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# Chemiluminescence of Carbon dots under strong alkaline solutions: A novel insights into carbon dots optical properties

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## Experimental

**Chemicals:** α- D-Glucose and EDTA-2Na. $H_2O$ was obtained from Beijing Xin Jing Ke Biotechnology Co, Led (Beijing, China), poly(ethylene glycol)(PEG-1500) was from Sigma-Aldrich (St. Louis, MO, USA), NaOH and KOH were purchased from Sinopharm Chemical Reagent Co., Ltd (Beijing, China). Water used for the preparation of solutions was from a Millipore Milli-Q (Biocel) water purification system. All the chemicals and solvents were of analytical grade without any further purification.

### Preparation of Carbon Dots

Carbon dots were prepared by the microwave hydrothermal method with glucose as the precursor, PEG1500 as the surface passivation reagent. Briefly, 2g glucose and 4g poly(ethylene glycol)(PEG-1500) were added to 14mL super-purified water to form a transparent solution. Then the solution was heated in a 700W domestic microwave oven for 10 min. After the reaction, the mixture cooled to room temperature, then dispersed in water to form colloidal fluids of dark brown.

Residual glucose and PEG were removed via dialysis for several days in super-purified water. The cutoff of the dialysis membrane is equal to molecular weight of 2000. Carbon dots solution

was then concentrated by rotary evaporator to 2 mL as stock solution and diluted with super-purified water before their using in the CL and EPR experiments.

The NaOH-carbon dots reaction mixture were dialyzed several days in super-purified water using the same dialysis membrane, then the printine-carbon dots solution and the NaOH-treated carbon dots solution were freezed drying into powders for the FTIR and XPS experiments.

**Instruments and characterization**

The CL kinetic curves were recorded by a BPCL Ultra-Weak Luminescence Analyzer (Institute of Biophysics, Chinese Academy of Sciences, Beijing, China). Fluorescence measurements were performed on a FluoroMax-4 spectrofluorometer (Horiba Jobin Yvon, Edison, NJ, USA), using 350-580nm excitation and a slit width of 5 nm. UV–vis absorption spectra were measured on an Agilent 8453 UV–visible spectrophotometer (Palo Alto, CA, USA).ESR spectra were collected on a Bruker spectrometer (ESP-300E, Bruker, Germany). High-resolution transmission electron microscopy (HRTEM) images were recorded by a electron microscope operating at 120 kV (JEM-2010, JEOL, Japan). Surface chemical bonding state were analyzed by X-ray photoelectron spectroscopy (ESCALAB250, Thermo Scientific, USA). Fourier transform infrared (FT-IR) measurements were carried out with a FT-IR spectrometer (6100, JASCO, Japan). The CL spectra were examined by a series of high-energy optical filters (440,460, 475, 490, 520, 535, 555, 575, 590, 605, 620 nm).

**CL Measurements**

The CL kinetic characteristics of carbon dots were obtained by batch experiments, which were achieved by a static system consisted of a glass cuvette and the BPCL Ultra-Weak Luminescence Analyzer. 100μL of carbon dots were added into the glass cuvette, and then oxidant was injected by a 100μL micro syringe from the upper injection pore.

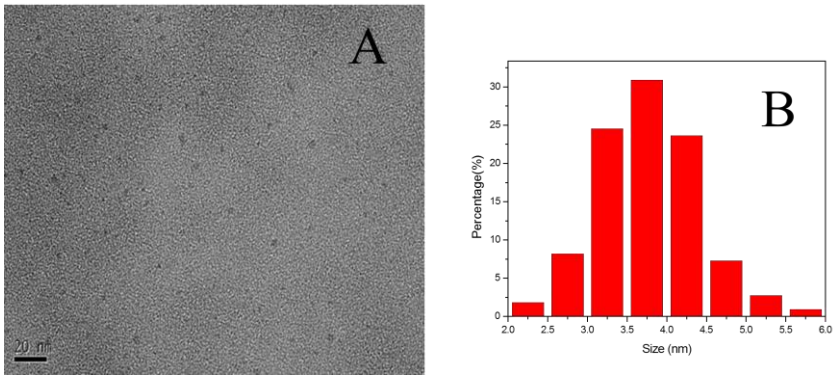


**Fig. S1** TEM image of Carbon Dots (A), the size distribution of Carbon Dots(B)

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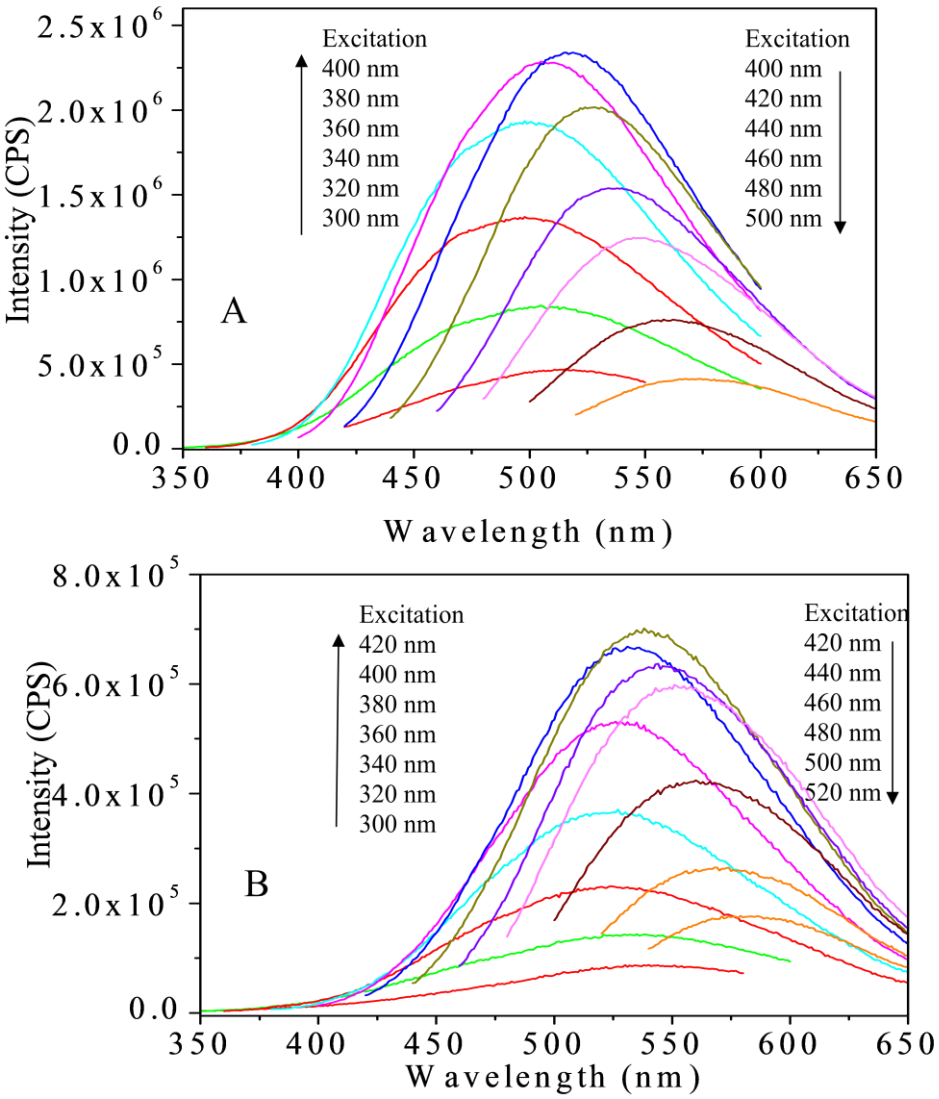


**Fig. S2** FL spectra for carbon dots (A) and carbon dots in NaOH solution (B) excited at wavelengths from 300 nm to 500 nm with 20 nm increment. The carbon dots was in the dilution of 1:32 and the NaOH concentration is 2M.

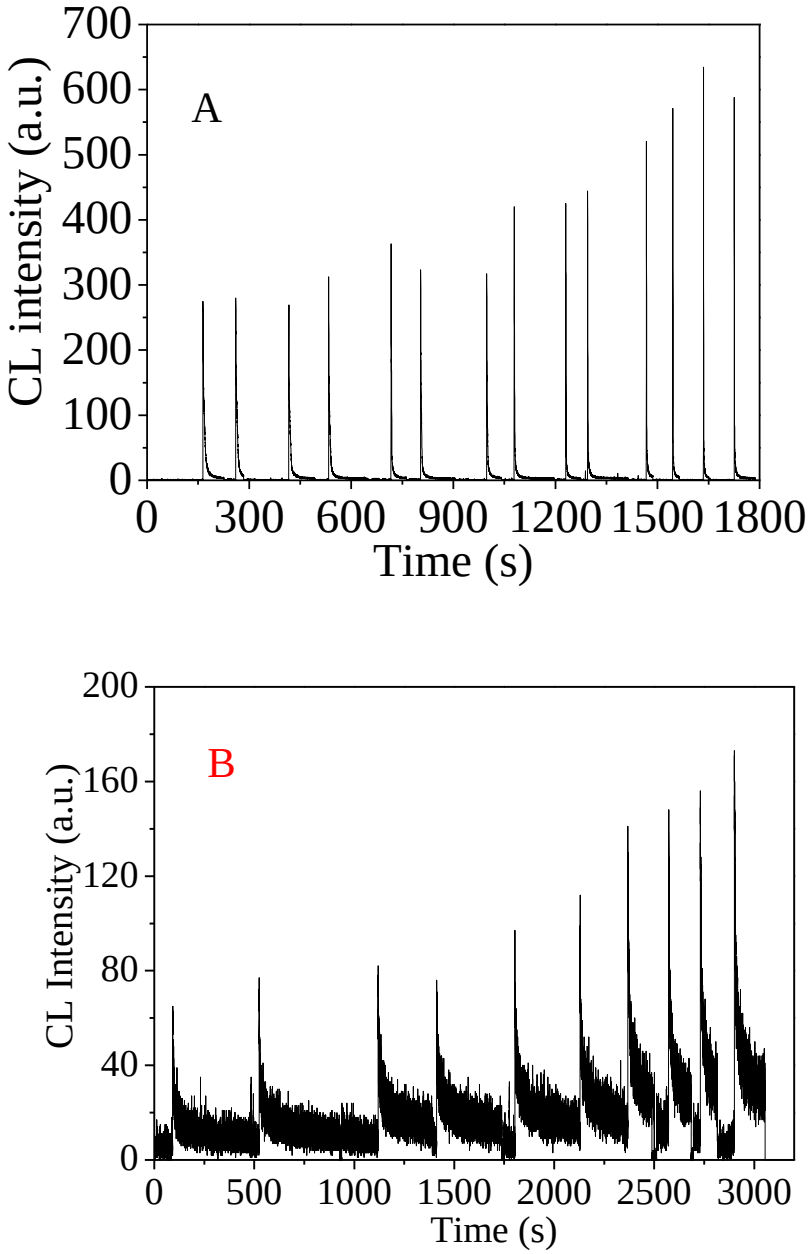


**Fig S3** CL kinetic curves of carbon dots-KOH system(A) carbon dots-NaOH system (B). In (A) carbon dots synthesized using microwave hydrothermal methods. Carbon dots are in the dilution of 1:32, the concentration of KOH is 0.5M, 1M, 2M, 2.5M, 3M, 4M and 5M. In (B), carbon dots synthesized by pyrolysis of EDTA, the concentration of NaOH is 0.02M, 0.1M, 0.5M, 2M, 5M. The peak determinations for each concentration were carried out in duplicate.

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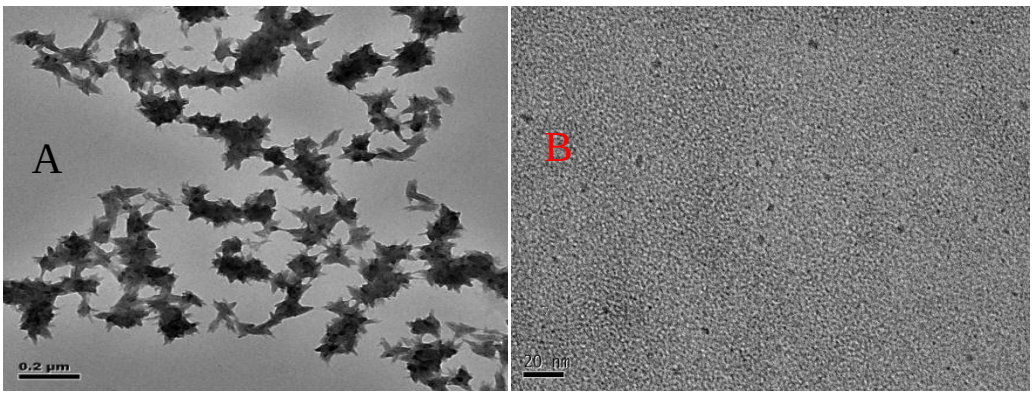


**Fig. S4** TEM images of carbon dots in 2 M NaOH solution(A) and NaOH-treated Carbon dots after dialysis

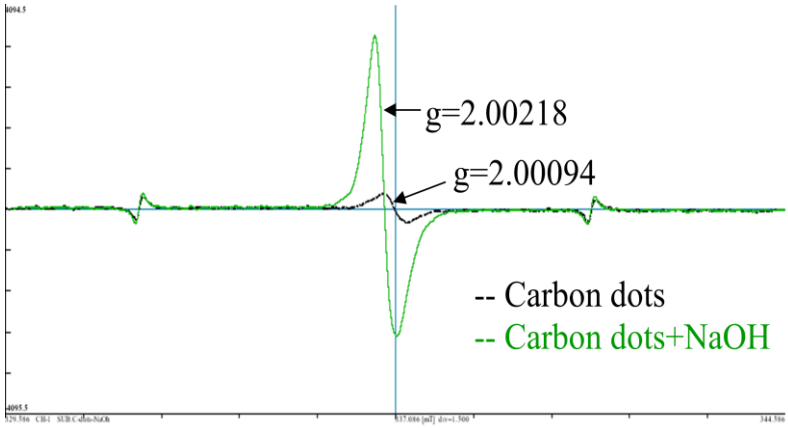


**Fig. S5** The EPR spectrum of pristine Carbon dots and NaOH-treated Carbon Dots