N-doped carbon dots synthesized by rapid microwave irradiation as highly fluorescent probe for Pb\(^{2+}\) detection

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ESI 1. Determination of quantum yields

The quantum yields of NCDs were calculated by using quinine sulfate (0.1M H₂SO₄, QY=0.54) solution as reference together with the following formula:

\[ QY = Q_{Yref} \times \frac{[I \times A_{ref} \times \eta^2]}{[I_{ref} \times A \times \eta_{ref}^2]} \]

Where \( QY \) is the quantum yield of unknown; \( Q_{Yref} \) is the quantum yield of the reference compound; \( \eta \) is the refractive index of the solvent, \( I \) is the integrated fluorescence intensity and \( A \) is the absorbance at the excitation wavelength. The absorbances at the wavelength of excitation is optimally kept in between \( A = 0.02-0.05 \) in order to avoid inner filter effects and ensure linear response on the intensity.

ESI 2. The reactant colour changed over time

![Fig. S1](image) The reactant colour changed over time under ultraviolet (UV) irradiation at 365 nm (from left to right 0, 2, 5, 10, 15, 20min).
ESI 3. FT-IR spectrum of NCDs

![FT-IR spectrum of NCDs](image)

**Fig. S2** The FTIR spectrum of NCDs

ESI 4. XPS spectra of NCDs

**Fig. S3** a) XPS, b) C1s, c) N1s and d) O1s, spectra of the NCDs
ESI 5. Fluorescence spectrum of NCDs under different pH

![Fluorescence spectrum of NCDs under different pH](image)

**Fig. S4** The emission spectrum of NCDs under different pH from 1 to 13

ESI 6. The stability of NCDs

![Stability of NCDs](image)

**Fig. S5** The stability of NCDs
ESI 7. The analysis result of Pb$^{2+}$ in water samples

Table S1. The analysis result of Pb$^{2+}$ in water samples

<table>
<thead>
<tr>
<th>Sample</th>
<th>Add / nM</th>
<th>Found / nM</th>
<th>Recovery / %</th>
<th>RSD / %</th>
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<td></td>
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<td>5.12</td>
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