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# **Supporting Information**

Nitrogen-doped carbon dots encapsulated in the mesoporous channels of SBA-15 with solid-state fluorescence and excellent stability

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#### **Experimental section**

# Synthesis of nitrogen-doped CDs (NCDs)

Citric acid (CA, 1.05 g) was dissolved in deionized water (25 mL). The mixture was transferred to Teflon autoclave (50 mL) and heated at 200 °C for 5h and cooled to room temperature. The obtained solution was purified with a 0.22  $\mu$ m filter membrane. The transparent solution containing CDs were collected. Then the obtained solution (10 mL) was mixed with 536  $\mu$ L of ammonia solution (25 wt%), and the resulting mixture was further transferred to Teflon autoclave (50 mL) and heated at 200 °C for 5h. After the reaction, the brown suspension was re-purified with filter membrane. Finally, the NCDs solution was obtained.

### Synthesis of SBA-15

In a typical synthesis, 2.4 g  $EO_{20}PO_{70}EO_{20}$  (P123) was dissolved in 84 ml HCl solution (1.3 M). After the solution became clear, 0.027 g NH<sub>4</sub>F was added and the mixture was kept stirring at 15 °C. Then a mixed solution of n-hexane (12.3 mL) and tetraethyl orthosilicate (TEOS, 5.5 mL) was introduced into the above solution dropwise under continuous stirring. After stirring for 20 h at 15 °C, the mixture was transferred to Teflon autoclave for further reaction at 100 °C for 48 h. The obtained product was collected by centrifugation and washed with pure water for several times. Finally, SBA-15 with ordered cylindrical mesopores was obtained after dried in air and calcined at 550 °C for 5 h to remove the surfactants.

## Synthesis of NCDs-in-SBA-15

30 mg as-synthesized SBA-15 powder was dispersed in 10 mL deionized water by ultrasonication. 1 mL prepared NCDs solution was poured into the mixture. The mixture was first stirred for 30 min and then treated by ultrasonication for another 30 min. After that, the

mixture was centrifuged. The sediment was washed by distilled water for 3 times and dried in 50 °C vacuum oven. The obtained composite was named as NCDs-in-SBA-15. To achieve better understanding of the confinement effects, we also prepared the composites of NCDs and silica with no pores, and labeled them as NCDs-silica-n (n = 0, 1, 2. 0: stirring and ultrasonic treatment; 1: hydrothermal treatment at 140 °C for 0.5 h; 2: hydrothermal treatment at 140 °C for 4 h).

#### **Characterization**

Transmission electron microscope (TEM) images were taken using a JEOL JEM-2010 electron microscope. X-ray diffraction patterns were recorded on a Bruker D8 Advance diffractometer equipped with a Cu Ka X-ray source operating at 40 kV and 40 mA. Fouriertransform infrared (FT-IR) spectra were obtained with a Thermo Nicolet 360 FTIR spectrometer. X-ray photoelectron spectroscopy (XPS) spectra were acquired using a Thermo ESCALAB 250 equipped with a multichannel detector. The N<sub>2</sub>-sorption isotherms were collected on a JW-BK300 apparatus. The surface area was calculated using the Brunauer-Emmett-Teller (BET) method. The pore size distribution plots were obtained from the analysis of the desorption branches of the isotherms using the Barrett-Joyner-Halanada (BJH) method. The UV-vis absorption spectra were recorded by a Shimadzu UV-2550 spectrometer. Photoluminescence emission and excitation spectra were measured using Hitachi F4500 fluorescence spectrophotometer. Time-resolved fluorescence emission spectra were performed on a Hamamatsu C11367 fluorescence spectrophotometer. The zeta potential measurements were carried out on a Malvern Nano ZS instrument. The photochemical measurements were performed on CHI-660D workstation in a standard three-electrode system using prepared samples as working electrodes, a Pt foil as the counter electrode, and Ag/AgCl as the reference electrode, respectively.



Fig. S1. TEM images of (A, B) silica and (C, D) NCDs-silica-0 composite.



Fig. S2 FT-IR spectra of the samples: (A) silica, NCDs-silica-0, NCDs-silica-1 and NCDs-silica-2; (B) NCDs, SBA-15 and NCDs-in-SBA-15.



Fig. S3 Photocurrent-time (*I-t*) curves of NCDs, SBA-15 and NCDs-in-SBA-15 under visible light irradiation.



Fig. S4 PL emission spectra of NCDs excited at different wavelengths. Insets: Normalized PL emission spectra and photographs of NCDs under day light and UV light of 365 nm.



Fig. S5 UV-vis absorption spectra and (Inset) PL emission spectra of NCDs-silica-n ( $\lambda ex = 340$  nm).



Fig. S6 Variation of PL intensity of supernate with stirring time ( $\lambda ex = 340$  nm).



Fig. S7 Photographs of (A) NCDs and (B) NCDs-in-SBA-15 under UV light of 365 nm after irradiation by a visible light source (4.5 KW m<sup>-2</sup>) for different time.



Fig. S8 Variation of PL intensity of NCDs-in-SBA-15 after repeated heat treatment at 400 °C.



Fig. S9 Photographs of NCDs in water, concentrated HCl, and ammonia solution under (A) daylight and (B) UV light of 365 nm. Photographs of NCDs-in-SBA-15 in (C) water, (D) concentrated HCl, and (E) ammonia solution under daylight (top) and UV light of 365 nm (bottom).



Fig. S10 (A) Schematic representation of PL quenching of NCDs and NCDs-in-SBA-15 in the presence of  $Fe^{2+}$  or  $Fe^{3+}$ . (B) Stern – Volmer plot versus different  $Fe^{3+}$  concentrations for NCDs-in-SBA-15. (C) Adsorption performance of NCDs-in-SBA-15 to  $Fe^{3+}$  (Inset: Photograph of NCDs-in-SBA-15 powders after the adsorption of  $Fe^{3+}$ ).

Table S1 The photoluminescence decay time ( $\tau$ ) and their relative amplitude (A) of NCDs and NCDs-in-SBA-15, which are derived from the time-resolved PL spectra in Figure 4D by triexponential decays.

Sample -	Decay time (ns)			Relative amplitude (%)			Average lifetime
	$\tau_1$	$\tau_2$	$\tau_3$	$A_1$	$A_2$	A <sub>3</sub>	(ns)
NCDs	1.32	4.26	10.28	48.08	32.94	18.98	6.74
NCDs-in-SBA-15	1.27	5.60	19.71	71.42	25.13	3.45	7.50