Electronic Supplementary Information

Highly Photoluminescent pH-independent Nitrogen-Doped Carbon Dots for Sensitive and Selective Sensing of p-Nitrophenol

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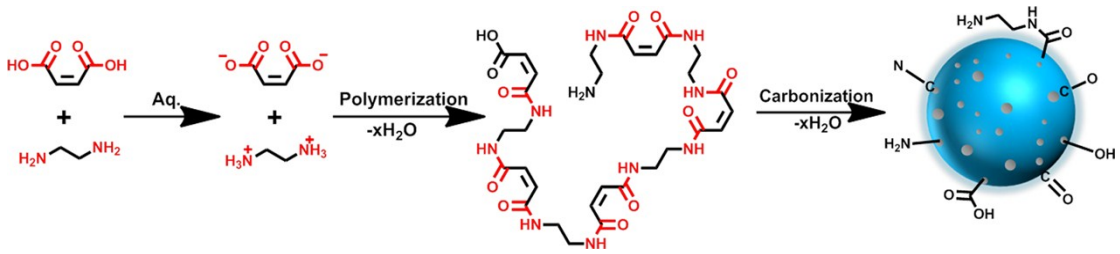


Fig. S1 Schematic diagram of the formation process of the N-CDs using maleic acid and ethylenediamine: from ionization to polymerization, and carbonization.

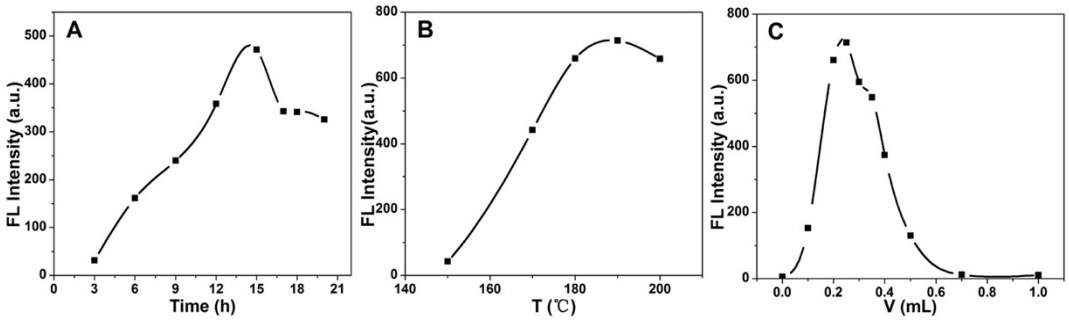


Fig. S2 (A) The fluorescence intensities of the as-prepared N-CDs with different hydrothermal reaction time, m(maleic acid)=0.50 g, v(ethylenediamine)=0.30 mL, T=190 ºC; (B) The fluorescence intensities of the N-CDs synthesized with different hydrothermal reaction temperature, m(maleic acid)=0.50 g, v(ethylenediamine)=0.25 mL, t=15 h; (C) The fluorescence intensities of the N-CDs prepared with the different volume of ethylenediamine, m(maleic acid)=0.50 g, t=15 h, T=190 ºC. λex=440 nm, λem=480 nm.

Table S1 Other reactions for bare CDs and the other N-CDs (In (Teflon) -lined autoclave/190 ºC for 15 h).

CDs	Precursors	QY (%)	Photos of CDs aqueous		Excitation/ Emission peak position (nm)
			visible light	UV light	
CDs1	Maleic acid, 0.5 g	1.4			440/500
CDs2	Fumaric acid, 0.5 g	1.3			440/500
CDs3	Ethylenediamine, 0.25 mL	2.5			401/471
N-CDs1	Maleic acid, 0.5 g Ethylenediamine, 0.25 mL	45			440/480
N-CDs	Fumaric acid, 0.5 g Ethylenediamine, 0.25 mL	45			440/480

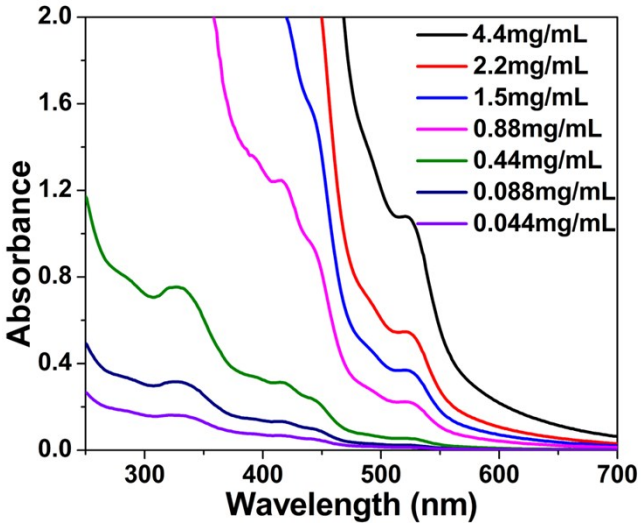


Fig. S3 UV/Vis absorption of the as-obtained N-CDs at different concentration from 0.044 to 4.4 mg/mL.

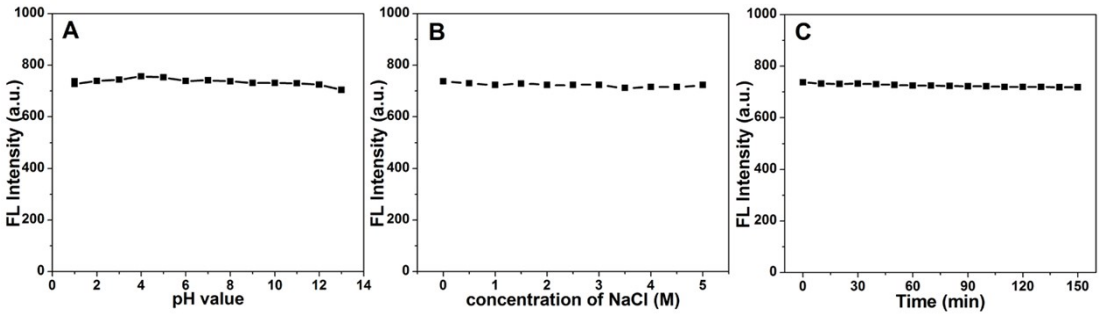


Fig. S4 (A) Fluorescence responses of the N-CDs (0.44 mg/mL) at different pH values; (B) Effect of ionic strengths on the fluorescence intensities of N-CDs (0.44 mg/mL) (ionic strengths were controlled by various concentrations of NaCl solutions); (C) Fluorescence intensity variation of the N-CDs (0.44 mg/mL) as a function of time at 440 nm excitation.

Table S2 Summary of Stern−Volmer equations for the fluorescence quenching of the N-CDs by 4-NP, 2-NP and 3-NP. c(N-CDs)=0.044 mg/mL, v($NaCO_3$-$NaHCO_3$)=1.5 mL, pH=10, λex=440 nm, λem=480 nm

Analytes	Kelvin temperature (k)	Stern−Volmer equations	K_{SV} (mL/μg)	Correlation coefficient (r)
4-NP	293	F_0/F=1.02+0.0775 [Q] (n=9)	0.0775	0.9968
	313	F_0/F=1.04+0.091 [Q] (n=9)	0.0909	0.9962
2-NP	293	F_0/F=0.99+0.0478 [Q] (n=9)	0.0478	0.9968
	313	F_0/F=1.02+0.0569 [Q] (n=9)	0.0569	0.9936
3-NP	293	F_0/F=1.05+0.0089 [Q] (n=9)	0.0089	0.9987
	313	F_0/F=1.05+0.0105 [Q] (n=9)	0.0105	0.9929

Table S3 The effect of nitrophenols on the fluorescence of the as-prepared N-CDs (c(N-CDs)=0.044 mg/mL, c(nitrophenols)=10 μg/mL, pH=10, λex=440 nm, λem=480 nm).

Nitrophenol compounds	Fluorescence quenching *%*	RSD/% (n=3)
4-NP	47.2	1.6
2-NP	15.5	2.3
3-NP	6.4	0.5

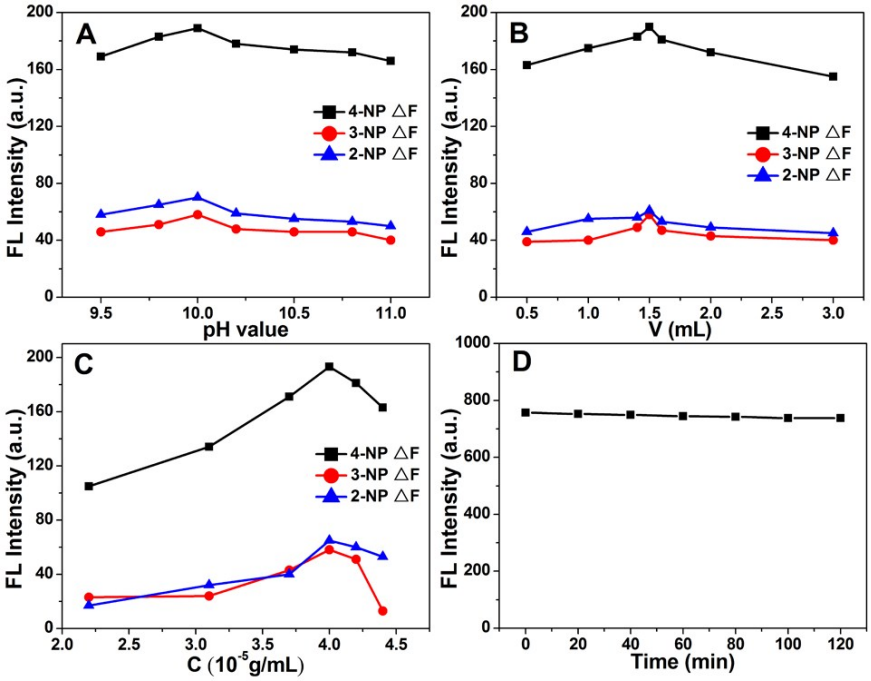
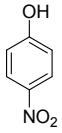
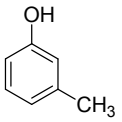
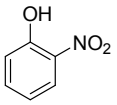
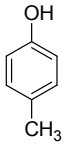
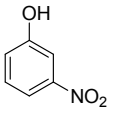
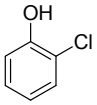
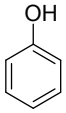
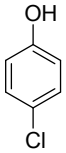
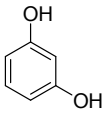
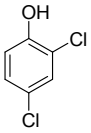
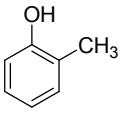


Fig. S5 Effects of pH value (A), $NaCO_3$-$NaHCO_3$ buffer volumes (B) and the concentration of N-CDs (C) on fluorescence intensities; (D) Fluorescence intensities of the N-CDs/4-NP with the variation of time. c(N-CDs)=0.044 mg/mL, c(4-NP)= 4 μg/mL, c(2-NP)=4 μg/mL, c(3-NP)=4 μg/mL, v($NaCO_3$-$NaHCO_3$)=1.5 mL, pH=10, λex=440nm, λem=480 nm.

Table S4 Chemical structures of 4-NP and the analogues.

Compound	Chemical structures	Compound	Chemical structures
p-nitrophenol		m-cresol	
o-nitrophenol		p-cresol	
m-nitrophenol		o-chlorophenol	
Phenol		p-chlorophenol	
resorcinol		2, 4-dichlorophenol	
o-cresol			

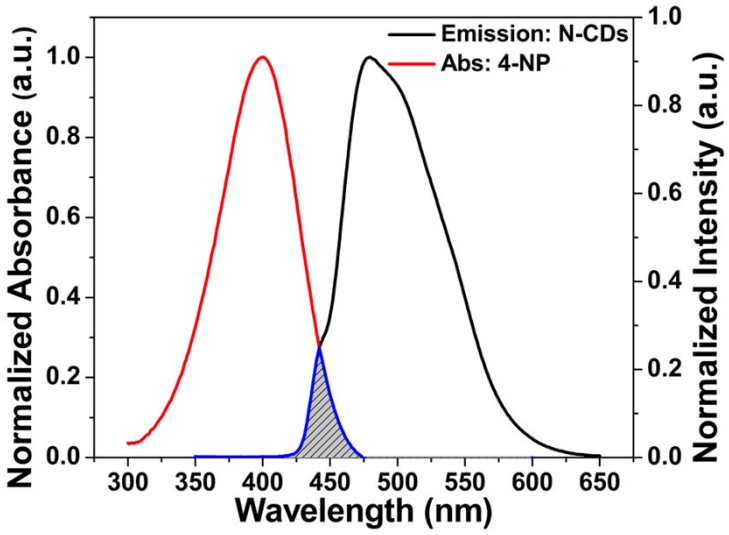


Fig. S6 The normalized UV−vis spectrum of 4-NP and the normalized fluorescence spectrum of the N-CDs.

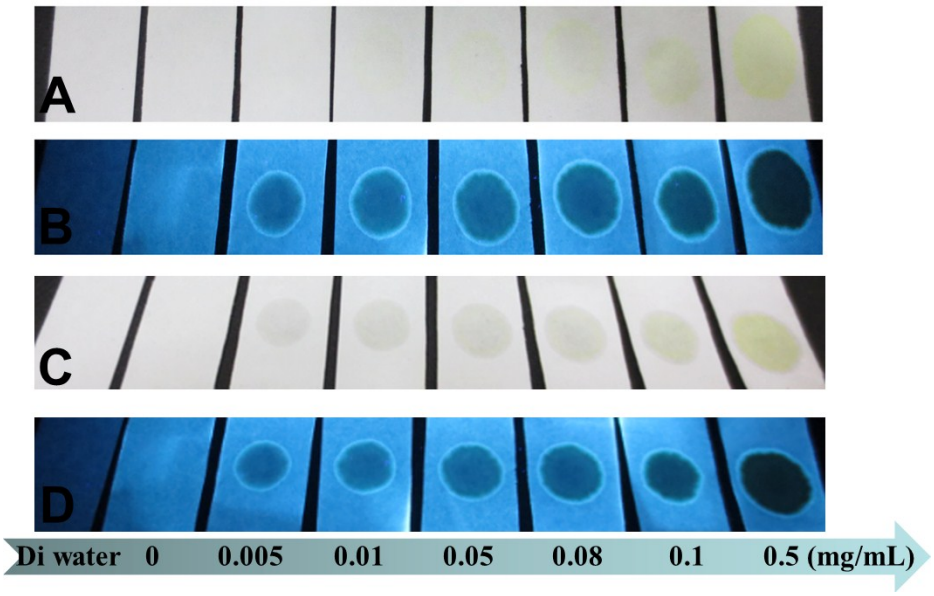


Fig. S7 Photographs of the filter paper of the N-CDs (0.044 mg/mL) after the addition of different concentrations of 4-NP in the daylight (A) and under 365 nm UV light (B) and images of the filter paper of the N-CDs (0.044 mg/mL) after the addition of tap water sample spiked with different concentrations of 4-NP in the daylight (C) and under UV light (D). c(4-NP, from left to right samples): 0, 0.005, 0.01, 0.05, 0.08 , 0.1 and 0.5 mg/mL.