Supporting Information

One-step extracting high fluorescent carbon quantum dots by physical method from carbon black

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Chemicals and Solutions

All chemicals were used without further purification. Carbon black was purchased from Jinan Xinzheng Chemical Co., Ltd. (Jinan, China). Ethanol anhydrous (CH_3CH_2OH) and Quinine hemisulfate salt hydrate were purchased from Sangon Biotech Co., Ltd. (Shanghai, China). Acetone (CH_3COCH_3), methanol (CH_3OH), methylbenzene (C_7H_8) were from Damao Reagent Co., Ltd. (Tianjin, China). Petroleum ether, sulfuric acid (H_2SO_4), ethyl acetate ($C_4H_8O_2$) and dichloromethane (CH_2Cl_2) were from Tianjin Fuyu Fine Chemical Co., Ltd. (Tianjin, China). Hexane (C_6H_{14}) was from Tianjin Kermel Reagent Co., Ltd.

Characterization

The UV-visible spectra were obtained using a UV-1800A spectrophotometer (Macy, Shanghai, China). The fluorescence spectra were recorded on a F97Pro fluorescence spectrophotometer (Lengguang Tech, Shanghai, China). The transmission electron microscopic (TEM) images were acquired on a Tecnai G2 F20 S-TWIN transmission electron microscope with an accelerating voltage of 200 kV. FT-IR spectra were received by a Nicolet iN10 MX & Is10 FT-IR Spectrometer & Microscope. The X-ray photoelectron spectrometer (XPS) was collected in a Thermo ESCALAB 250 spectrometer and samples were dried before XPS measurements.

Separation and purification of CQDs from carbon black

In our procedure, 1g carbon black was put into 20 mL acetone followed by stirring for 2 min and then standing for 24 h at room temperature. The upper light yellow solution was collected. After centrifuged with an ultrafiltration centrifugal tube (MWCO 3K) at 5000 rpm for 10 min, and evaporated the solvent in an oven at 60℃, the as-extracted CQDs were obtained.

Quantum yield (QY) :

QY of the as-extracted CDs was calculated by the equation below:

$$\Phi = \Phi' \times (A'/I') \times (I/A) \times (\eta/\eta')^2$$

In this equation, Φ is the QY of our samples and I is the measured sample's integrated emission intensity. A is the optical density, η is the refractive index (1.33 for water

and 1.36 for acetone). The superscript "′" refers to the referenced fluorescence dyes of known QY. Specially, we selected quinine sulfate (QY=55% in 0.1 M H_2SO_4) as the reference (emission range of 400-480 nm).

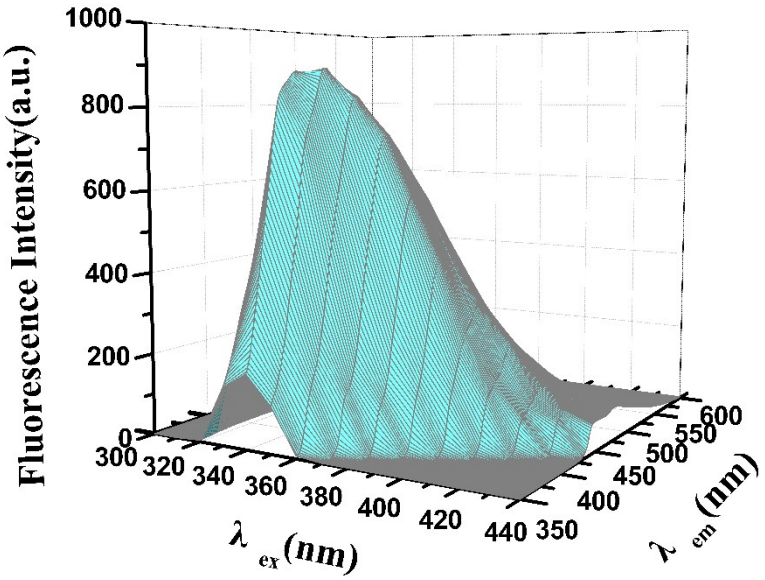

Fig. S1 Excitation-emission matrix spectra of CQDs extracted by acetone.

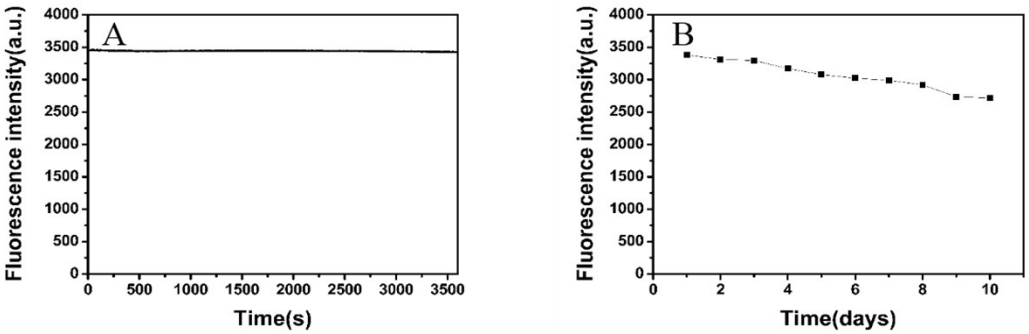

Fig. S2 Photostability of as-extracted CQDs in acetone solutions (A)under continuous illumination with a λ= 345 nm UV light for one hour and (B) in natural environment.

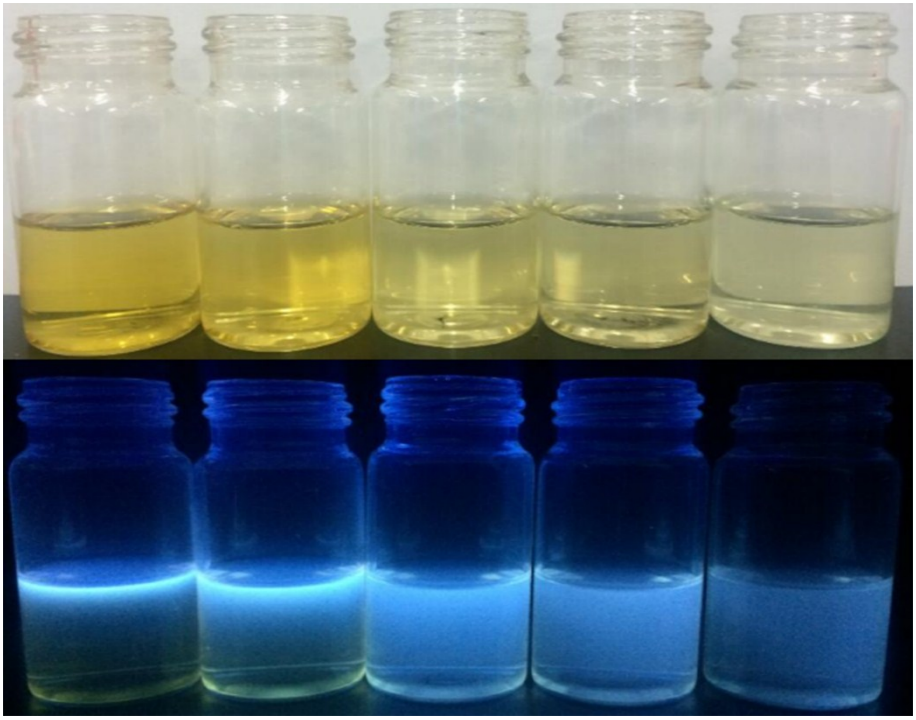

Fig. S3 CQDs was repeatedly extracted by acetone through 1-5 times (from left to right) under daylight (top) and 365 nm UV lamp (down) illumination.

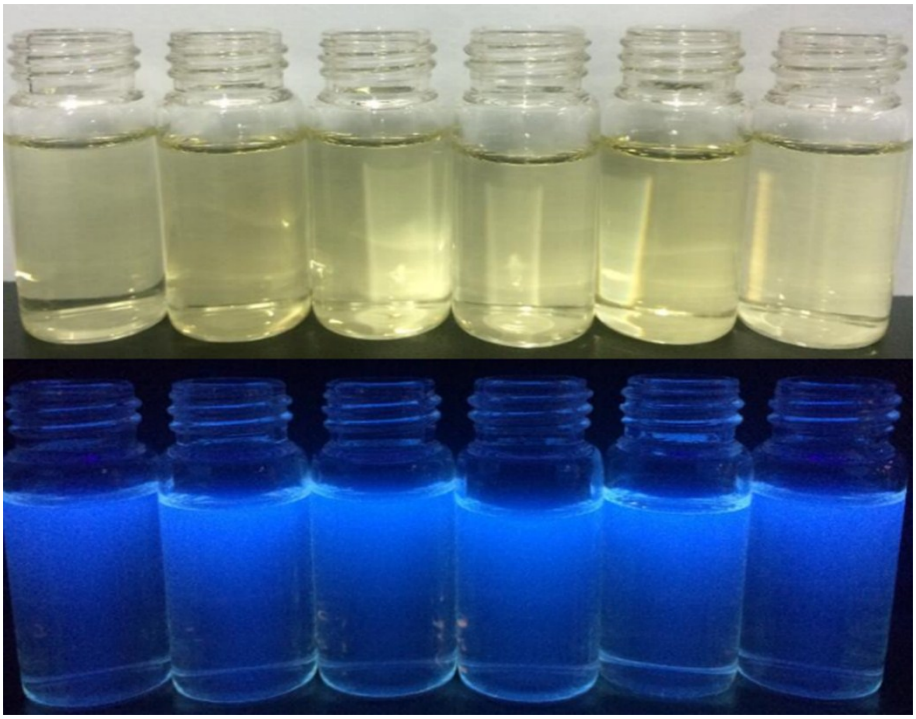

Fig. S4 As-extracted CQDs was dissolved in different organic solvents under daylight (top) and 365 nm UV lamp (down) illumination. From left to right, hexane, dichloromethane, ethyl acetate, methanol, methylbenzene, petroleum ether, respectively.

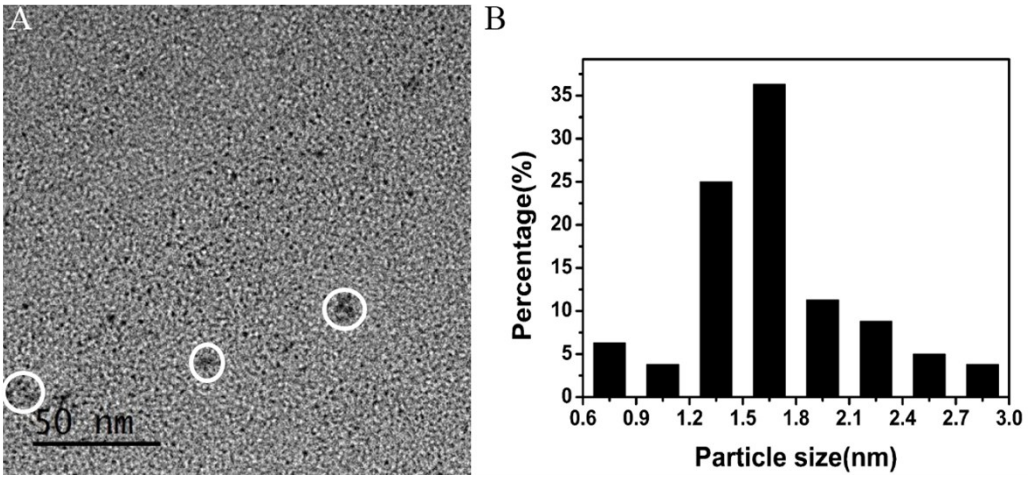

Fig. S5 TEM images (A) and size distribution histograms (B) CQDs extracted by ethanol.

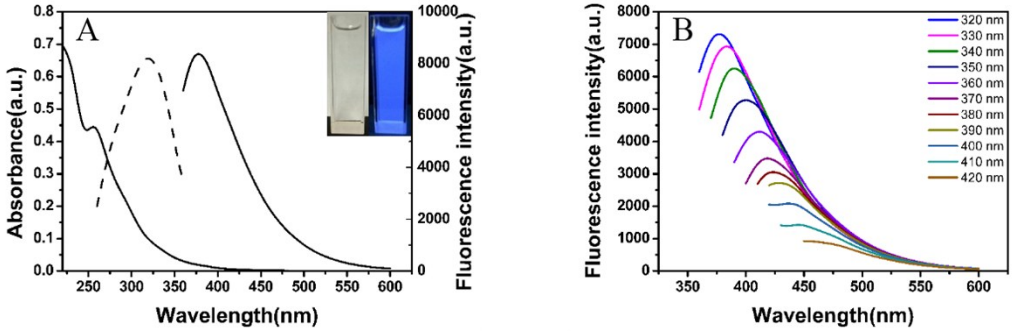

Fig. S6 UV-Vis absorption (A), PL excitation and PL emission spectra of CQDs extracted by ethanol at different excitation wavelengths (B), maximum excitation wavelength (dotted line) and maximum emission wavelength (solid line). Inset are the photos of CQDs solution extracted by ethanol under daylight (left) and 365 nm UV lamp (right) illumination.

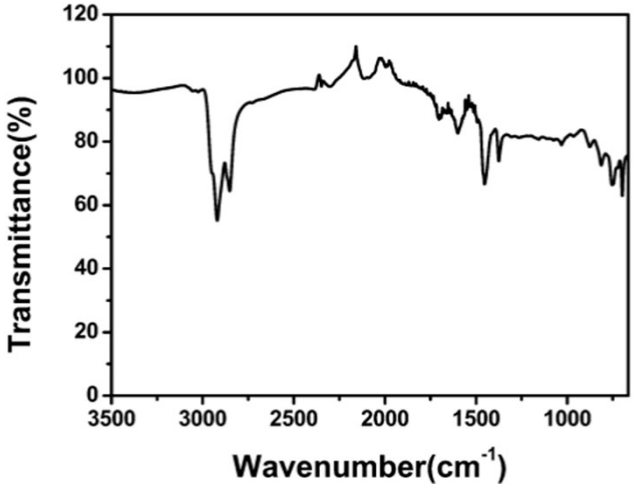

Fig. S7 FTIR spectra of CQDs extracted by ethanol.

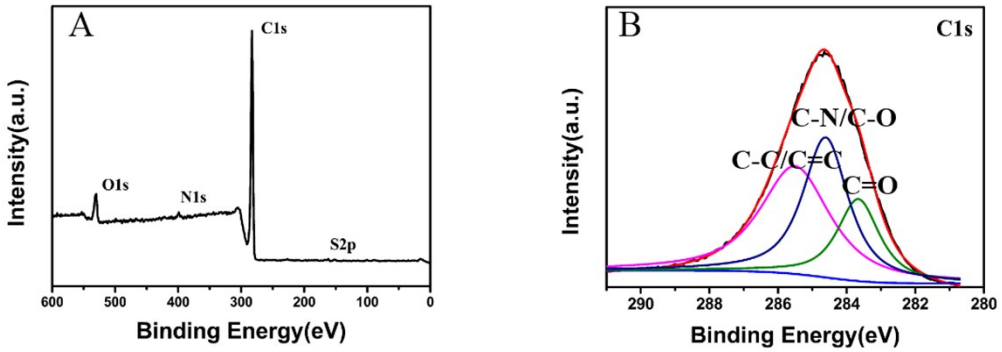

Fig. S8 Whole survey XPS spectrum (A) and C 1s XPS spectrum (B) of as-purified CQDs.