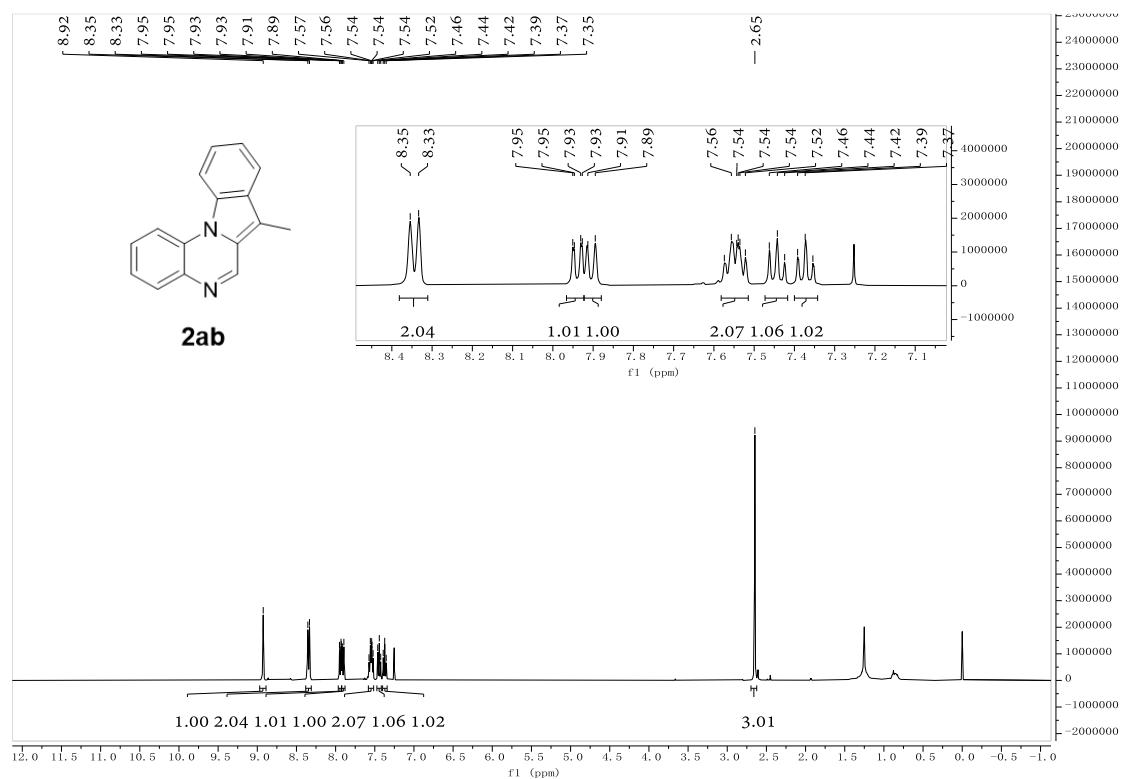
<sup>1</sup> H NMR spectra of **2aa** (400 MHz, CDCl<sub>3</sub>)



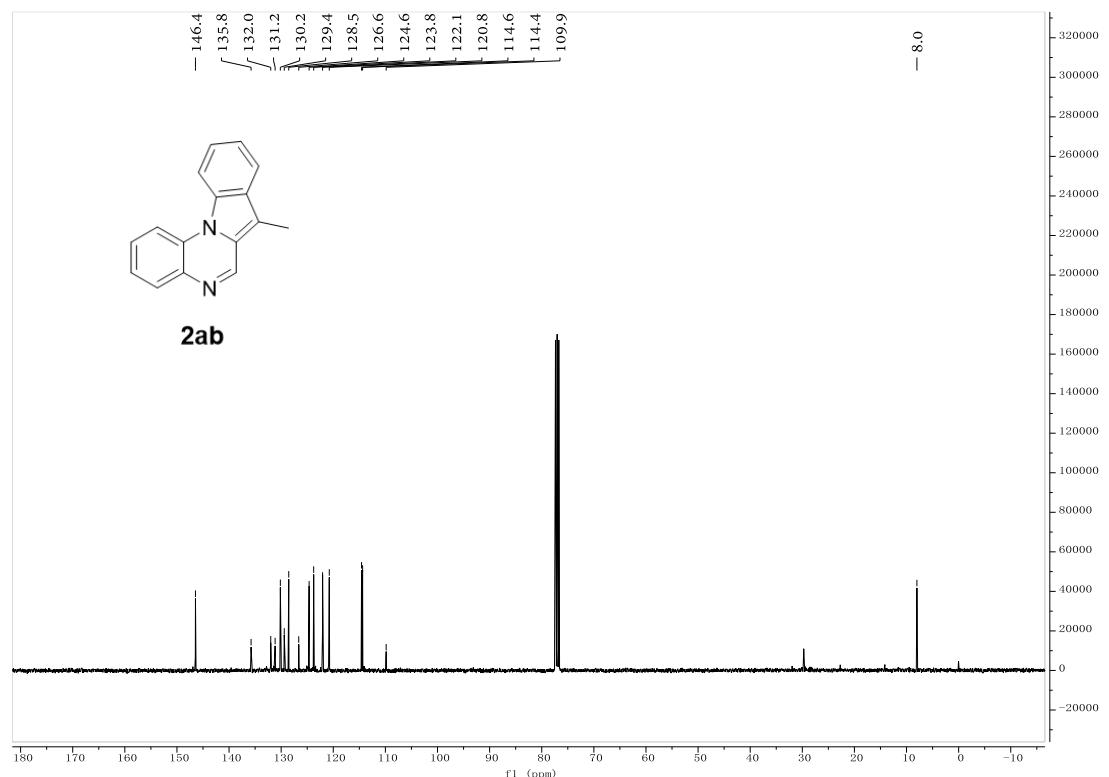
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2aa** (100 MHz, CDCl<sub>3</sub>)



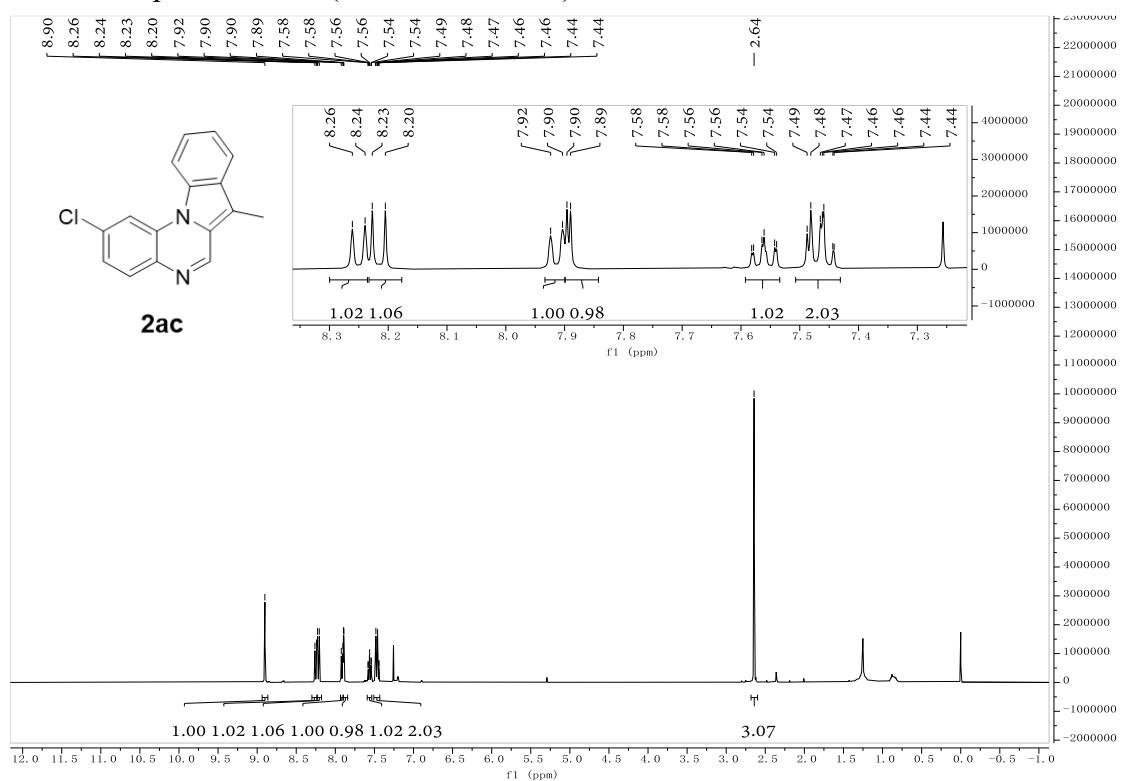
<sup>1</sup> H NMR spectra of **2ab** (400 MHz, CDCl<sub>3</sub>)



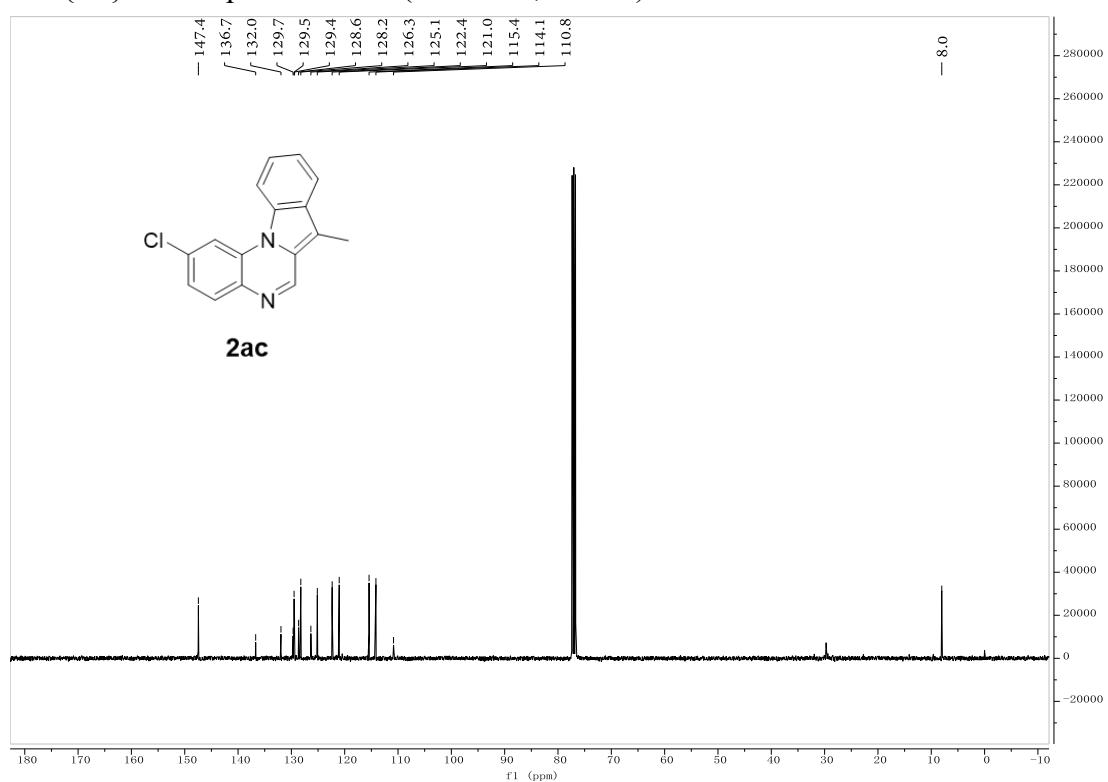
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2ab** (100 MHz, CDCl<sub>3</sub>)



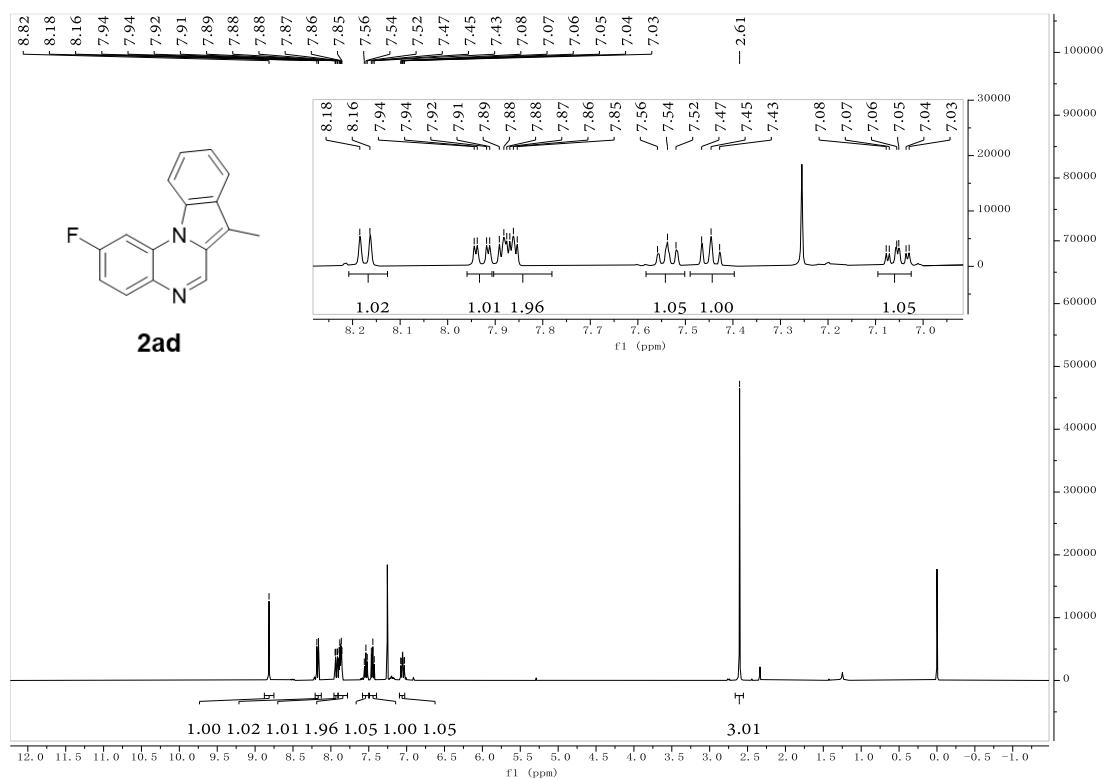
<sup>1</sup> H NMR spectra of **2ac** (400 MHz, CDCl<sub>3</sub>)



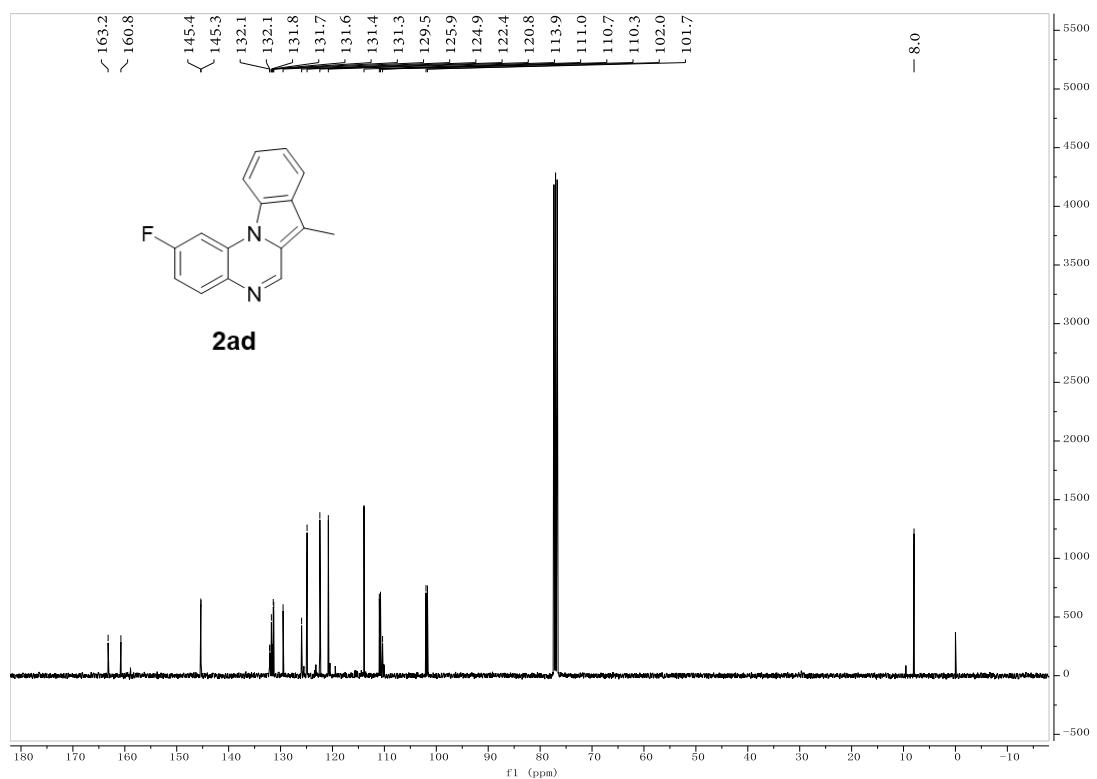
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **2ac** (100 MHz, CDCl<sub>3</sub>)



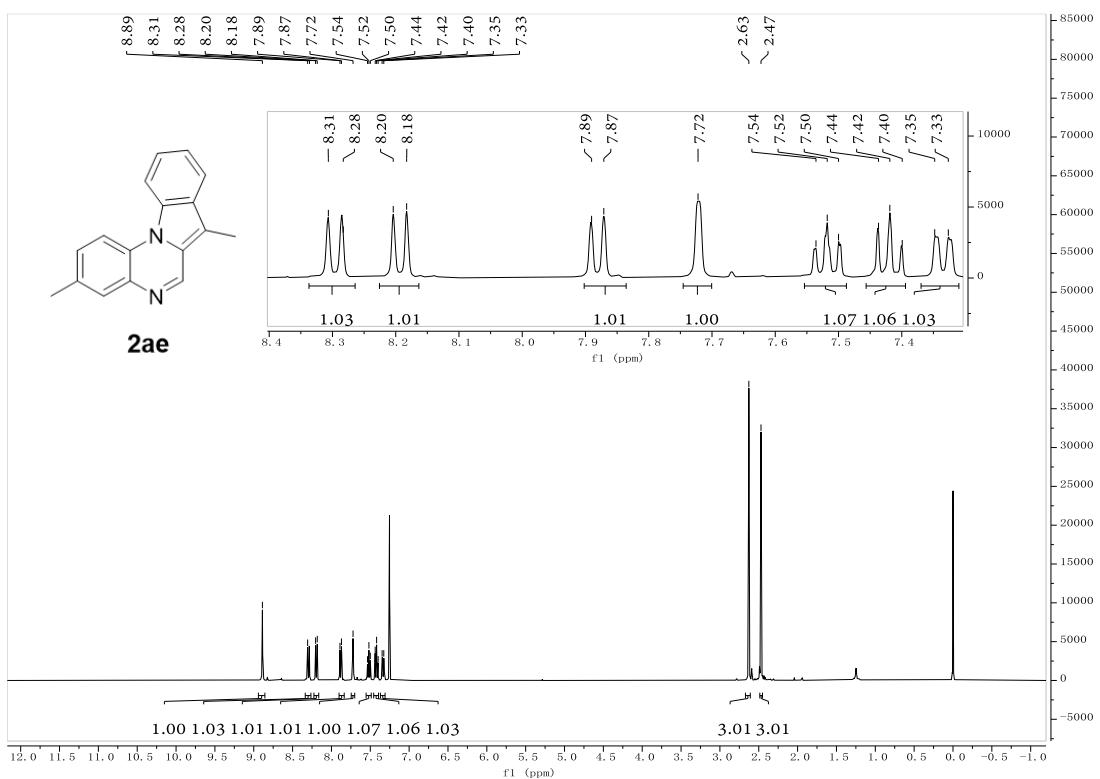
<sup>1</sup> H NMR spectra of **2ad** (400 MHz, CDCl<sub>3</sub>)



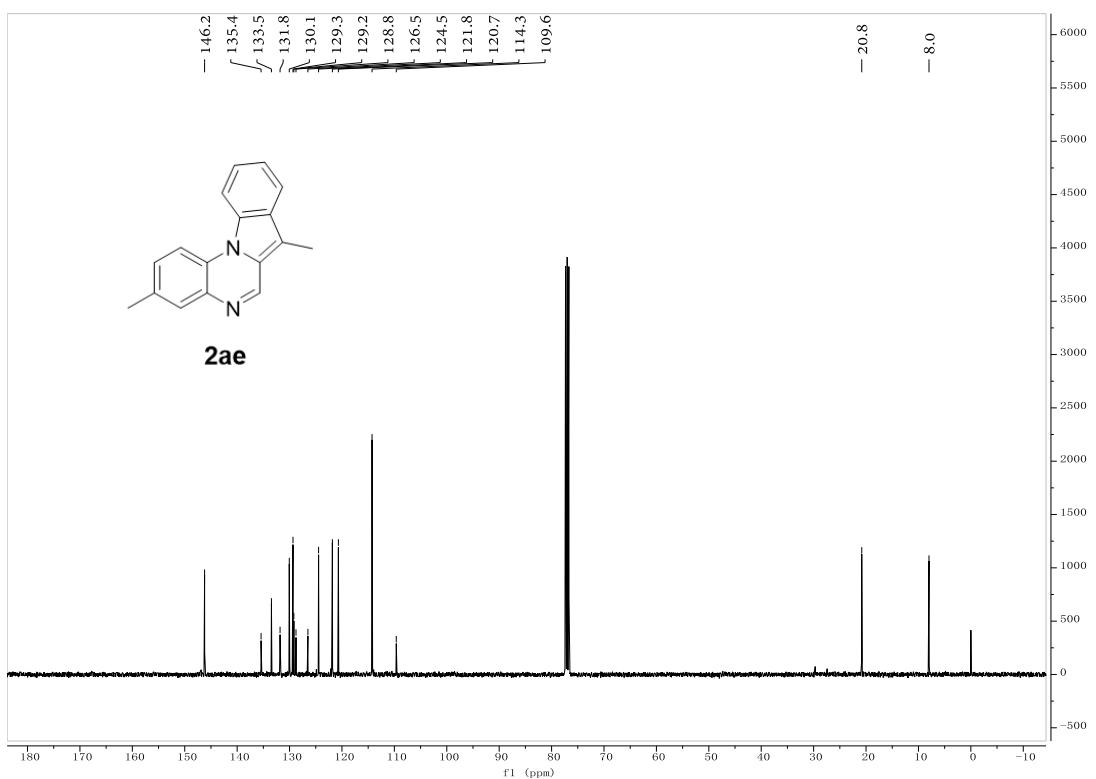
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **2ad** (100 MHz, CDCl<sub>3</sub>)



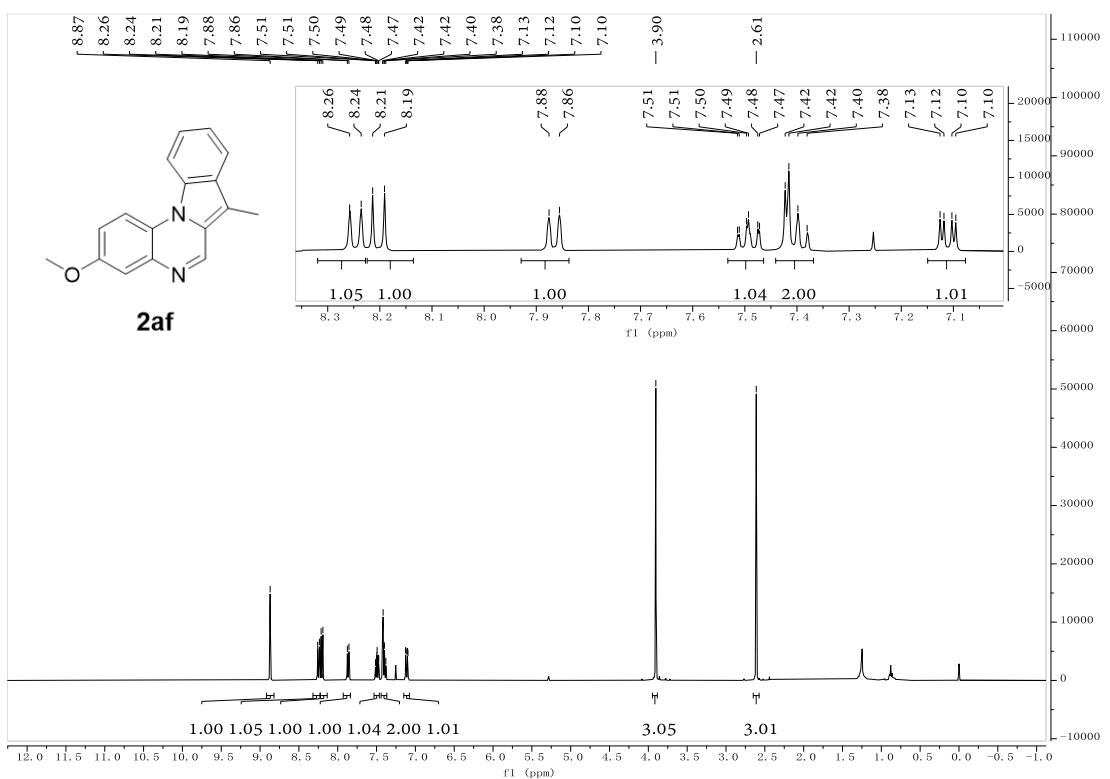
<sup>1</sup> H NMR spectra of **2ae** (400 MHz, CDCl<sub>3</sub>)



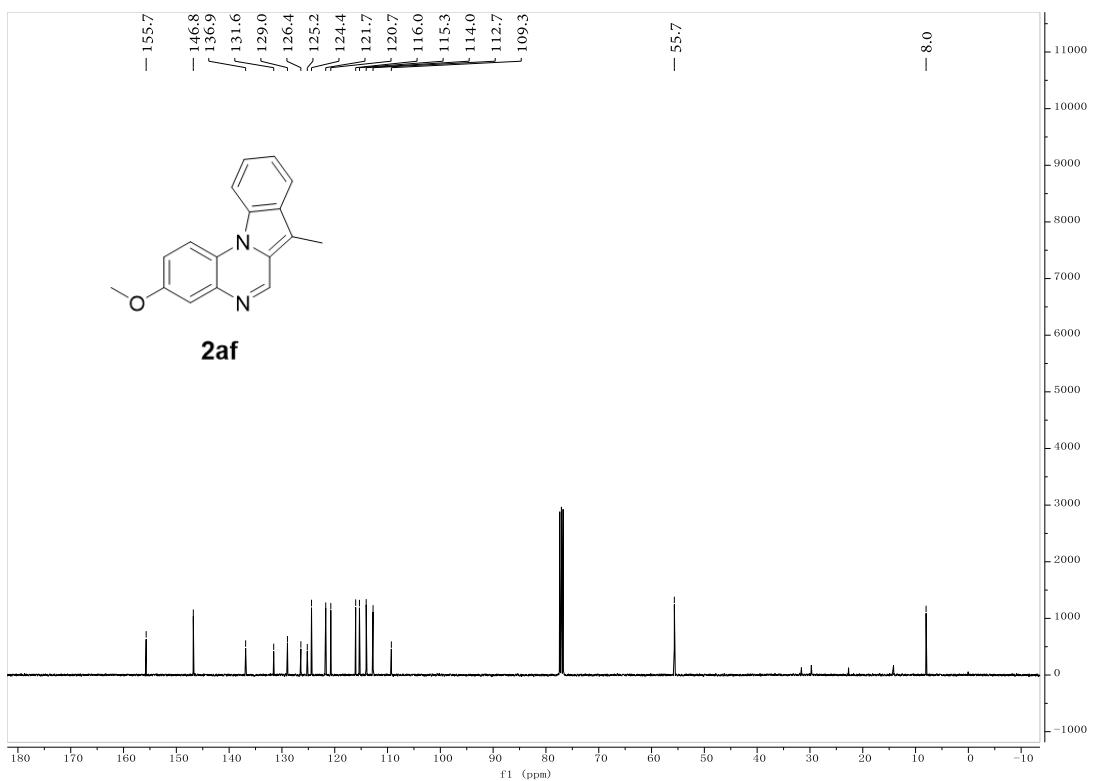
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2ae** (100 MHz, CDCl<sub>3</sub>)



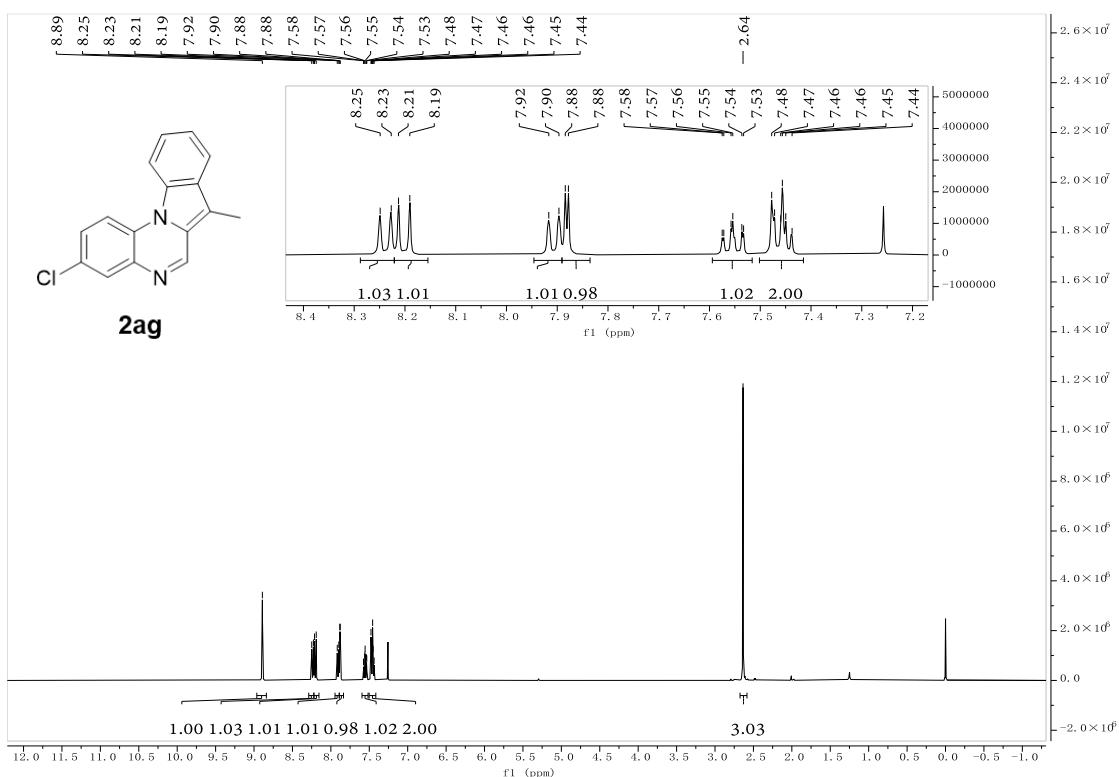
<sup>1</sup> H NMR spectra of **2af** (400 MHz, CDCl<sub>3</sub>)



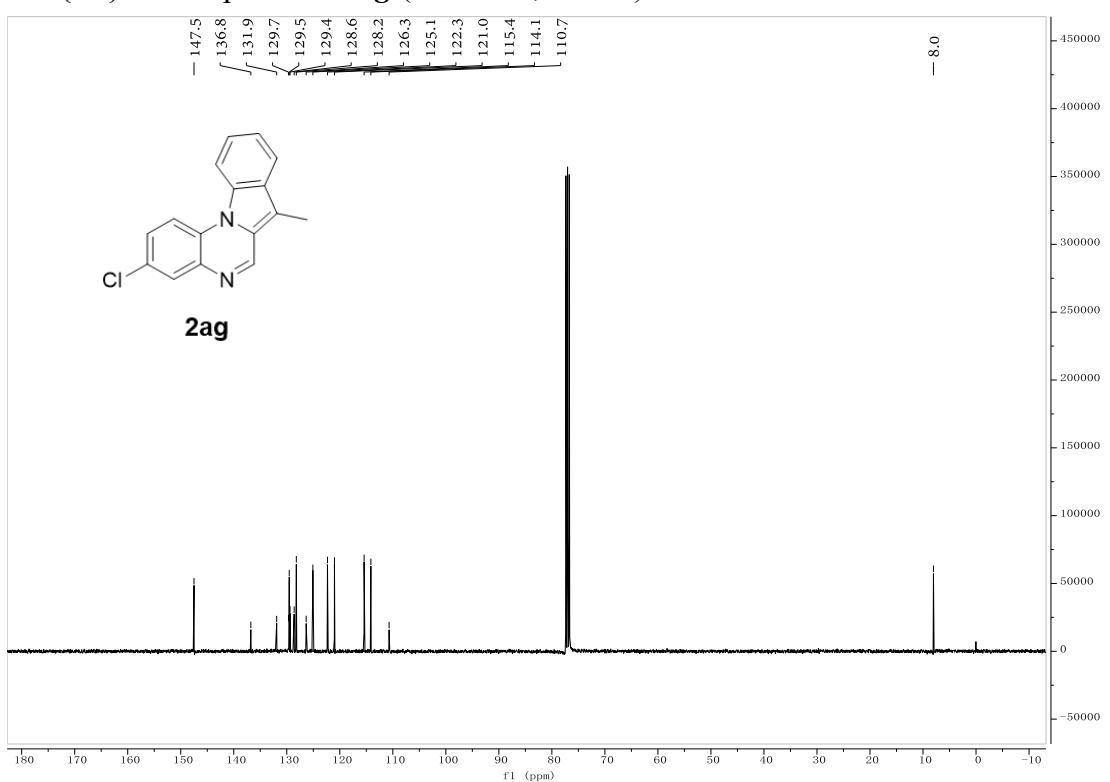
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2af** (100 MHz, CDCl<sub>3</sub>)



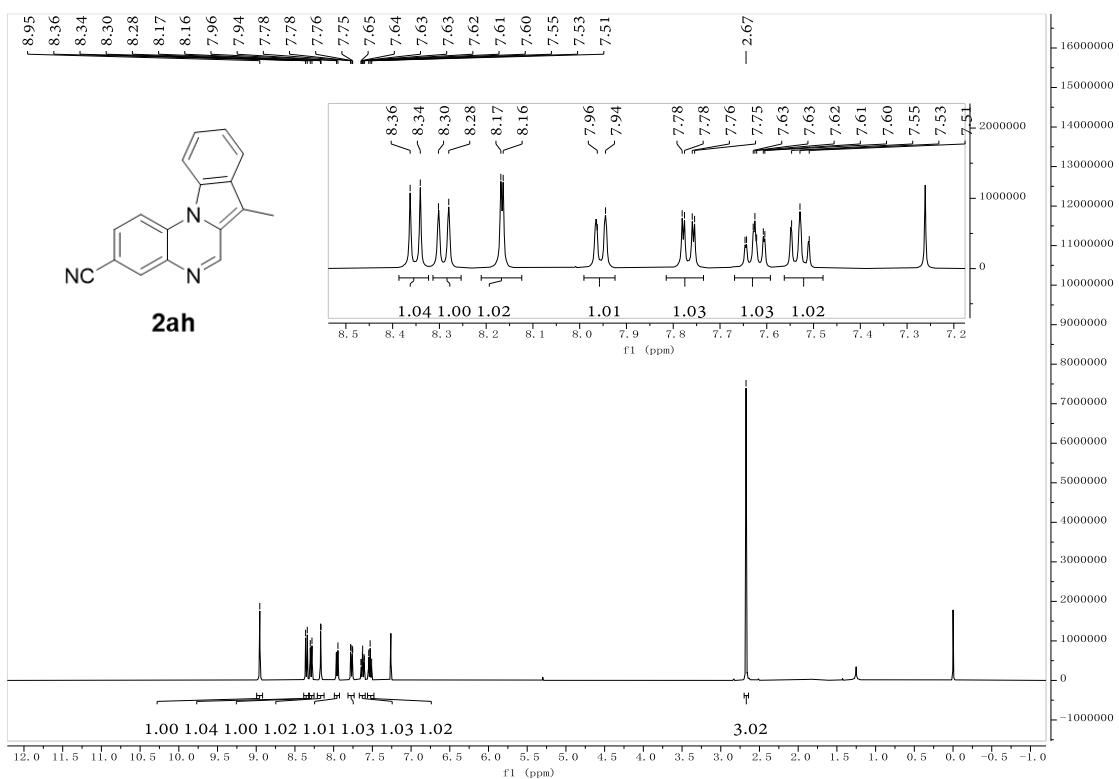
<sup>1</sup> H NMR spectra of **2ag** (400 MHz, CDCl<sub>3</sub>)



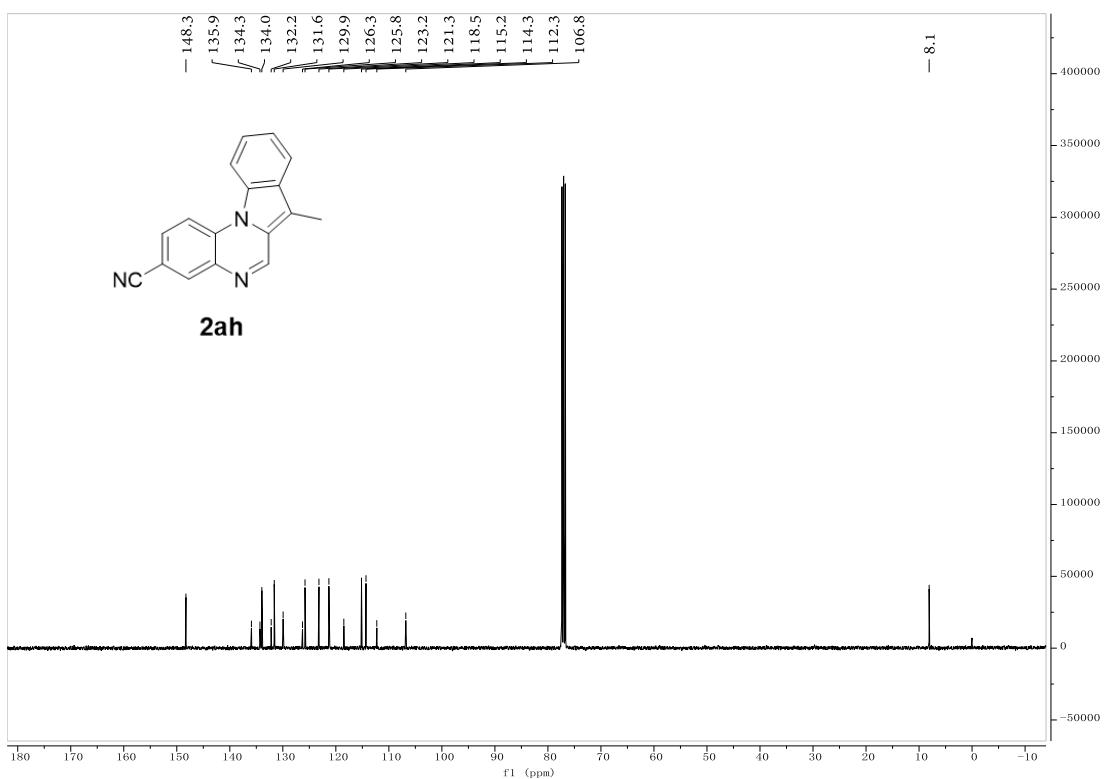
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **2ag** (100 MHz, CDCl<sub>3</sub>)



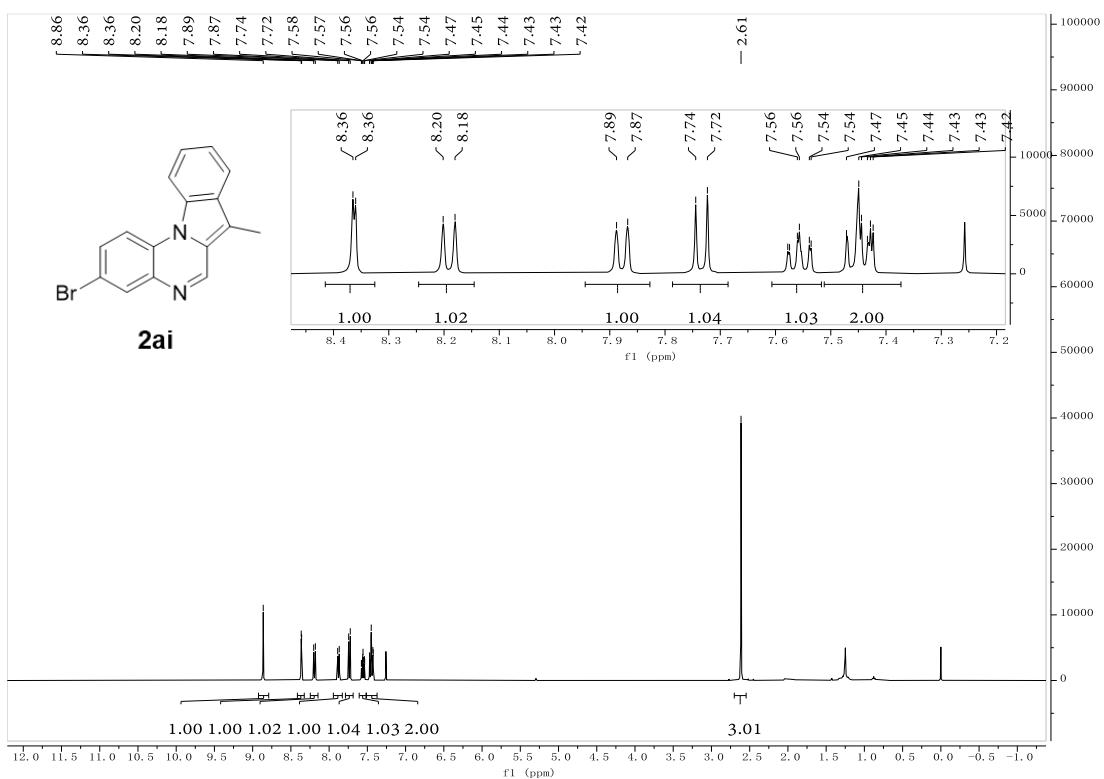
<sup>1</sup> H NMR spectra of **2ah** (400 MHz, CDCl<sub>3</sub>)



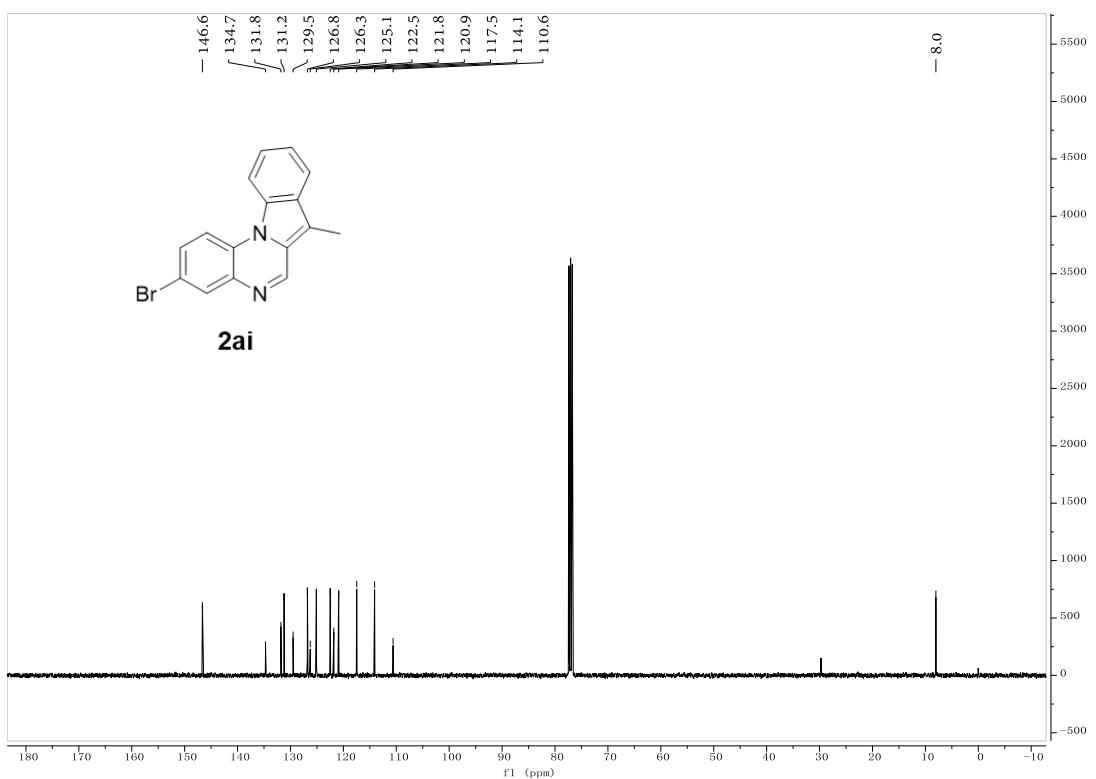
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **2ah** (100 MHz, CDCl<sub>3</sub>)



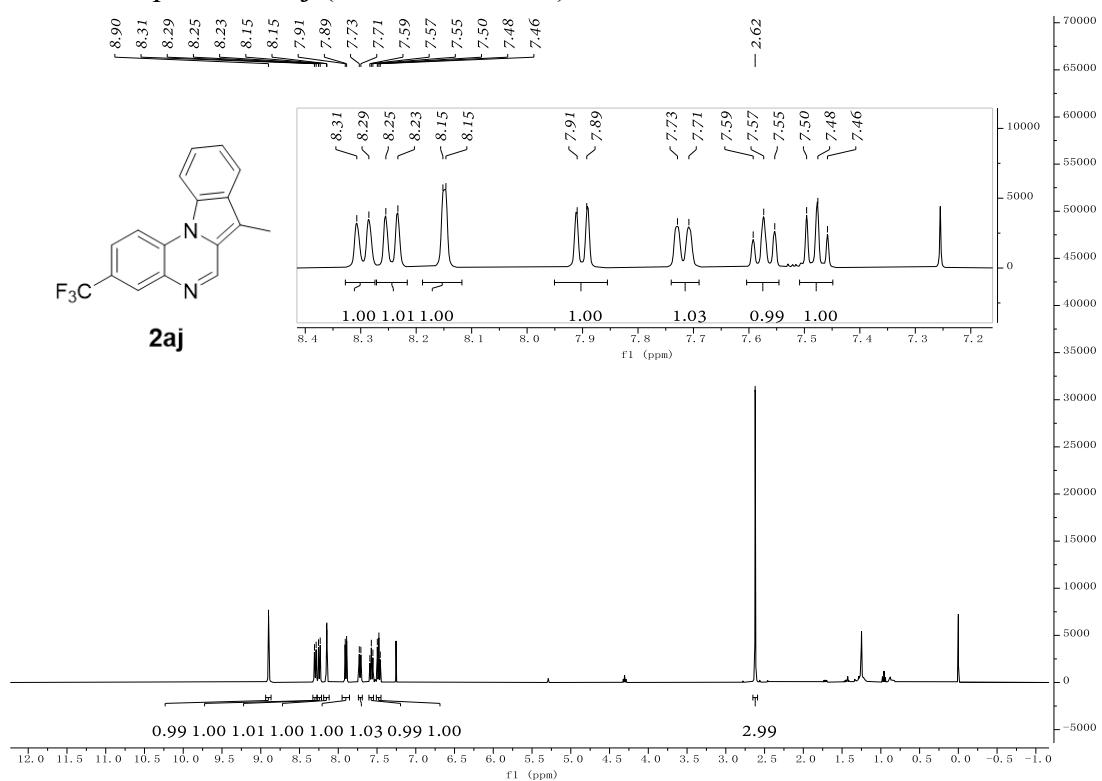
<sup>1</sup> H NMR spectra of **2ai** (400 MHz, CDCl<sub>3</sub>)



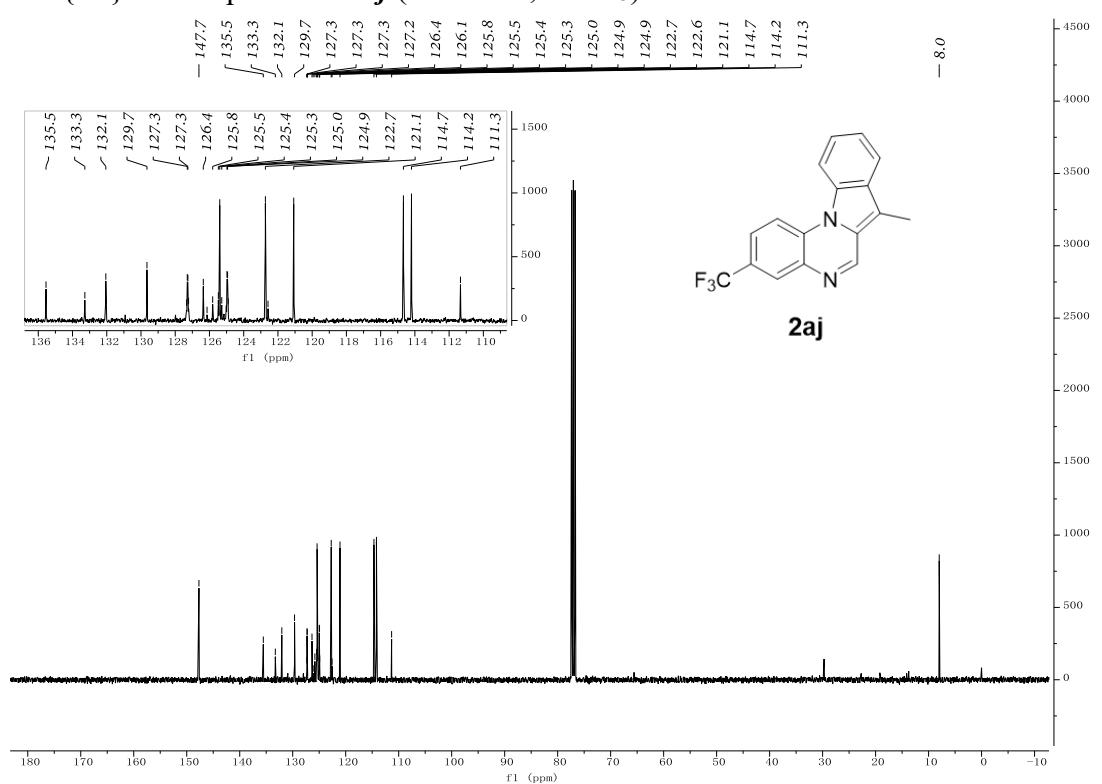
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2ai** (100 MHz, CDCl<sub>3</sub>)



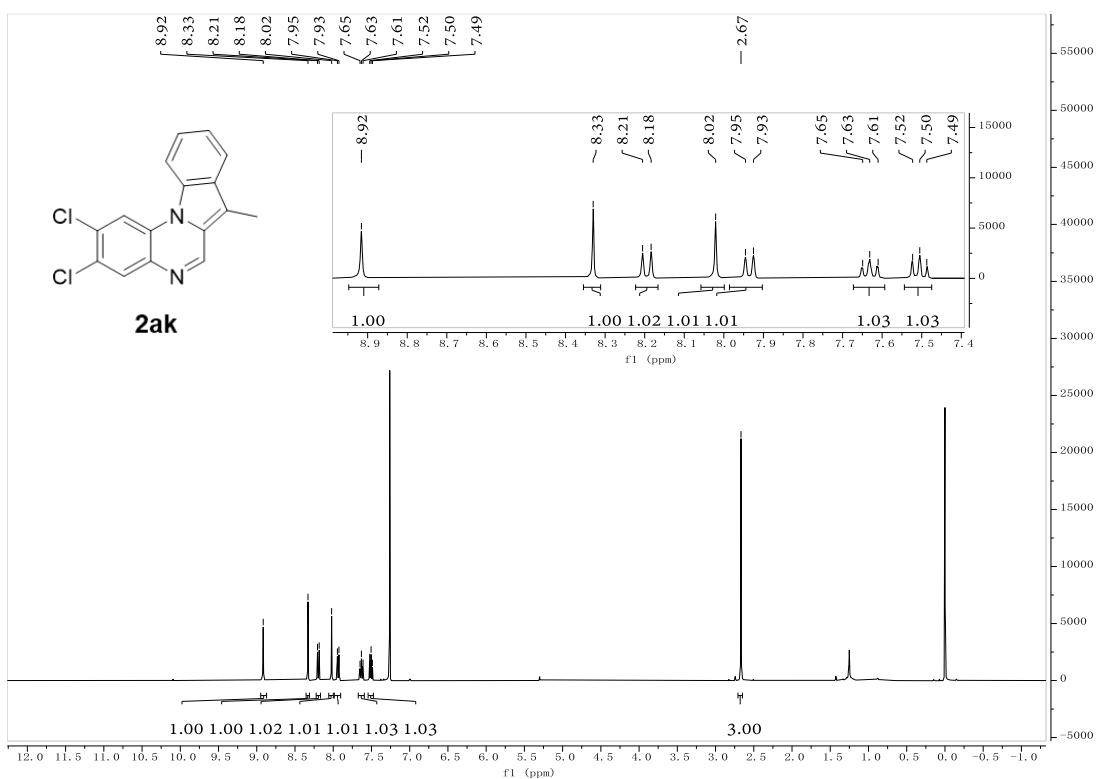
<sup>1</sup> H NMR spectra of **2aj** (400 MHz, CDCl<sub>3</sub>)



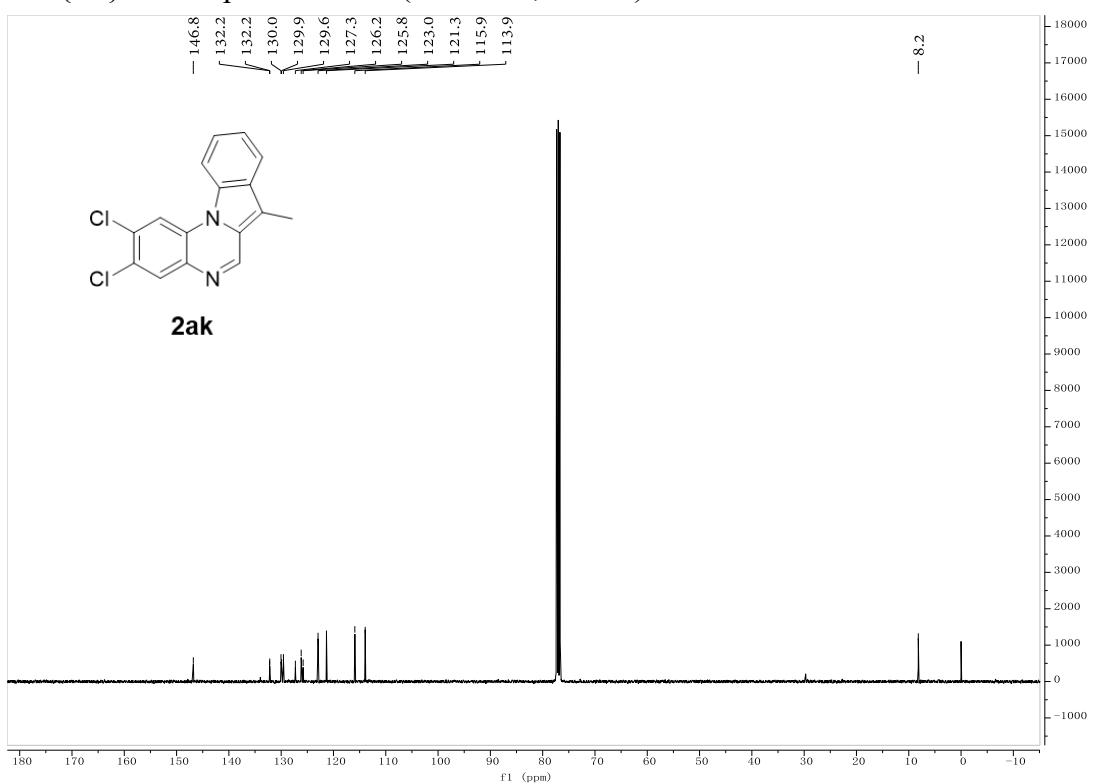
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **2aj** (100 MHz, CDCl<sub>3</sub>)



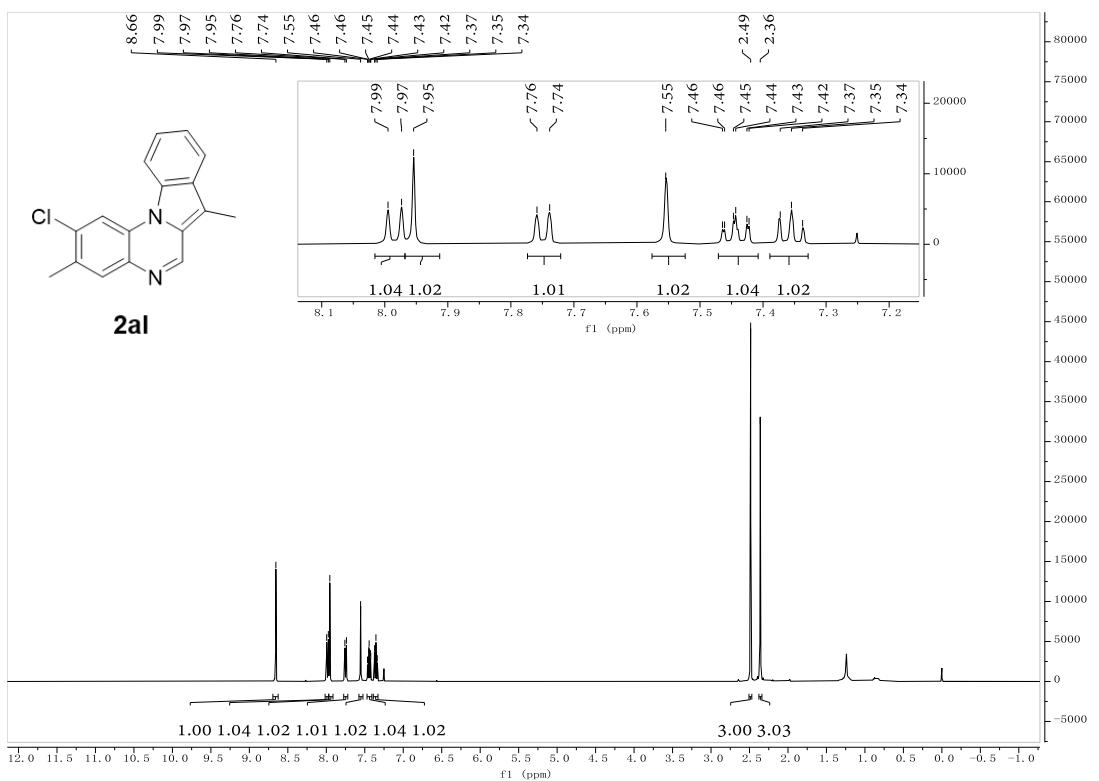
<sup>1</sup> H NMR spectra of **2ak** (400 MHz, CDCl<sub>3</sub>)



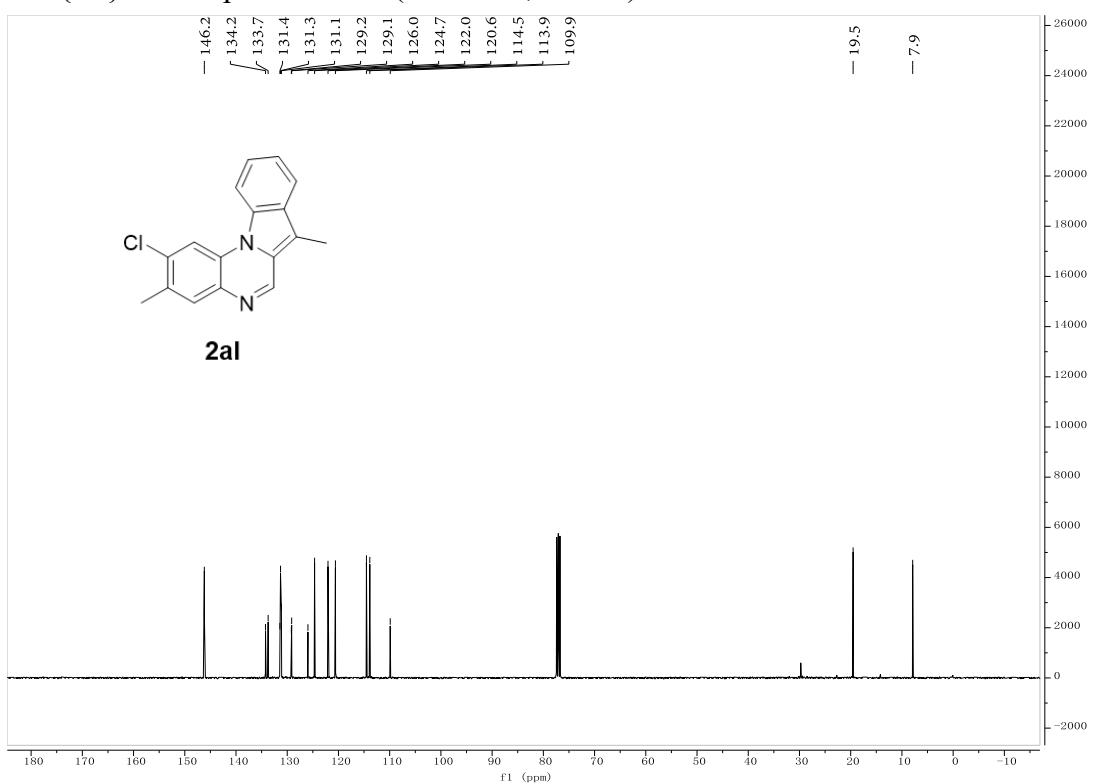
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2ak** (100 MHz, CDCl<sub>3</sub>)



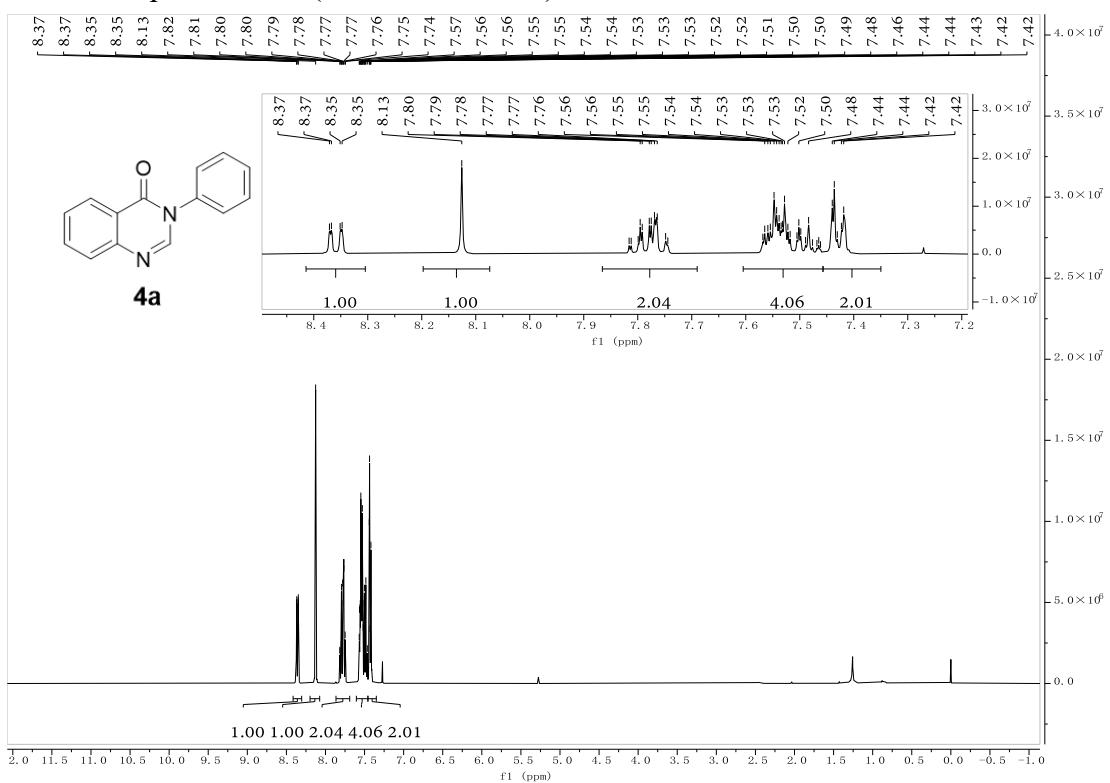
<sup>1</sup> H NMR spectra of **2al** (400 MHz, CDCl<sub>3</sub>)



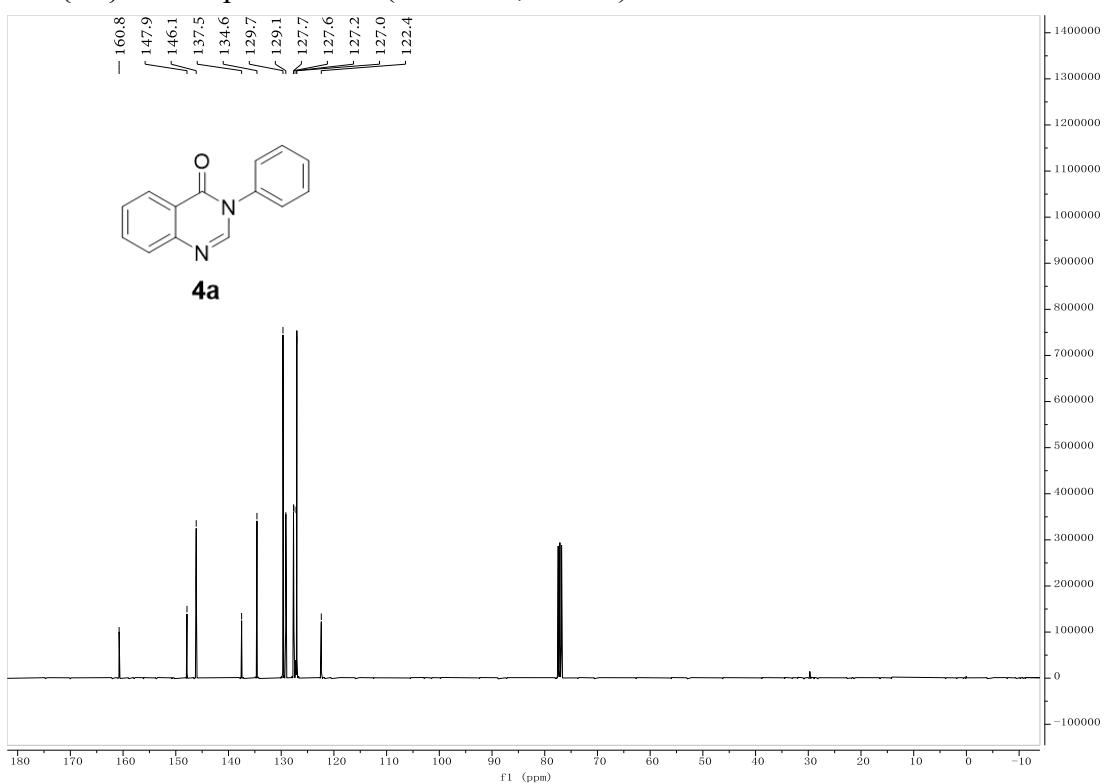
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **2al** (100 MHz, CDCl<sub>3</sub>)



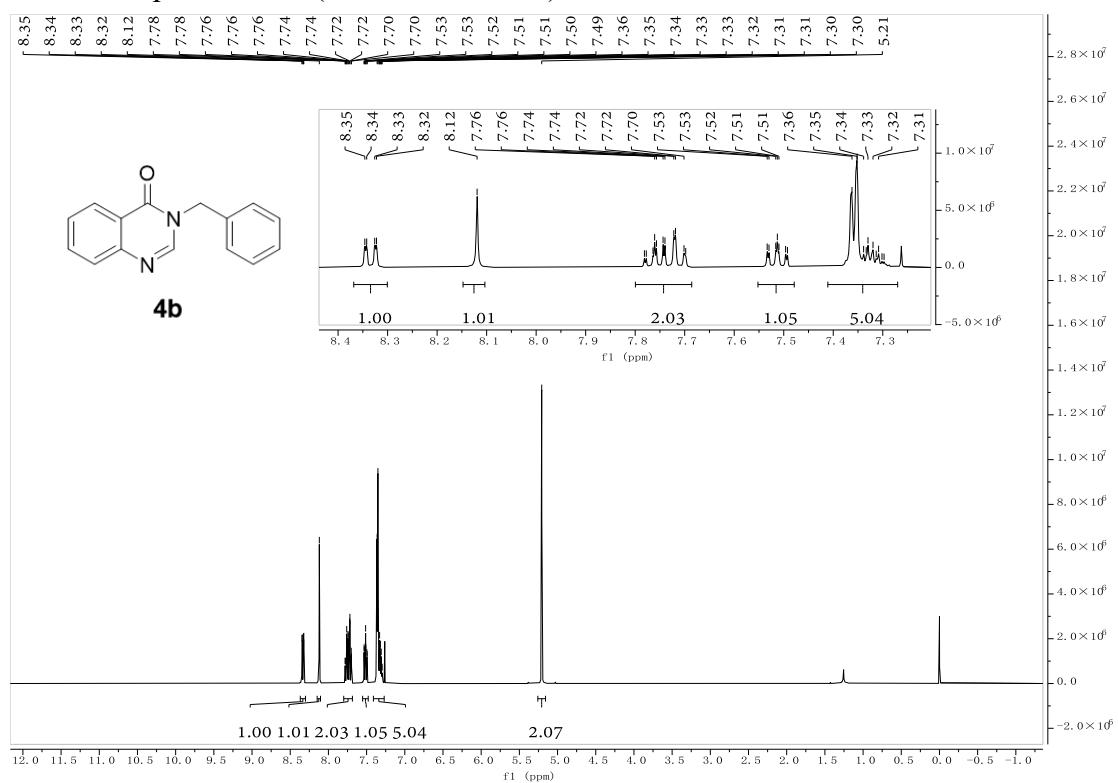
<sup>1</sup> H NMR spectra of **4a** (400 MHz, CDCl<sub>3</sub>)



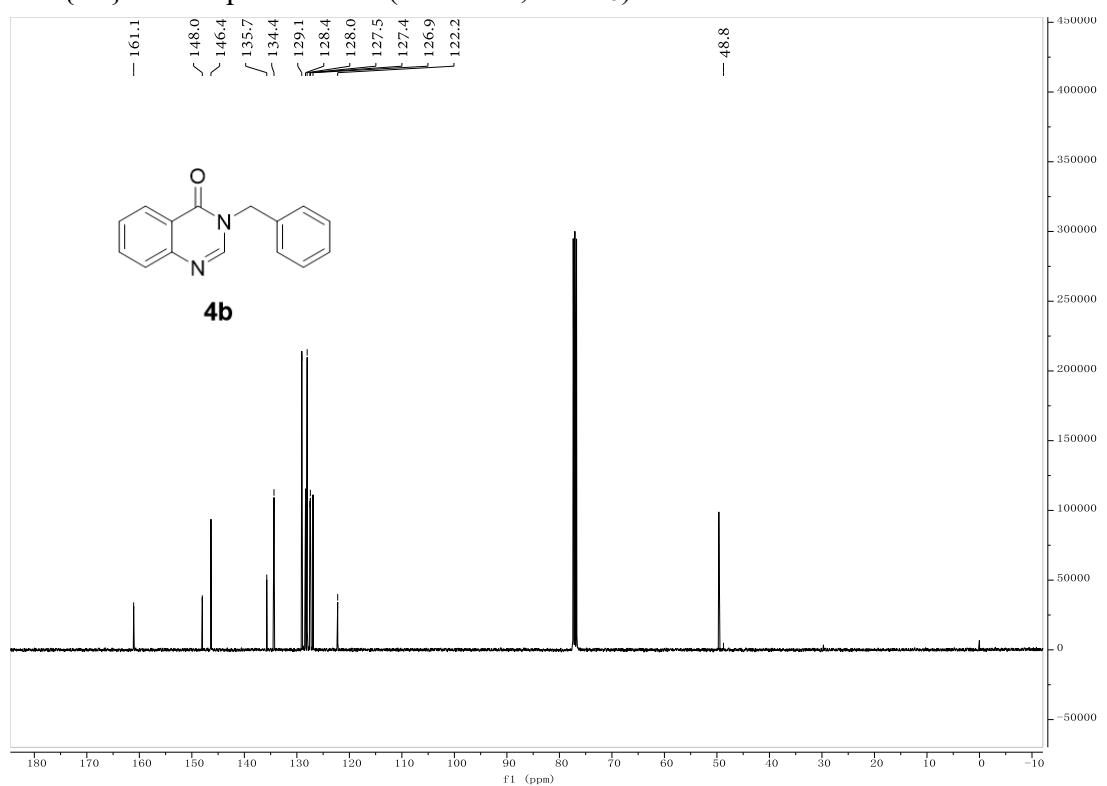
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **4a** (100 MHz, CDCl<sub>3</sub>)



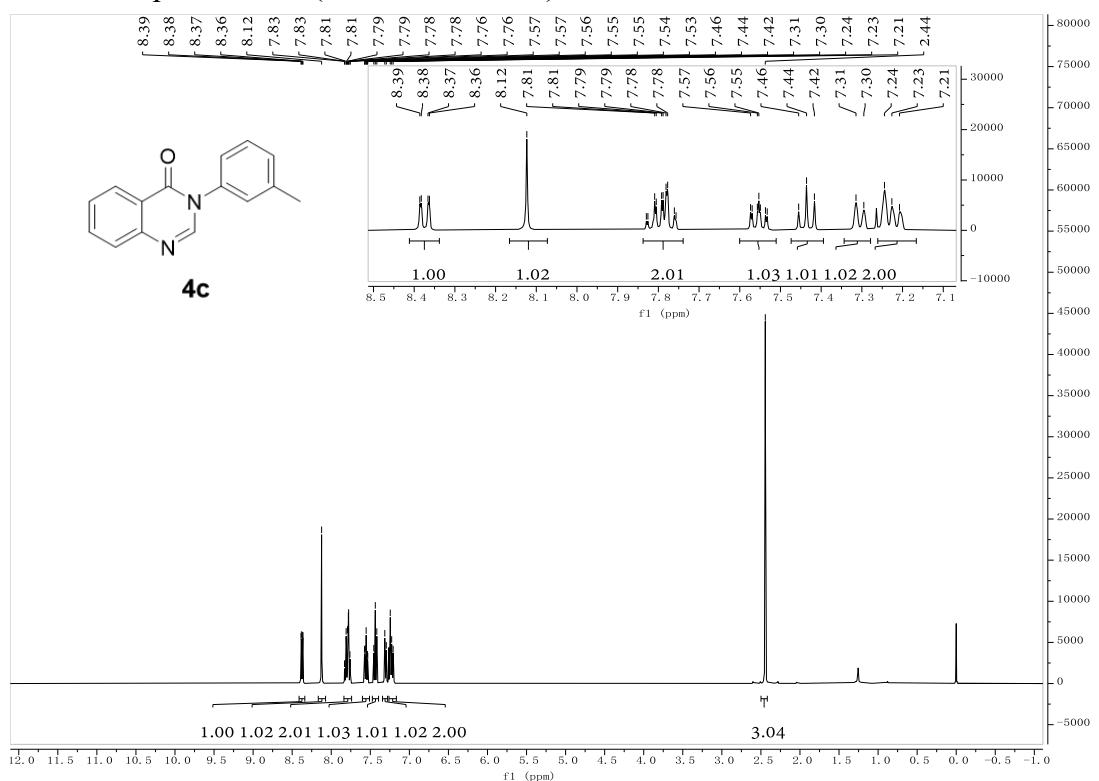
<sup>1</sup> H NMR spectra of **4b** (400 MHz, CDCl<sub>3</sub>)



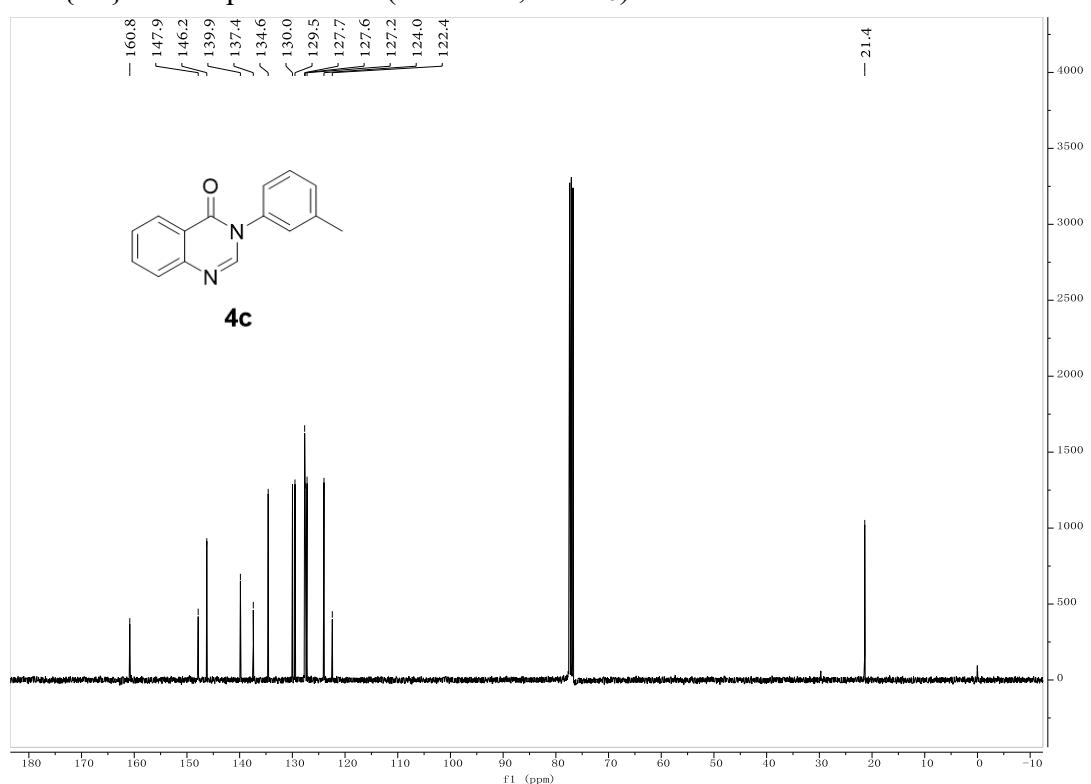
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **4b** (100 MHz, CDCl<sub>3</sub>)



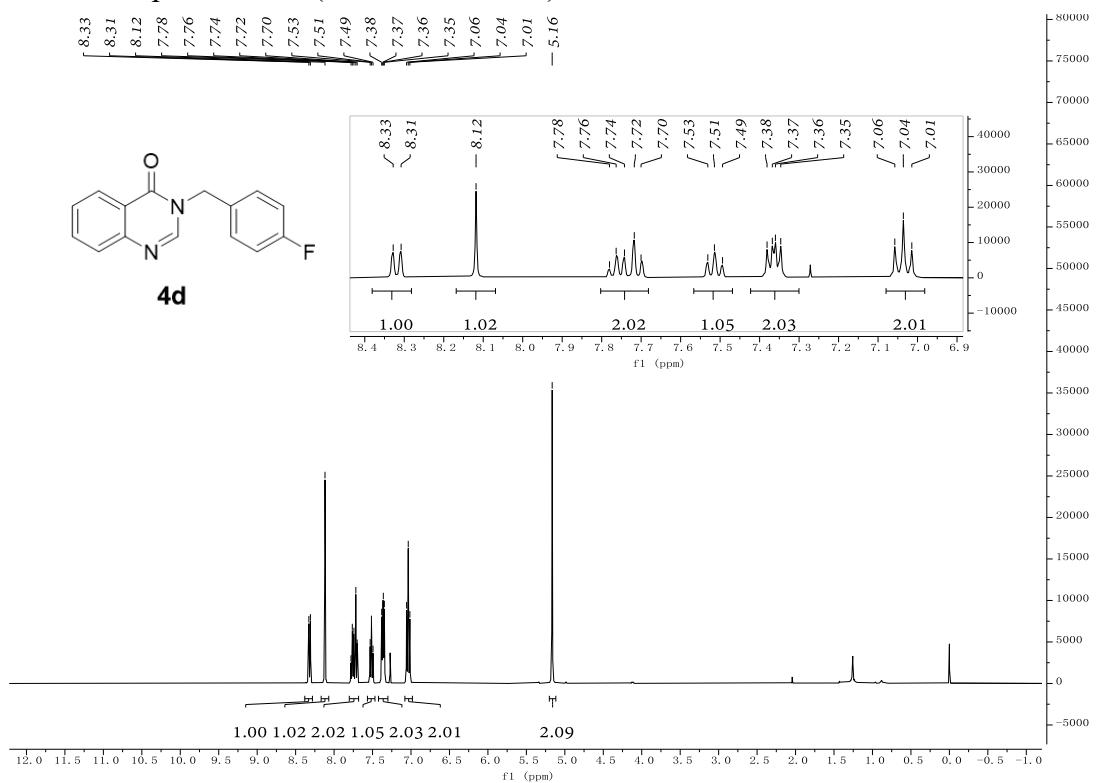
<sup>1</sup> H NMR spectra of *4c* (400 MHz, CDCl<sub>3</sub>)



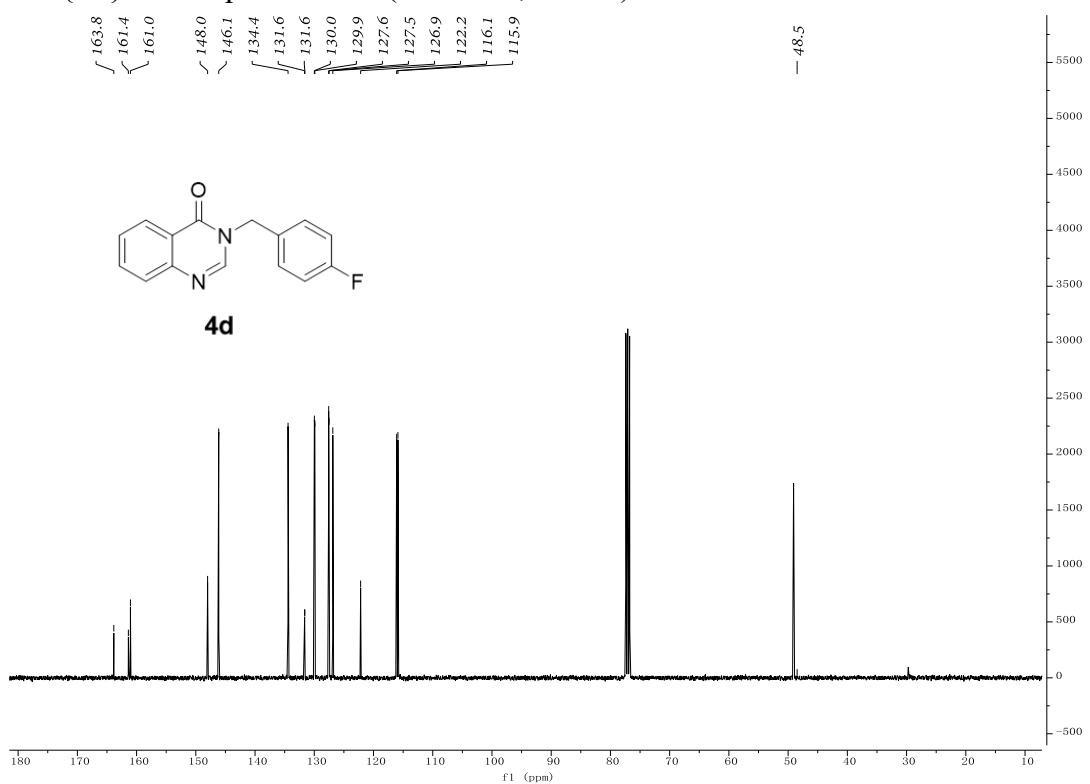
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **4c** (100 MHz, CDCl<sub>3</sub>)



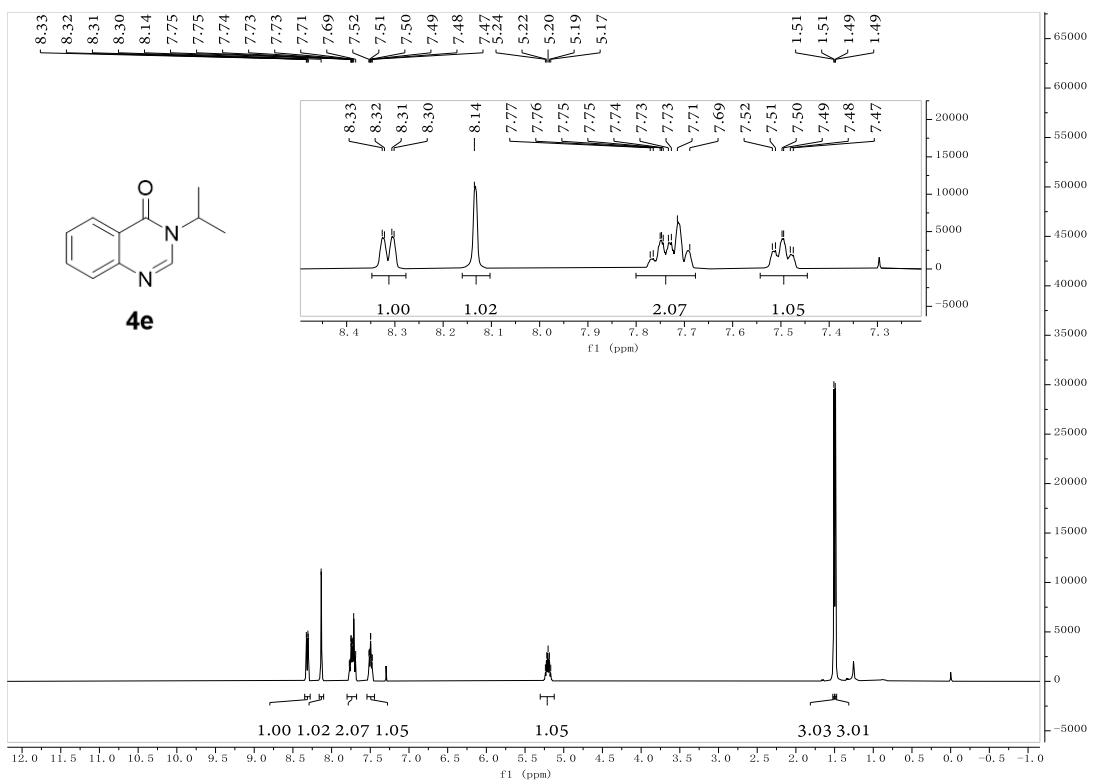
<sup>1</sup> H NMR spectra of **4d** (400 MHz, CDCl<sub>3</sub>)



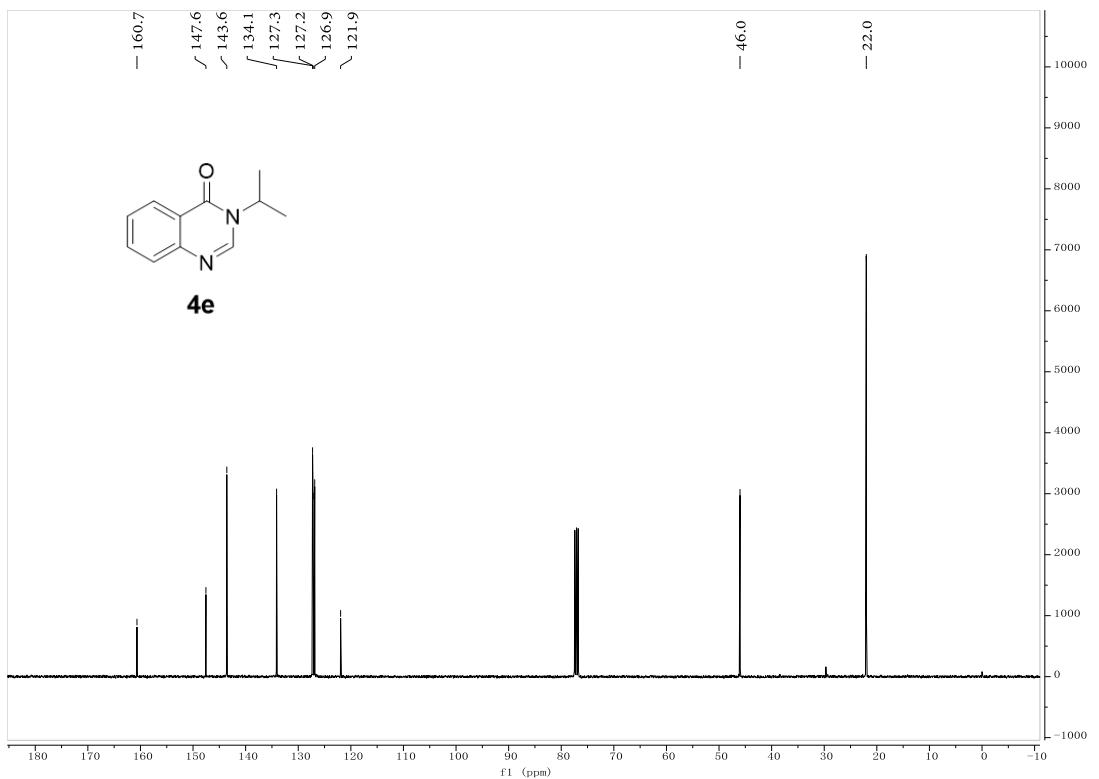
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **4d** (100 MHz, CDCl<sub>3</sub>)



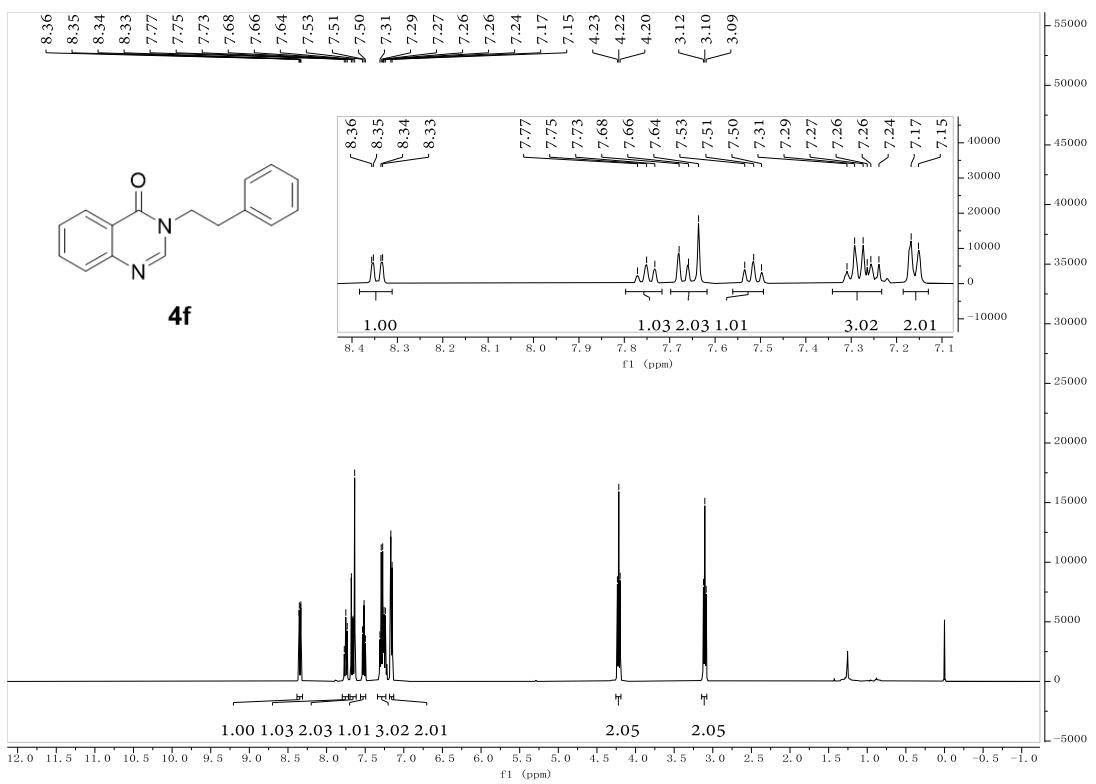
<sup>1</sup> H NMR spectra of **4e** (400 MHz, CDCl<sub>3</sub>)



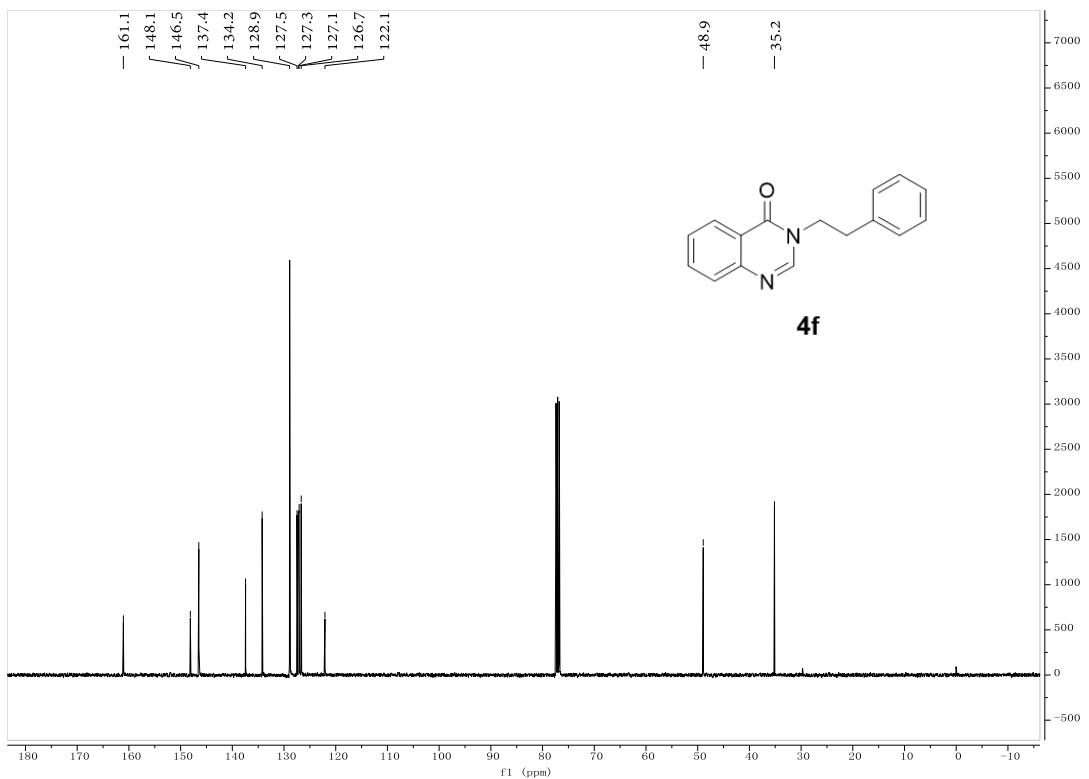
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **4e** (100 MHz, CDCl<sub>3</sub>)



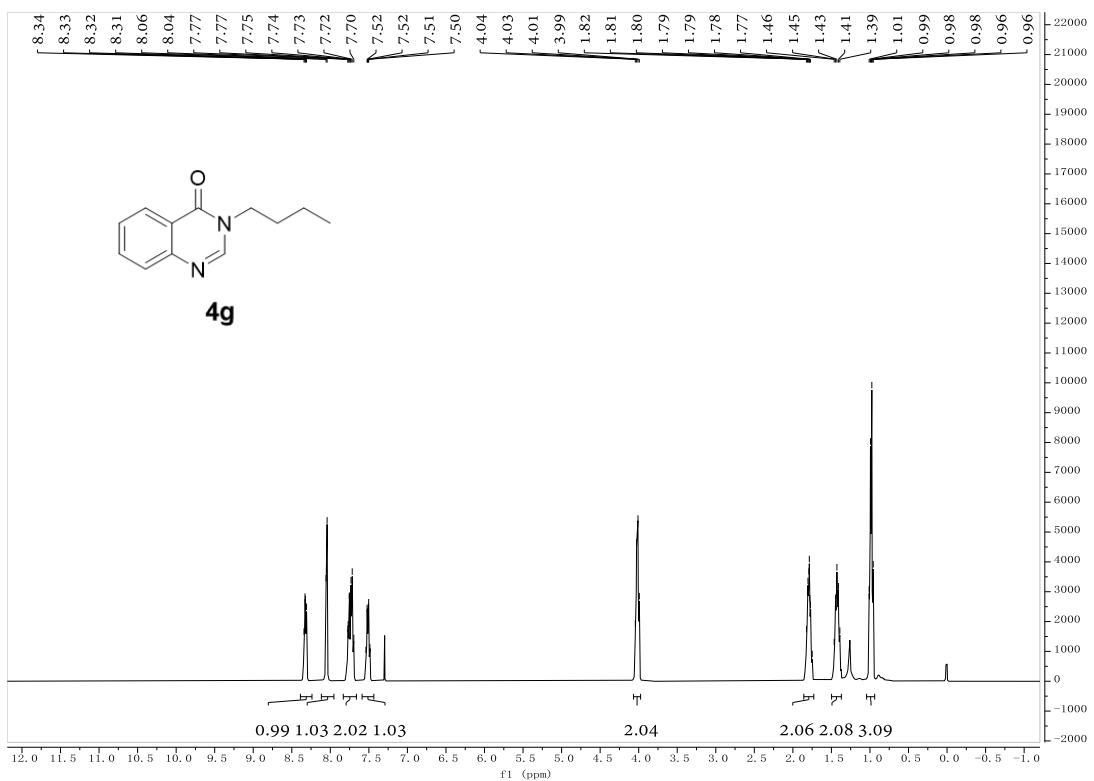
<sup>1</sup> H NMR spectra of **4f** (400 MHz, CDCl<sub>3</sub>)



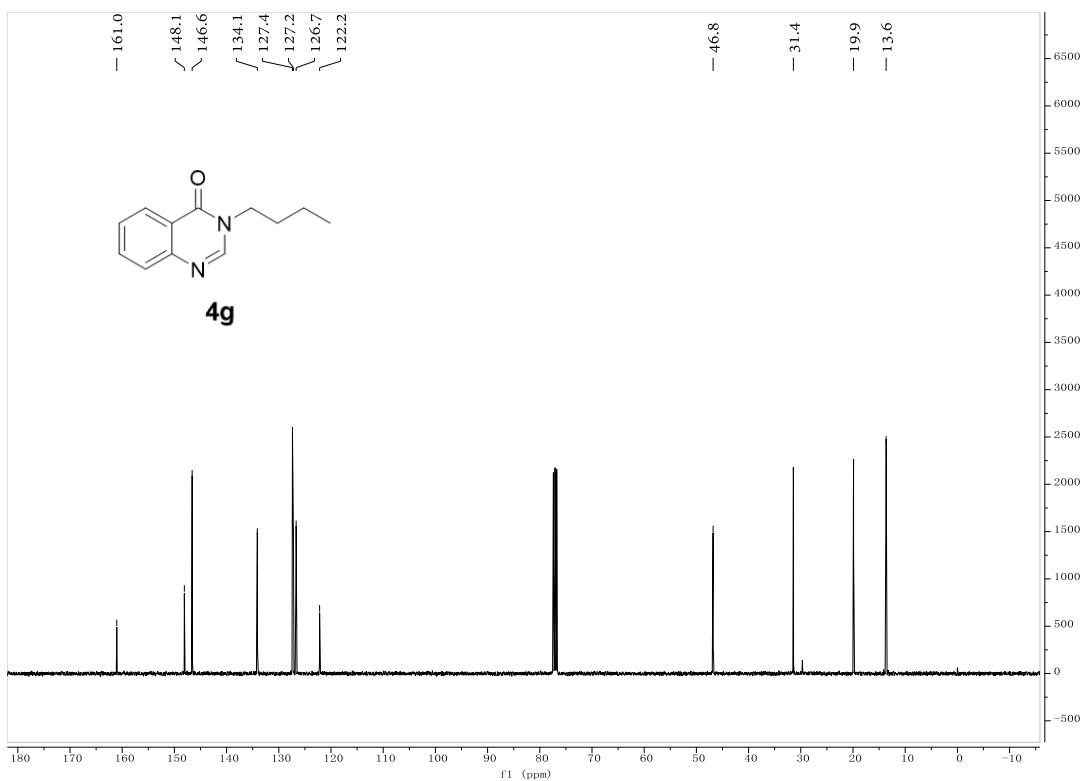
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **4f** (100 MHz, CDCl<sub>3</sub>)



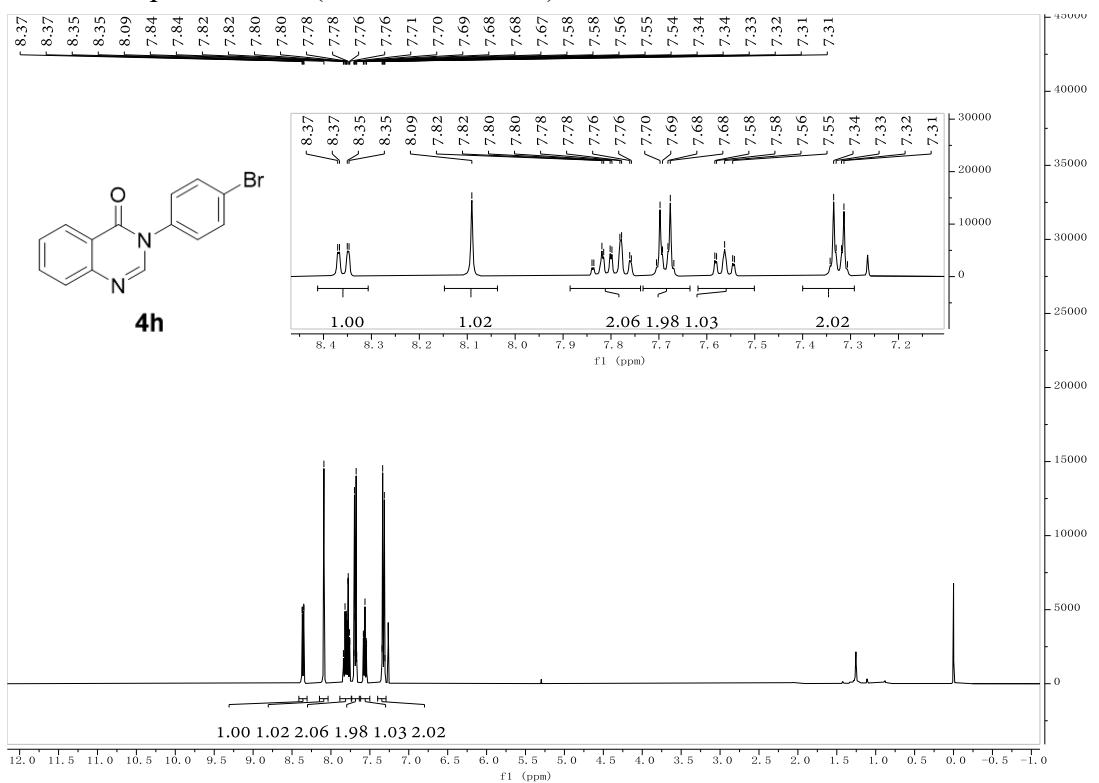
<sup>1</sup> H NMR spectra of **4g** (400 MHz, CDCl<sub>3</sub>)



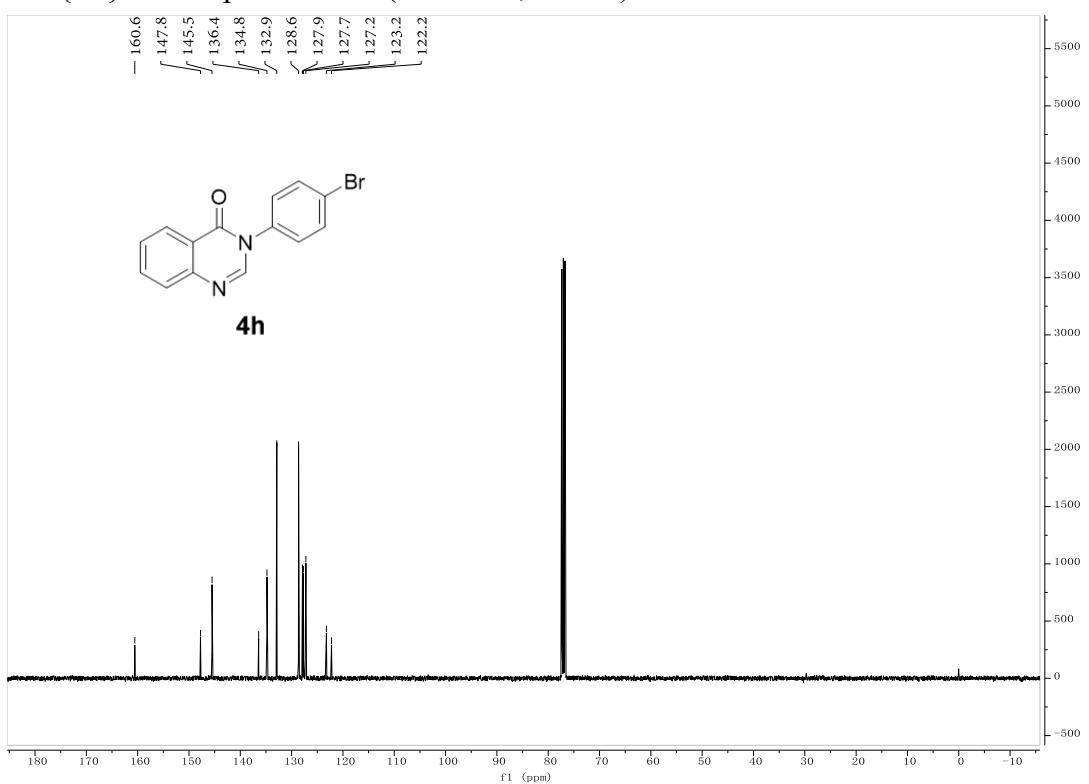
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **4g** (100 MHz, CDCl<sub>3</sub>)



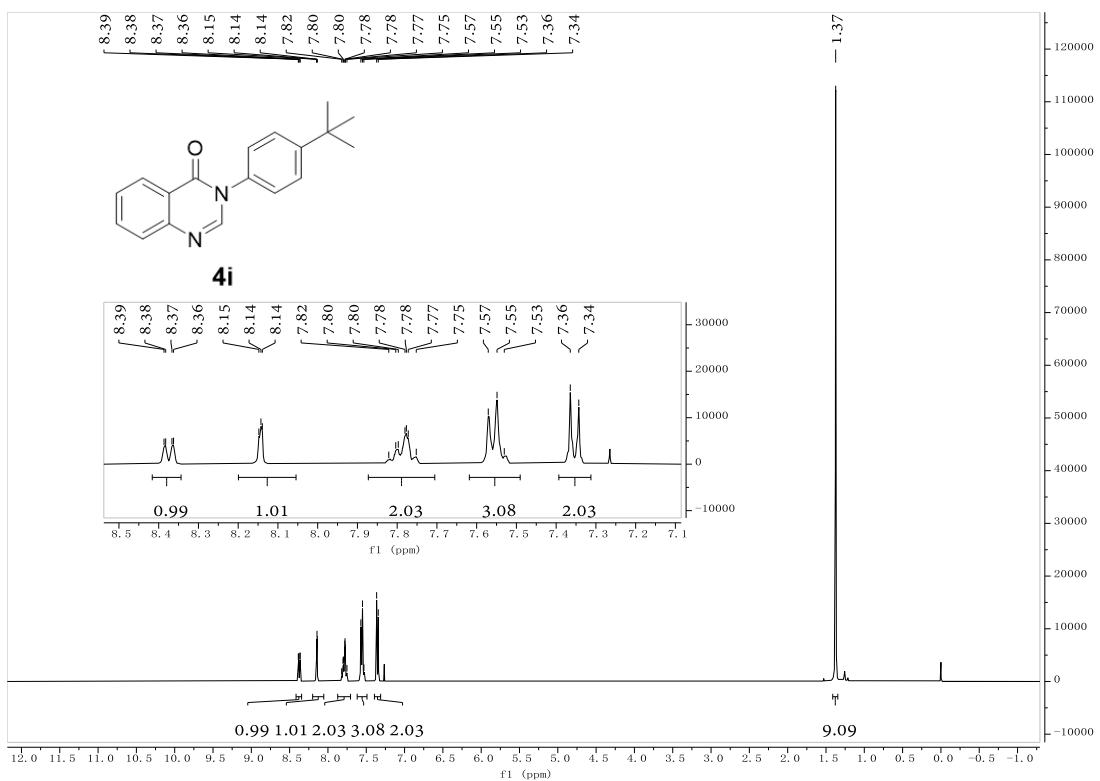
<sup>1</sup> H NMR spectra of **4h** (400 MHz, CDCl<sub>3</sub>)



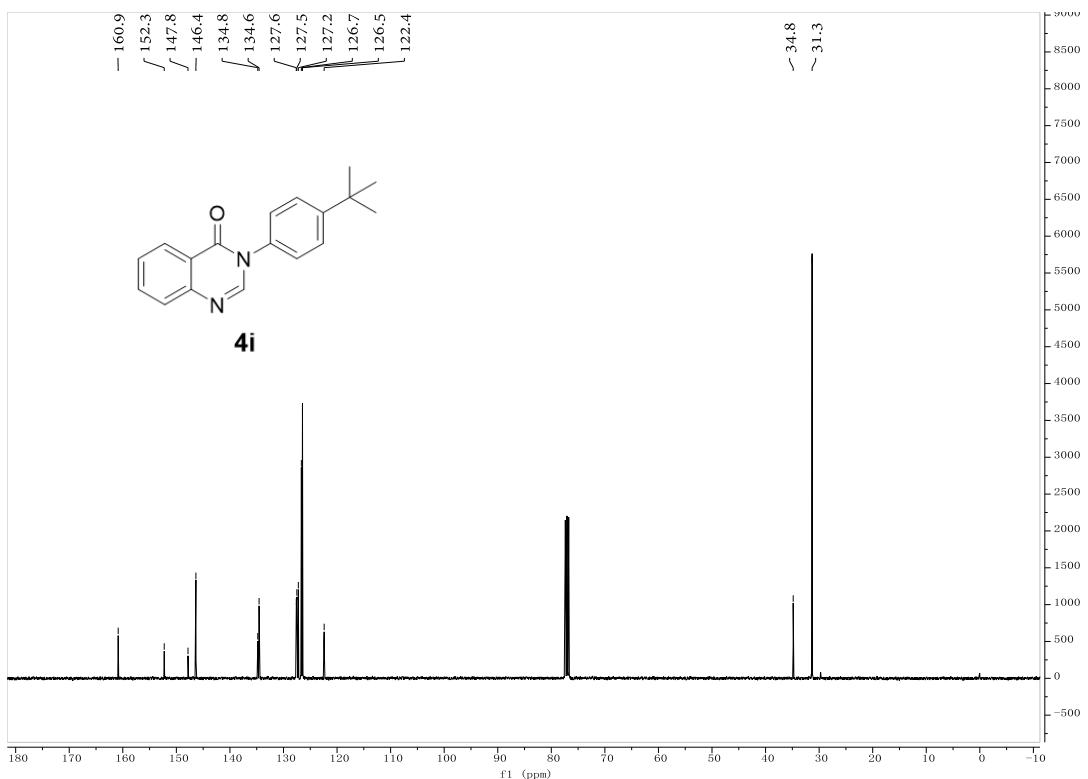
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **4h** (100 MHz, CDCl<sub>3</sub>)



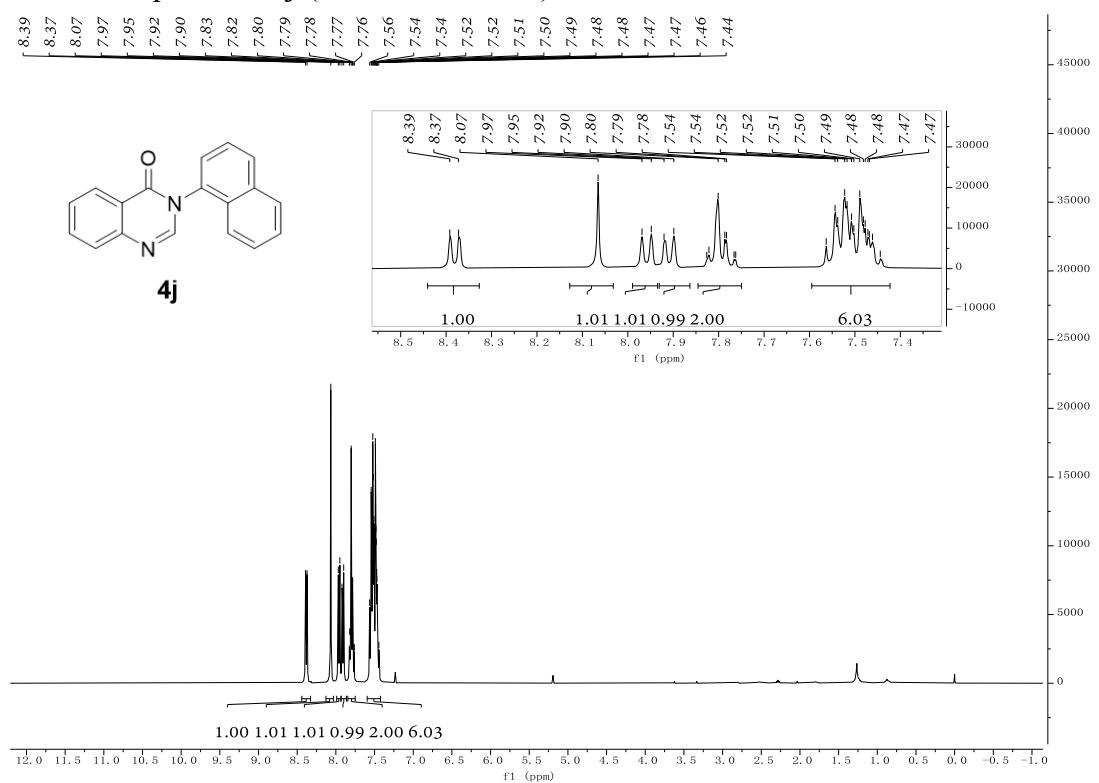
<sup>1</sup> H NMR spectra of **4i** (400 MHz, CDCl<sub>3</sub>)



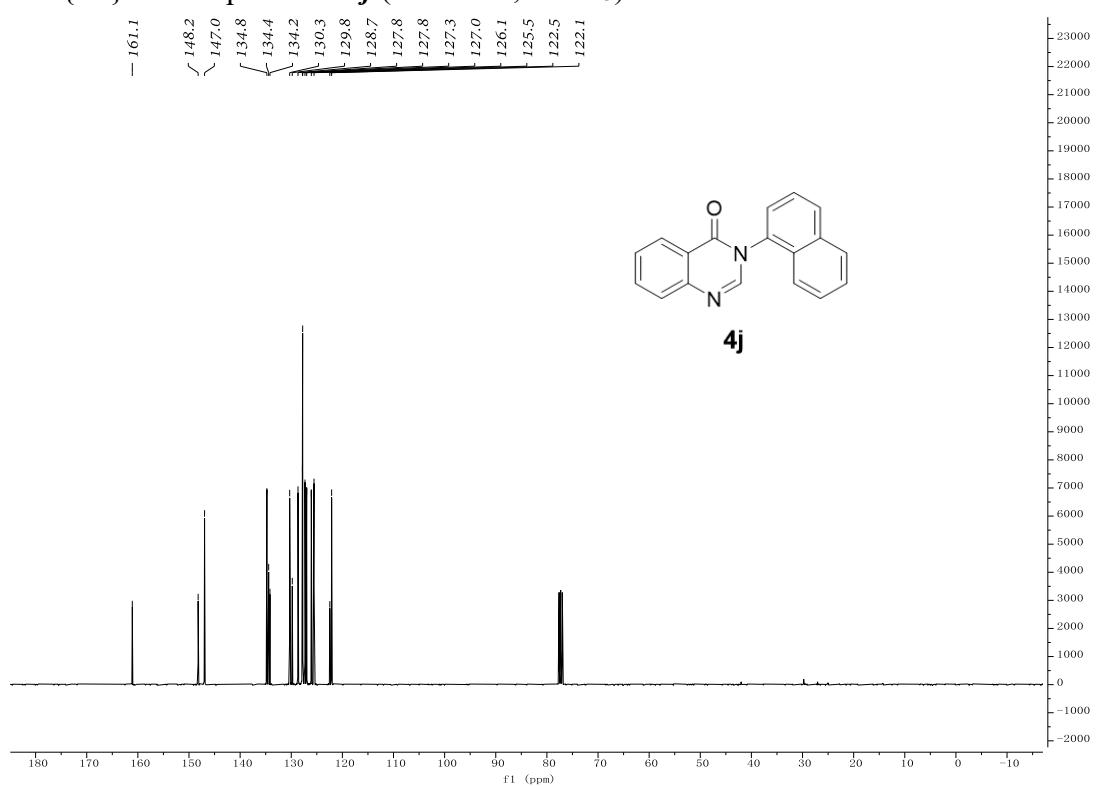
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **4i** (100 MHz, CDCl<sub>3</sub>)



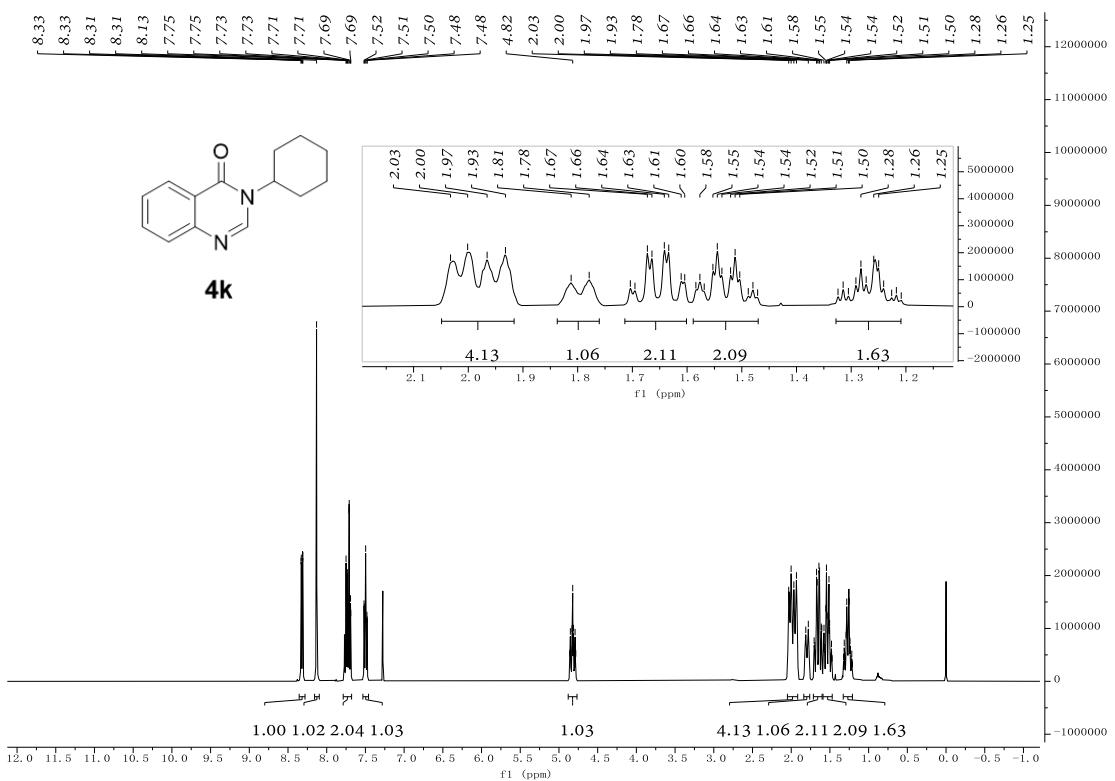
<sup>1</sup> H NMR spectra of *4j* (400 MHz, CDCl<sub>3</sub>)



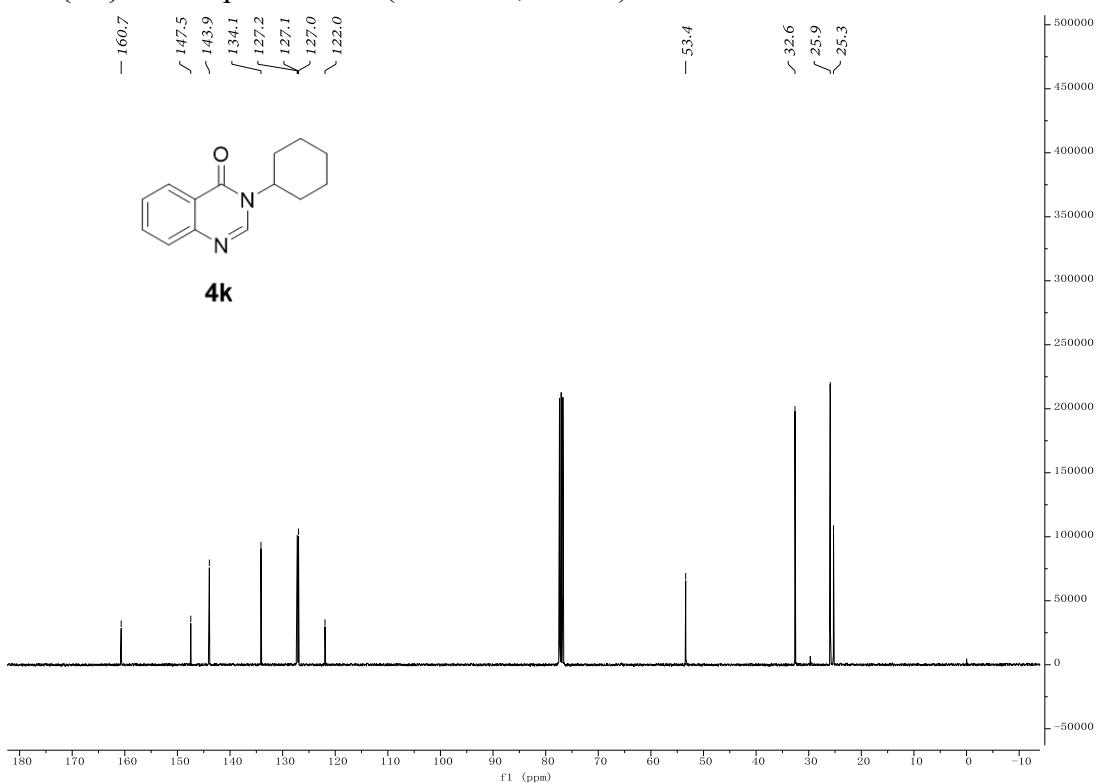
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **4j** (100 MHz, CDCl<sub>3</sub>)



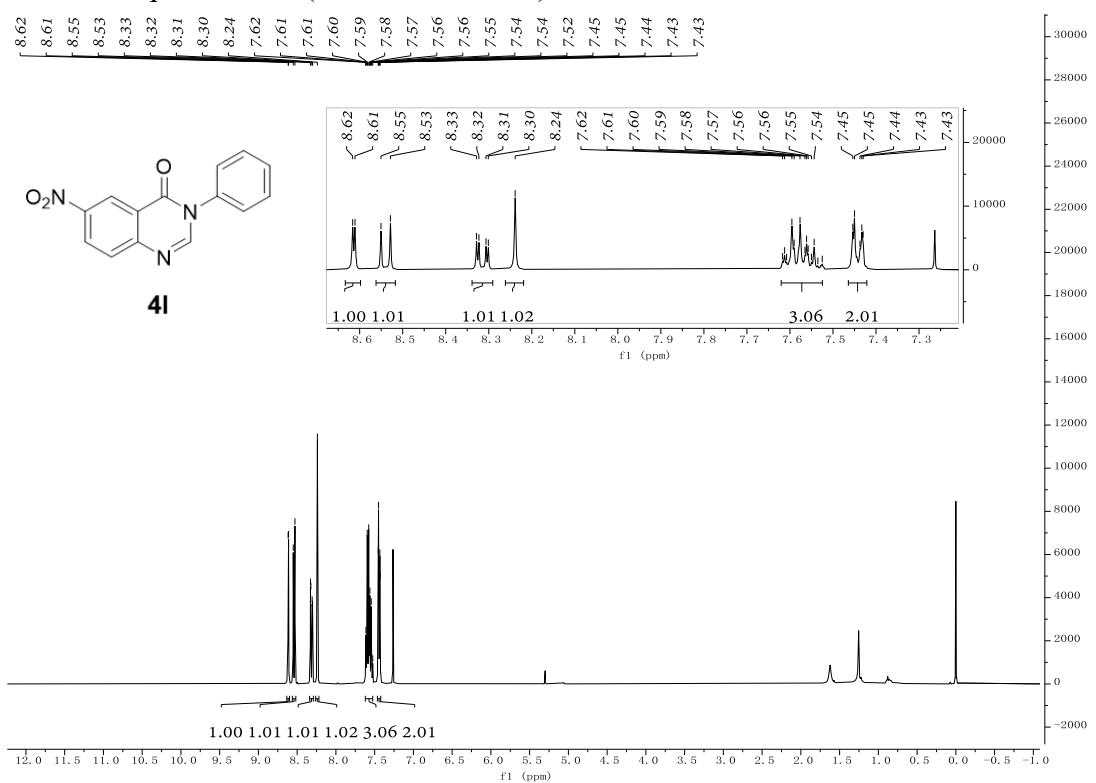
<sup>1</sup> H NMR spectra of **4k** (400 MHz, CDCl<sub>3</sub>)



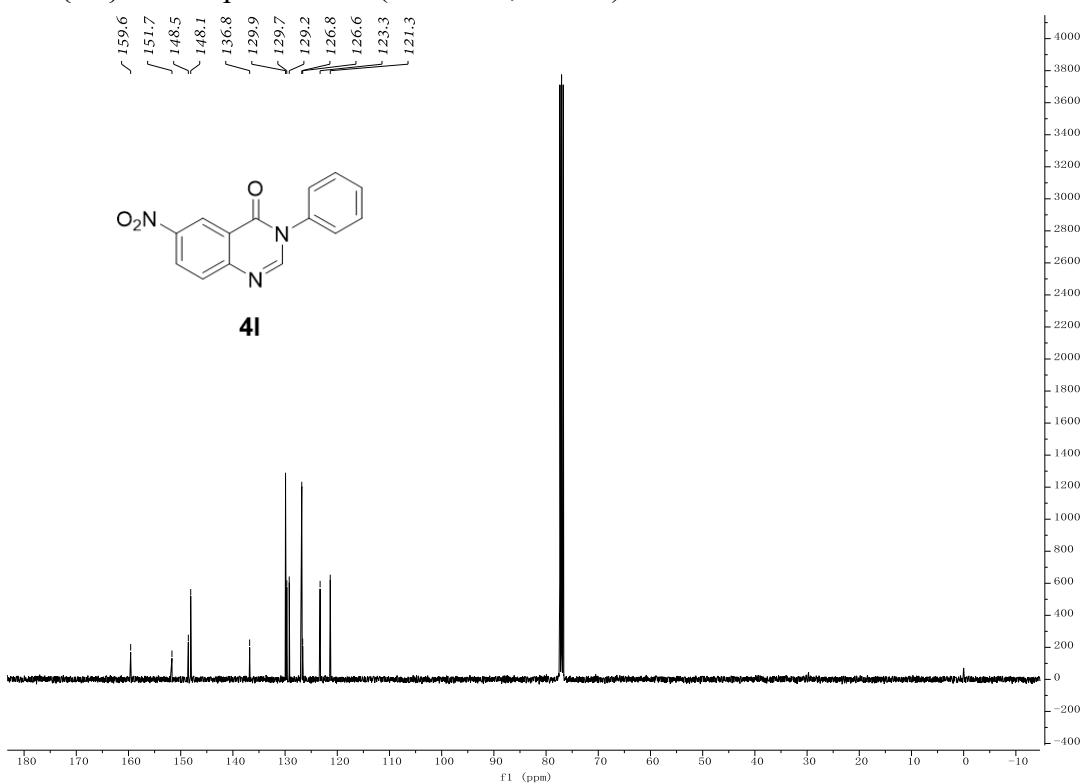
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **4k** (100 MHz, CDCl<sub>3</sub>)



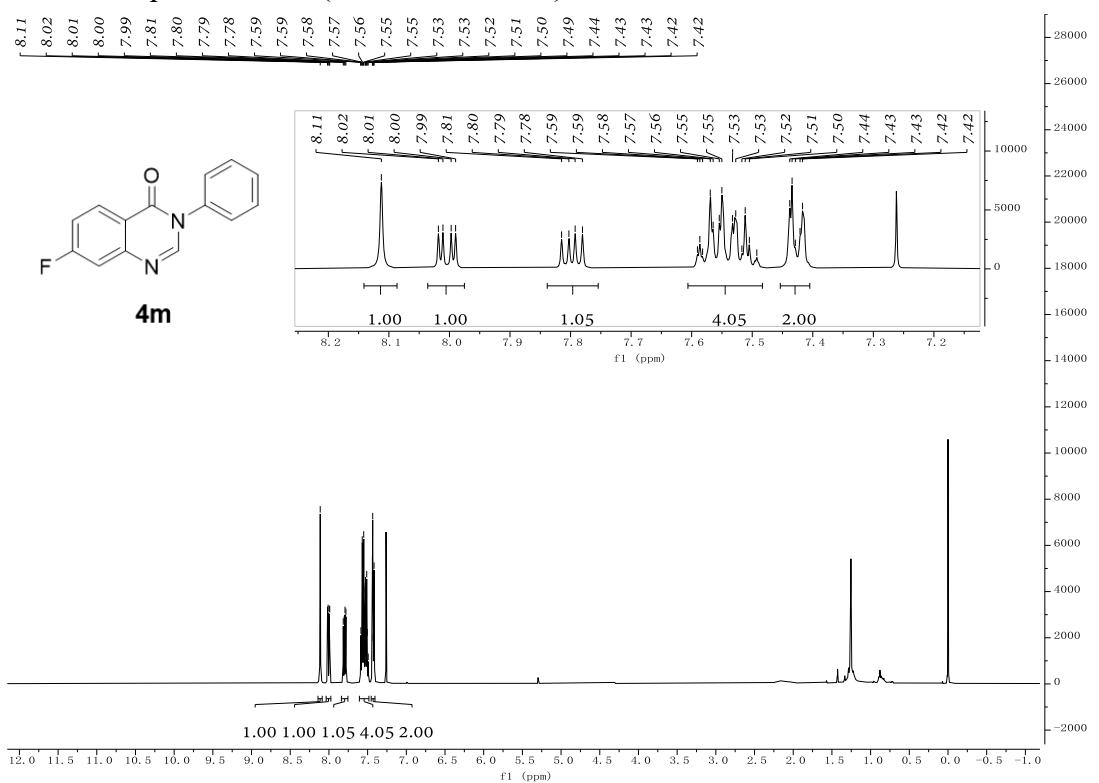
<sup>1</sup> H NMR spectra of *4l* (400 MHz, CDCl<sub>3</sub>)



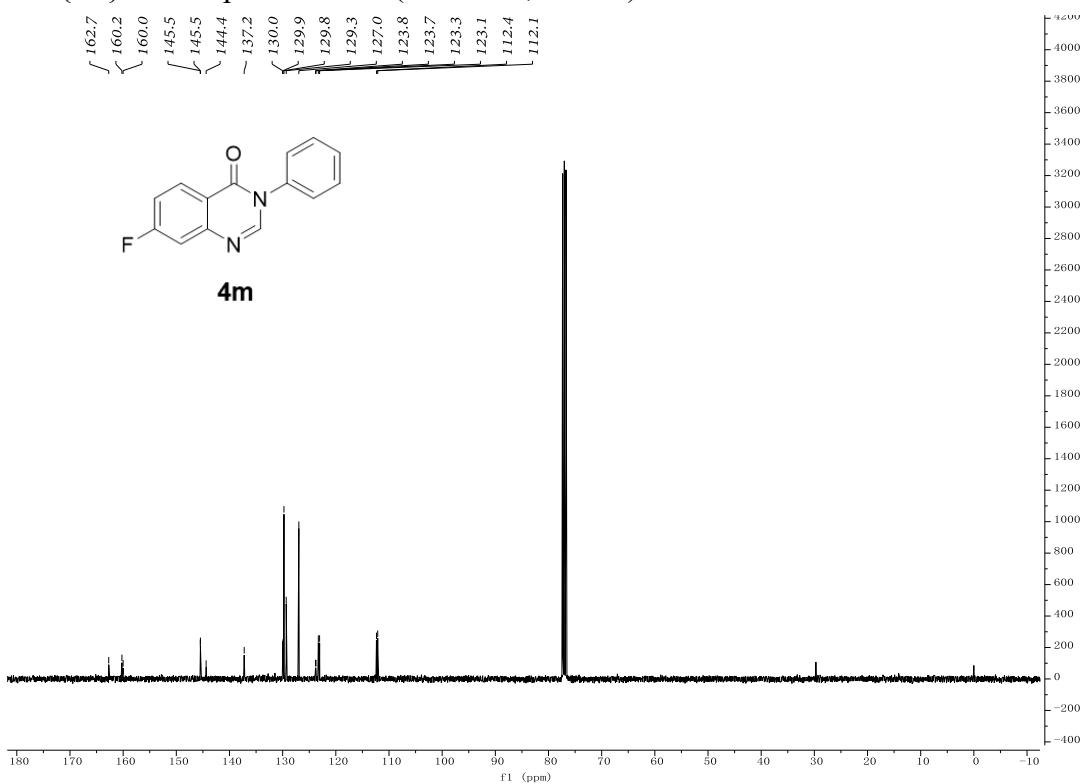
$^{13}\text{C}\{\text{H}\}$  NMR spectra of *4l* (100 MHz,  $\text{CDCl}_3$ )



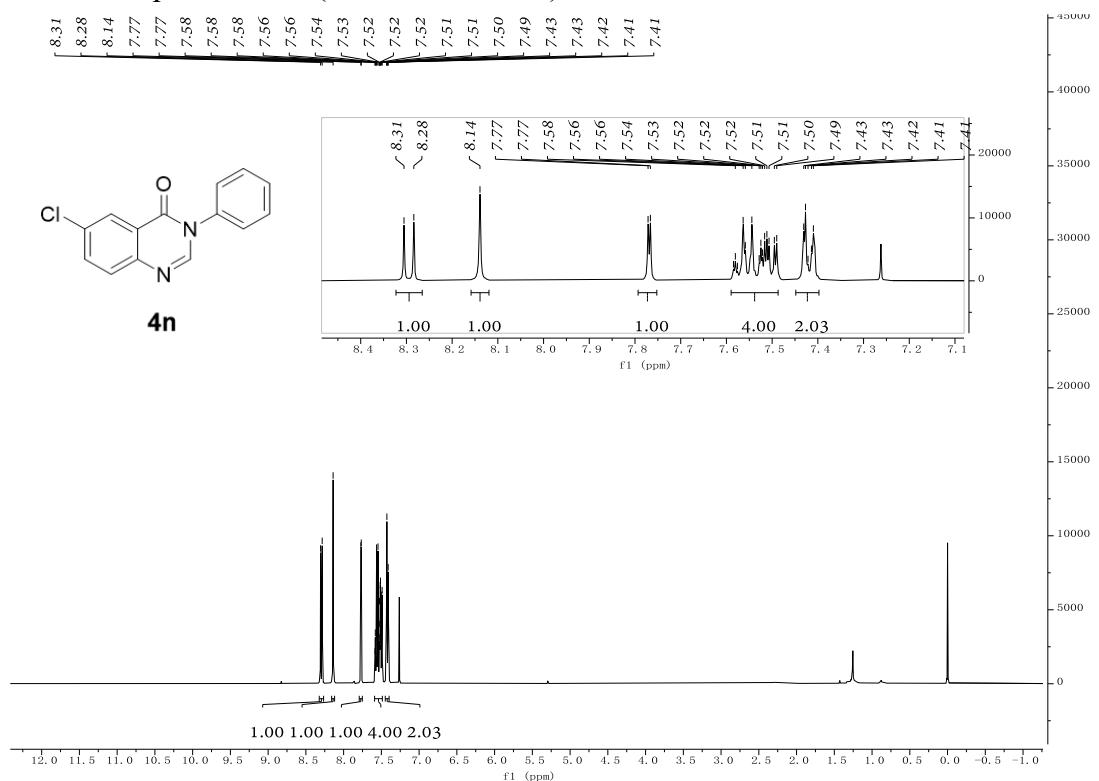
<sup>1</sup> H NMR spectra of **4m** (400 MHz, CDCl<sub>3</sub>)



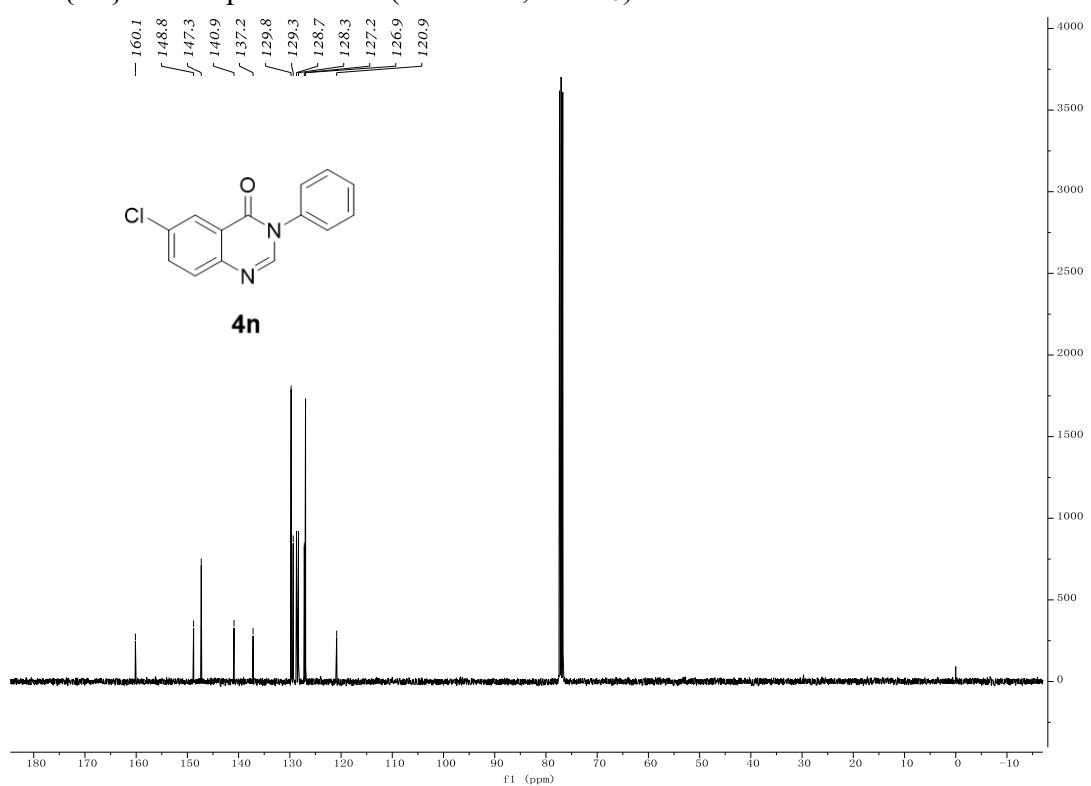
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **4m** (100 MHz, CDCl<sub>3</sub>)



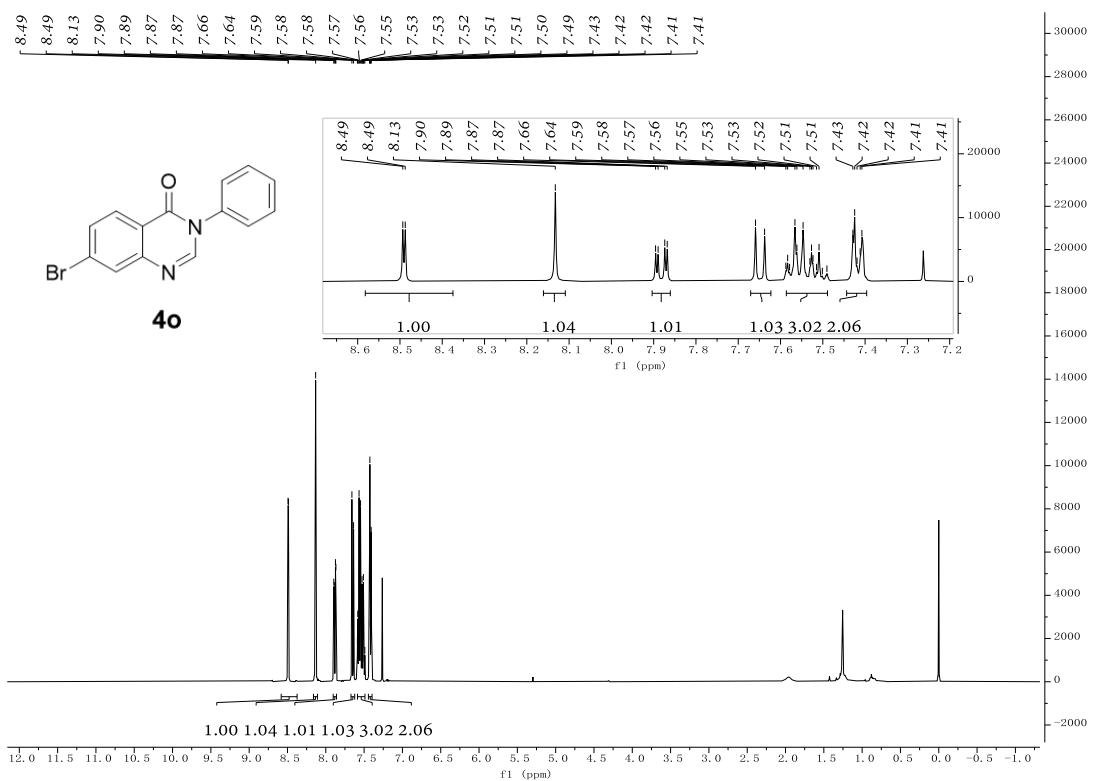
<sup>1</sup> H NMR spectra of **4n** (400 MHz, CDCl<sub>3</sub>)



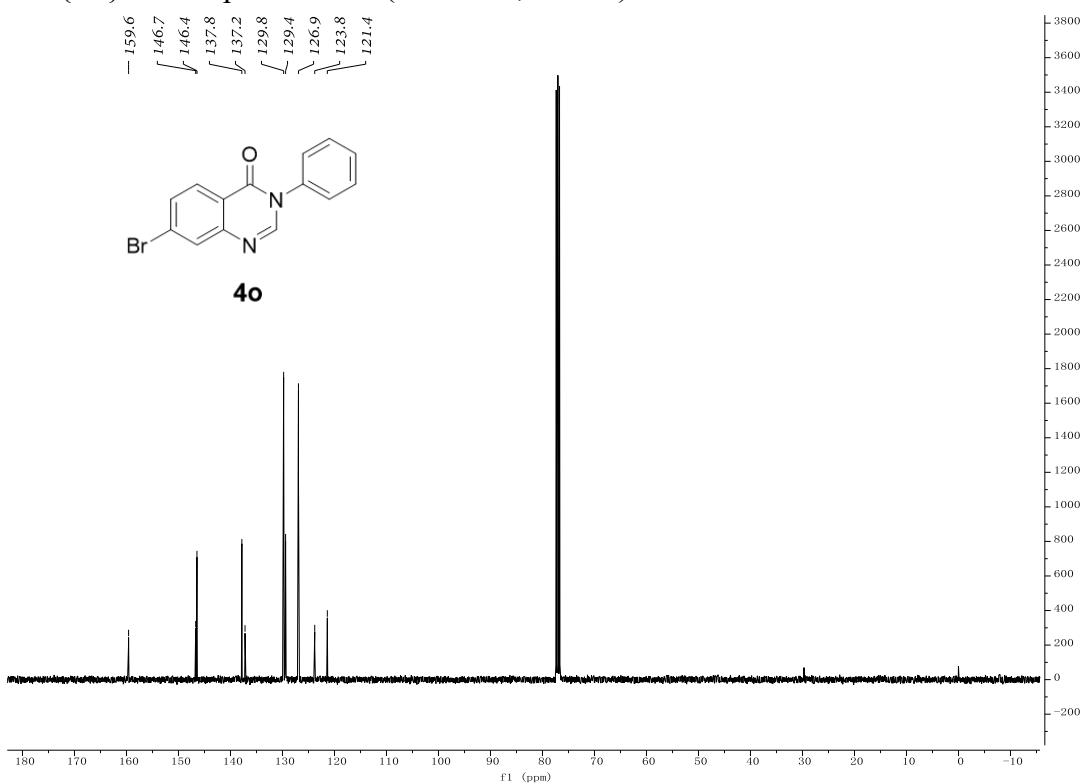
<sup>13</sup>C{<sup>1</sup>H} NMR spectra of **4n** (100 MHz, CDCl<sub>3</sub>)



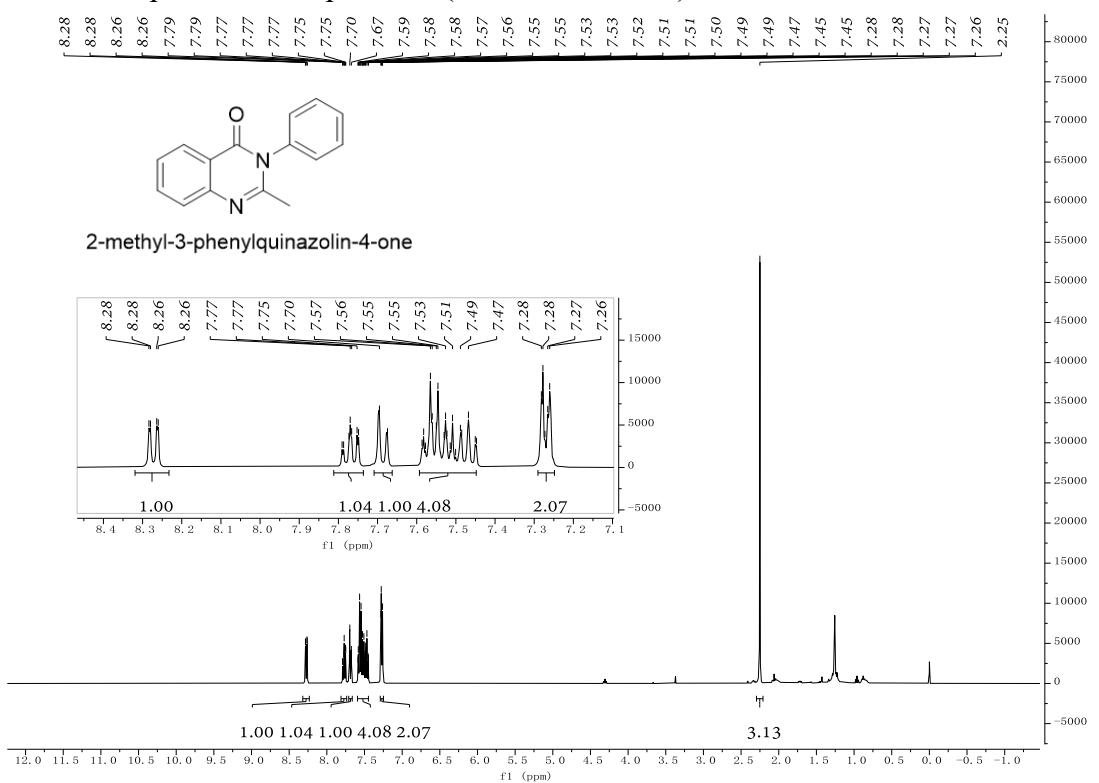
<sup>1</sup> H NMR spectra of **4o** (400 MHz, CDCl<sub>3</sub>)



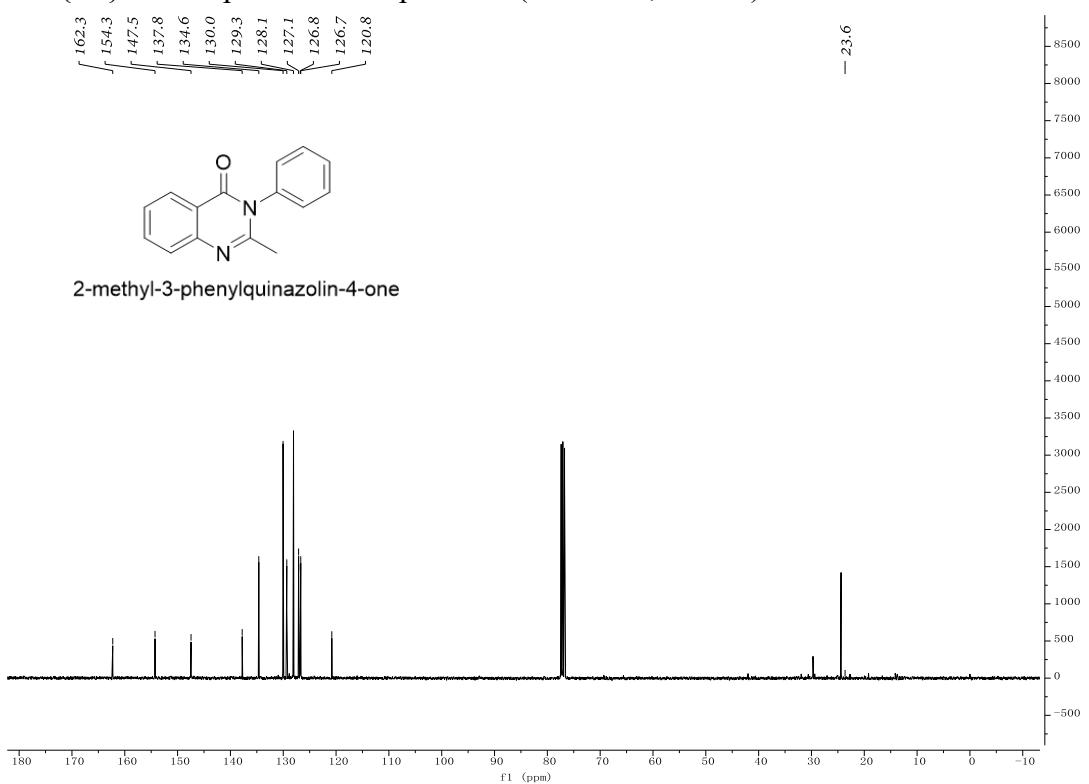
<sup>13</sup> C{<sup>1</sup>H} NMR spectra of **4o** (100 MHz, CDCl<sub>3</sub>)



<sup>1</sup> H NMR spectra of compound A (400 MHz, CDCl<sub>3</sub>)



<sup>13</sup> C{<sup>1</sup>H} NMR spectra of compound A (100 MHz, CDCl<sub>3</sub>)



2. HRMS of pyrrolidine.

