

## Supplementary Information

### Fast one-step synthesis of N-doped carbon dots by pyrolyzing ethanolamine

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#### Experimental section

##### *Chemicals:*

Ethanolamine and hydrogen peroxide aqueous solution (30%hydrogen peroxide) were of analytical-reagent grade and purchased from Sinopharm Chemical Reagent Co., Ltd (Shanghai, China). Deionized water with a resistivity of 18.1 MΩ cm was used for all experiments.

##### *Preparation of N-CDs:*

In the synthesized experiment of N-CD1, the ethanolamine (3 ml) in a beaker (200 ml) was pyrolyzed in the stove at 150 °C under air environment for 2 hours. The color of liquid changed from colorless to bright yellow liquid after 1 hour, and then dark at last, implying the formation of N-CD1.

In the synthesized experiment of N-CD2, the beaker (200 ml) with the

mixture of 3 ml ethanolamine and 4.5 ml hydrogen peroxide aqueous solution ( $\text{H}_2\text{O}_2$ ) was put into the stove at 250 °C and kept for 7 minutes to obtain N-CD2. During the procedure of N-CD2 preparation, the color of ethanolamine changed into bright yellow just after adding  $\text{H}_2\text{O}_2$ , then the color become dark at last. In this process the all the  $\text{H}_2\text{O}_2$  was reacted, and water was volatilized. The obtained dark colloidal solid was added into 200 ml distilled water, the carbon dots solution was obtained. The product was dissolved into the water very rapidly. Then the solution was centrifuged at 14000 rpm for 30 min. It is worth noting that any sediment was not obtained, so no large particles ware emerged during the procedure of N-CDs preparation.

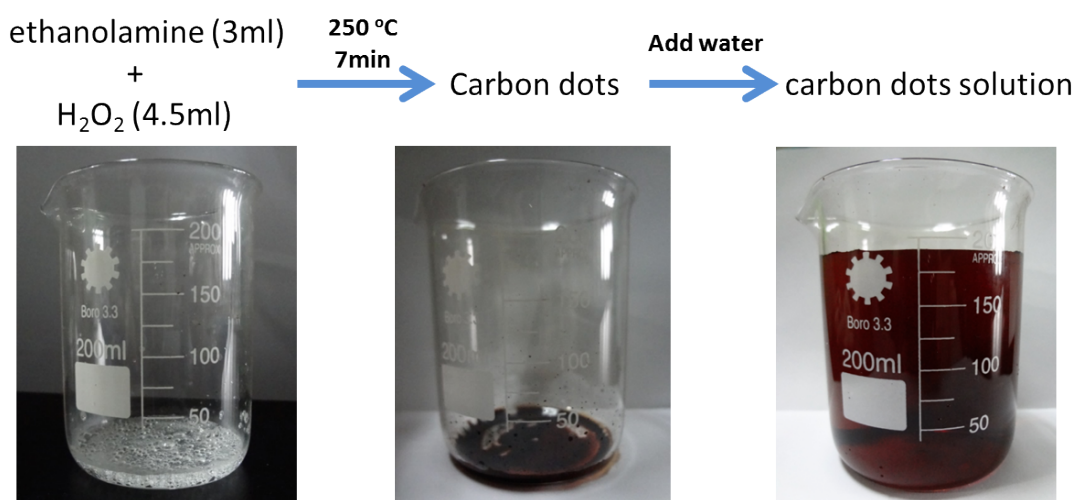
***Preparation of Carbon dots fluorescent film:***

Firstly, 2 ml (1 mg/ml) of N-CDs aqueous solution was mixed with 2 ml PVA solution (5 wt%) by slow shaking in order to obtain uniform carbon dot/PVA solution. Then the mixture was coated onto glass substrate with brush and then dried in an oven under 70 °C for 2 hours to obtain the carbon dots fluorescent films.

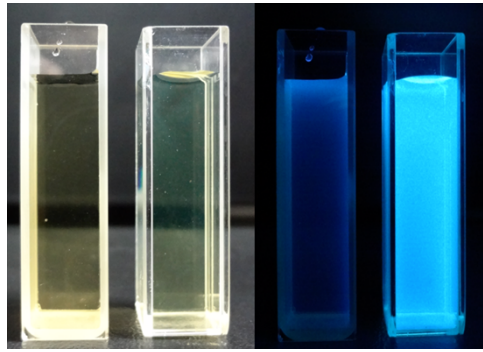
***Characterization:***

The morphologies of the samples were observed by JEM-2100 microscope (Japan, JEOL) with an accelerating voltage of 200 kV and AFM (SII Nanonavi E-Sweep). X-ray diffraction (XRD) analysis was carried out using a D8 Advance, Bruker AXS Corporation, Germany. X-

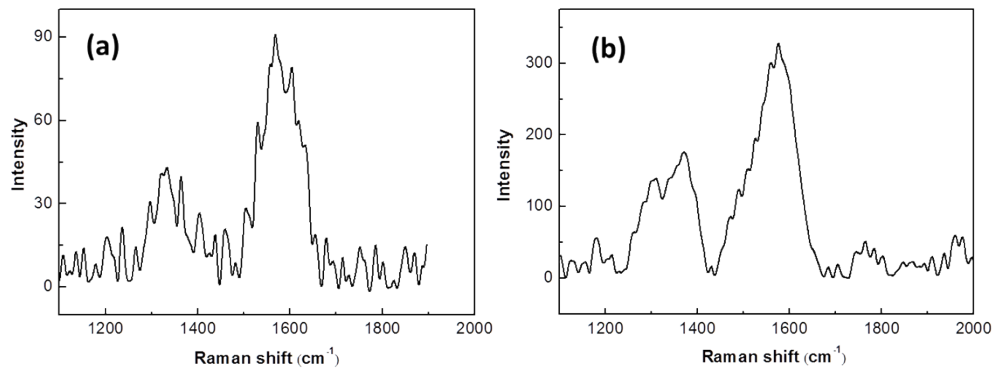
ray photoelectron spectra (XPS) were acquired with a Japan Kratos Axis UltraDLD spectrometer using a monochromatic Al K $\alpha$  source (1486.6 eV). FTIR spectra were recorded on a Bruker (Germany) VERTEC 80v vacuum FTIR spectrometer. The UV-Vis absorption spectra were recorded on a Perkin-Elmer Lambda 950 UV-Vis-NIR spectrophotometer. The photoluminescent (PL) spectra were recorded using a fluorescent spectrophotometer (F-4600, Hitachi, Japan). The fluorescence lifetime was measured using a steady-state & time-resolved fluorescence spectrofluorometer (QM/TM/IM, PTI, USA).



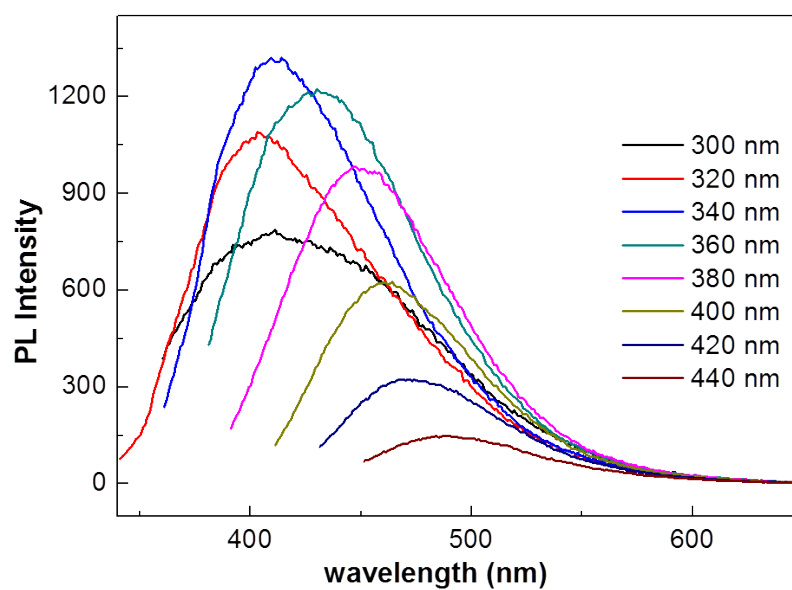
**Fig. S1** Synthesis procedure of N-doped CDs.



**Fig. S2** Photographs of aqueous solution dispersed with intermediate products (left) and N-CD2 (right) under room light and under 365 nm irradiation.

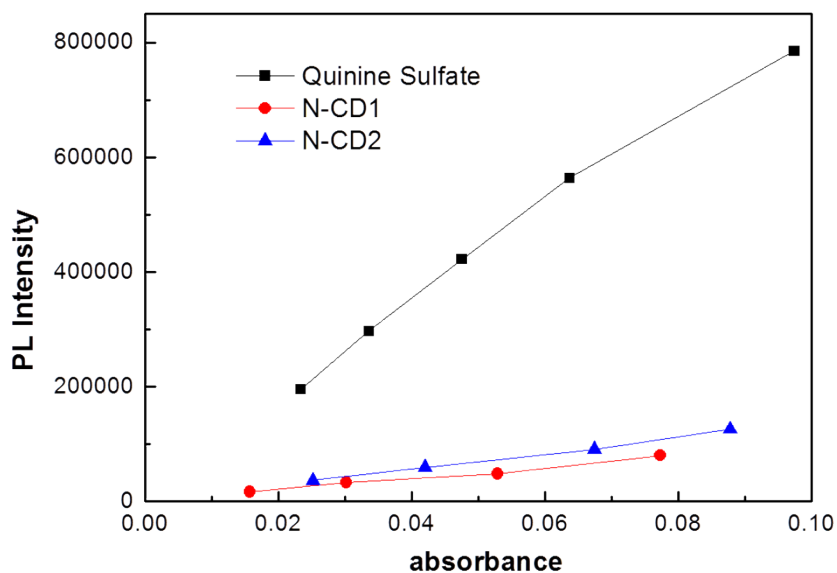


**Fig. S3** Raman spectra of N-CD1(a) and N-CD2(b).

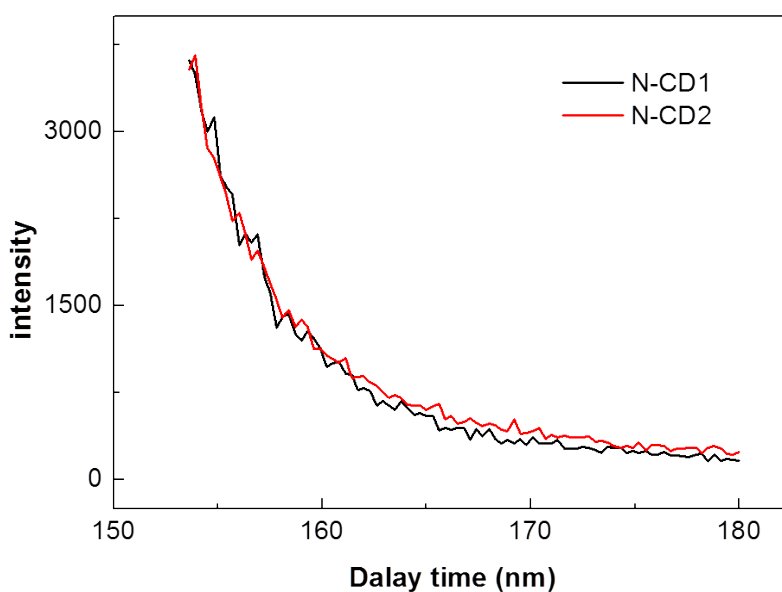


**Fig. S4** Emission spectra for the N-CD1 dispersed in water at excitation

wavelengths progressively increasing from 300 to 440 nm.



**Fig. S5** Photoluminescence and absorbance of N-CDs and quinine sulfate.



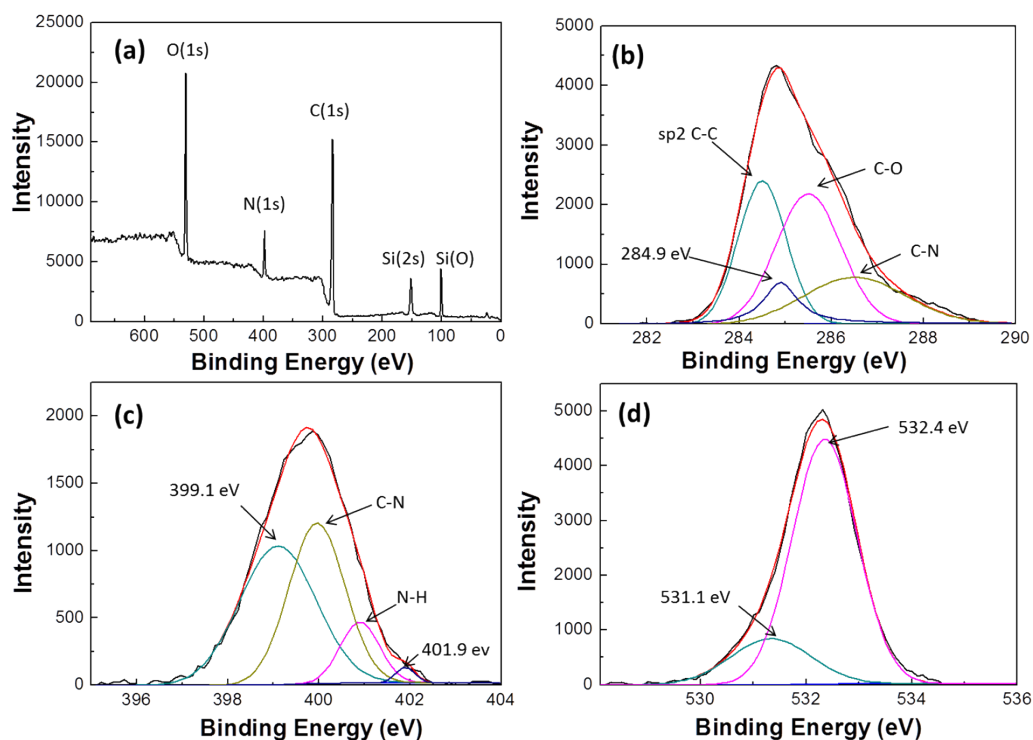
**Fig. S6** Fluorescence decay profile ( $\lambda_{ex} = 360$  nm,  $\lambda_{em} = 450$  nm) of N-CDs.

The fluorescence lifetime ( $t$ ) of N-CDs was assessed by time-resolved photoluminescence measurements. As seen in Fig. S6, the decay

trace for N-CDs was fitted using single exponential functions  $Y(t)$  based on non-linear least squares analysis in Equation (1).

$$Y(t) = \alpha \exp(-t / \tau) \quad (1)$$

Where  $\alpha$  are the fractional contributions of time resolved decay lifetime of  $\tau$ .



**Fig. S7** (a) XPS spectra of the N-CD2. (b)–(d) High-resolution C1s(b), N1s(c), and O1s(d) peaks of the N-CD1.

The results show that the surface groups of N-CD2 are very similar to the N-CD1. The high-resolution spectra of C1s (Fig. S7b) exhibits four main peaks. The binding energy peak at 284.5 eV confirms the graphitic structure (sp<sup>2</sup>C-sp<sup>2</sup>C) of the N-CDs. The binding energy peaks at 284.9

eV are mainly vacancy defects, pentagon-heptagon, and sp<sup>2</sup>C-sp<sup>2</sup>C influenced by functional groups. The peaks at 285.5 and 286.5 eV suggest the presence of C-O and C-N. The high-resolution spectra of N1s (Fig. S7c) reveal the presence of pyridinic type (399.1eV), the binding energy of 400 eV and 400.9 eV is associated with C-N and N-H groups. The binding energy of 401.9 eV is correspond to N-O, this is different from the N-CD1. The high-resolution spectra of O1s (Fig. S7d) reveal the presence of C=O-containing groups (531.1 eV, 532.4eV).

**Table S1.** Different reaction conditions for N-CDs, and their product yield and quantum yield

	Reaction condition	Product yield(%)	Quantum yield(%)
N-CD1	150°C for 120 min	6	7
N-CD2-a	Add H <sub>2</sub> O <sub>2</sub> , 150°C for 60 min	51	10.1
N-CD2-b	Add H <sub>2</sub> O <sub>2</sub> , 200°C for 30 min	53	10
N-CD2-c	Add H <sub>2</sub> O <sub>2</sub> , 250°C for 8 min	47	10.3
N-CD2-d	Add H <sub>2</sub> O <sub>2</sub> , 300°C for 3 min	30	8

In the improved experiment, the condition at different temperatures was attempted to prepare the N-CD2. With the synthesis temperature increased from 150 to 250 °C, the synthesis time of N-CDs was shortened

obviously, the product yield and quantum yield were nearly unchanged.

**Table S2.** The quantitative determination of N-CD1 by XPS.

Name	C1s	N1s	O1s
%at	67.11	13.84	19.05