Supplementary Information

Supramolecular interactions via hydrogen bonding contributing to citric-acid derived carbon dots with high quantum yield and sensitive photoluminescence

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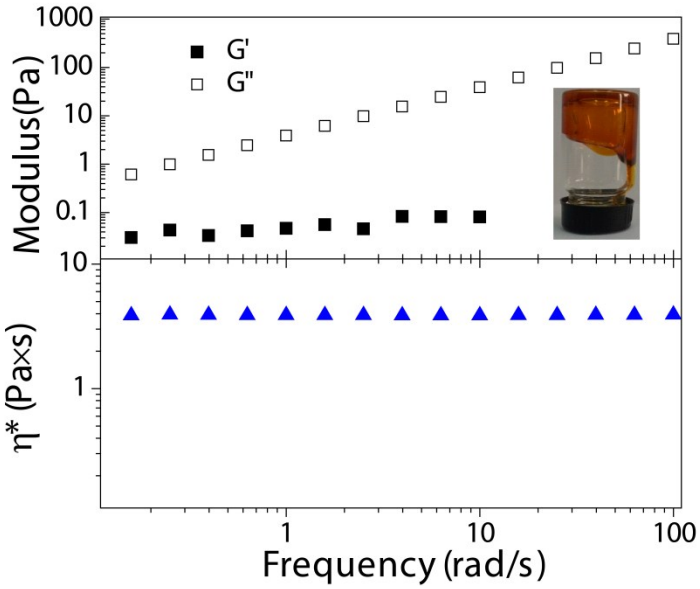

Figure S1. Storage modulus (G'), loss modulus (G") and complex viscosity (η*) as a function of angular frequency (ω).

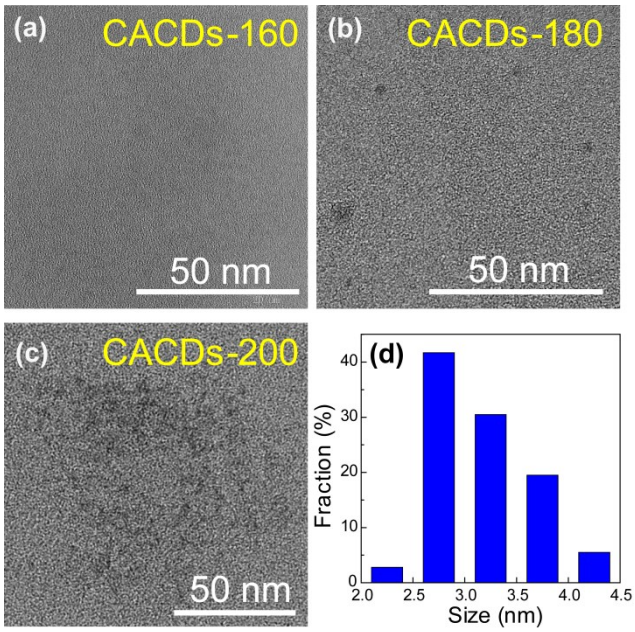

Figure S2. Representative TEM images of CACDs-160 (a), CACDs-180 (b), and CACDs-200 (c). (d) Size distribution of CACDs-200.

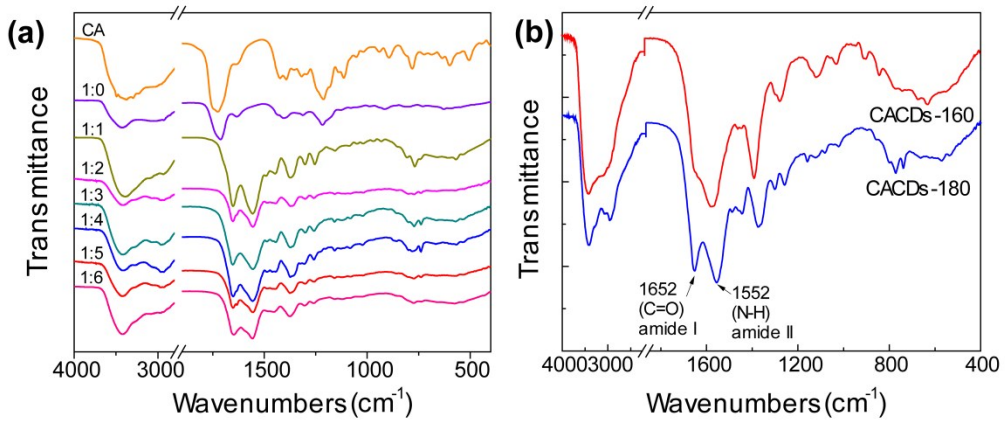

Figure S3. Effect of CA/DETA molar ratio (a) and hydrothermal temperature (b) on FTIR spectra of CACDs. Compared with hydrothermal product of citric acid in the absence of DETA (CA-180), some new bands appear for the CACDs-160 and CACDs-180. The bands at 1652 cm^{-1} and 1552 cm^{-1} are due to the C═O stretching vibrations of the amide I and the N−H stretching vibrations of the amide II, respectively.

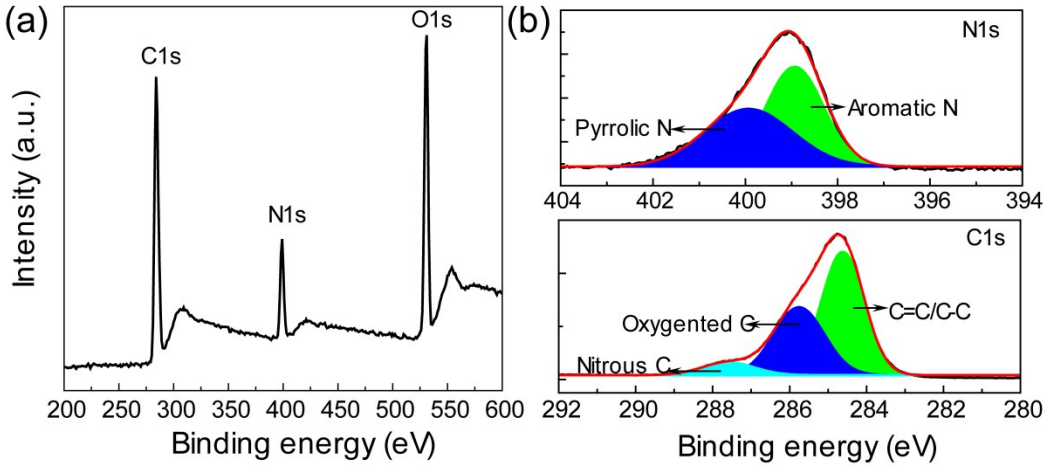

Figure S4. Full scan survey (a), high-resolution C1s and N1s (b) X-ray photoelectronspectroscopy (XPS) spectra of CACDs-180. C1s, N1s, and O1s signals in the full scan XPS spectrum are observed at 284, 399, and 530 eV, respectively. The high-resolution C1s XPS spectrum of CDs sample reveals different types of carbon atoms: graphitic or aliphatic (284.6 eV), oxygenated (285.8 eV), and nitrous (287.6 eV). The high-resolution N1s XPS spectrum can be fitted with two Gaussian peaks at 399.8 and 398.9 eV that correspond to the pyrrolic N and aromatic N, respectively.

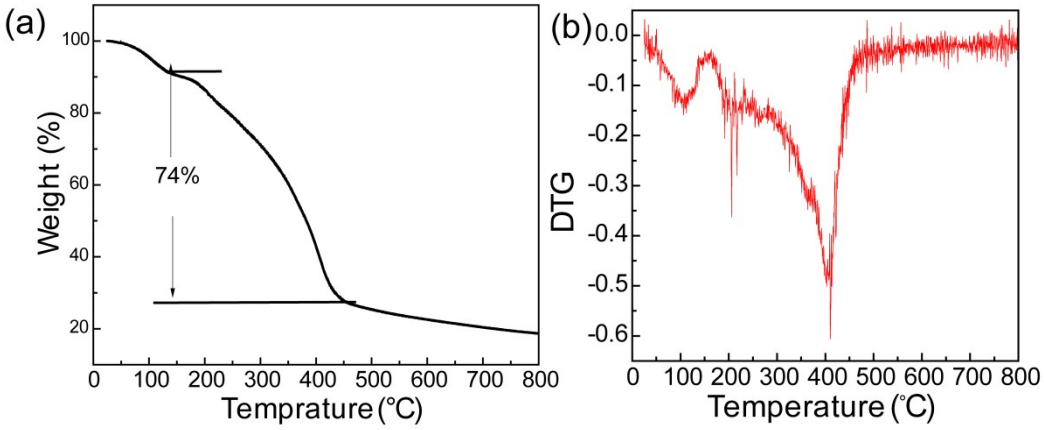

Figure S5. Thermogravimetric (TG, a) and thermogravimetric derivative (DTG, b) curves for CACDs under a nitrogen atmosphere. The slight weight loss before 140 °C is due to physisorbed water.

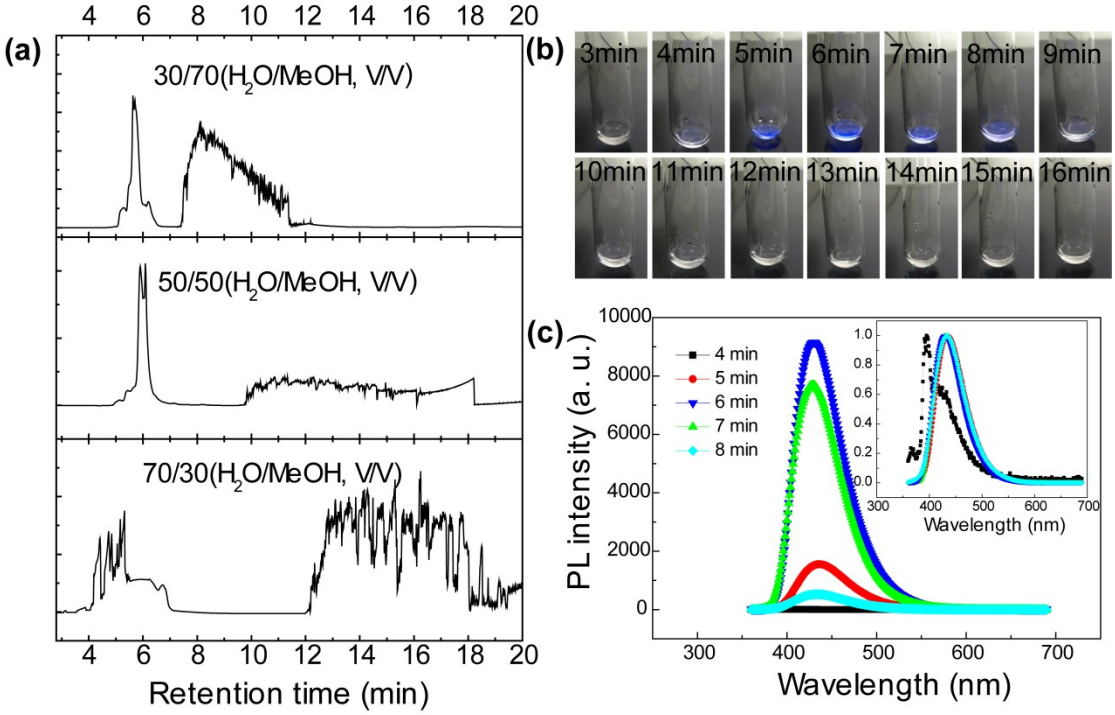

Figure S6. (a) Chromatographic separation of CACDs monitored by PDA at 254 nm. Elution conditions: mobile phase, H_2O-MeOH (3:7, 5:5, 7:3, v/v); flow rate, 3 mL/min; detection wavelength, 254 nm; injection volume, 5 mL. (b) PL photographs of eluted portions arranged in the order of retention time. The samples are illuminated by UV 365 nm lamp. Elution conditions: mobile phase, H_2O-MeOH (7:3, v/v). (c) PL spectra of eluted portions with different retention time. Normalized spectra show inset.

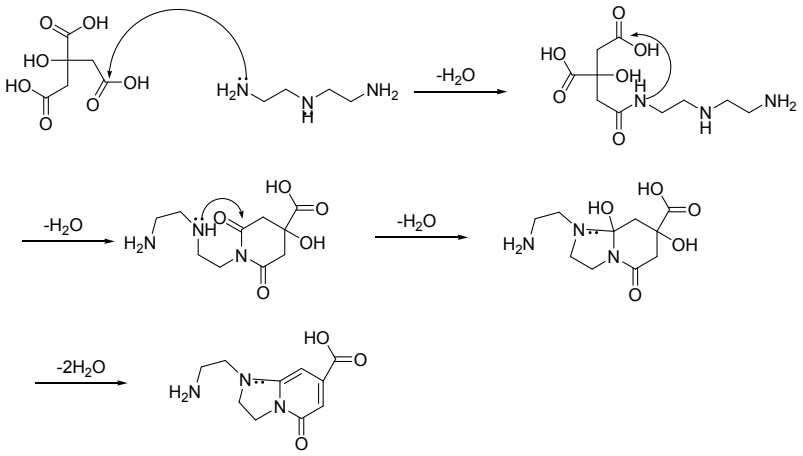

Figure S7. Proposed formation process of fluorescent AEIOP from CA and DETA.

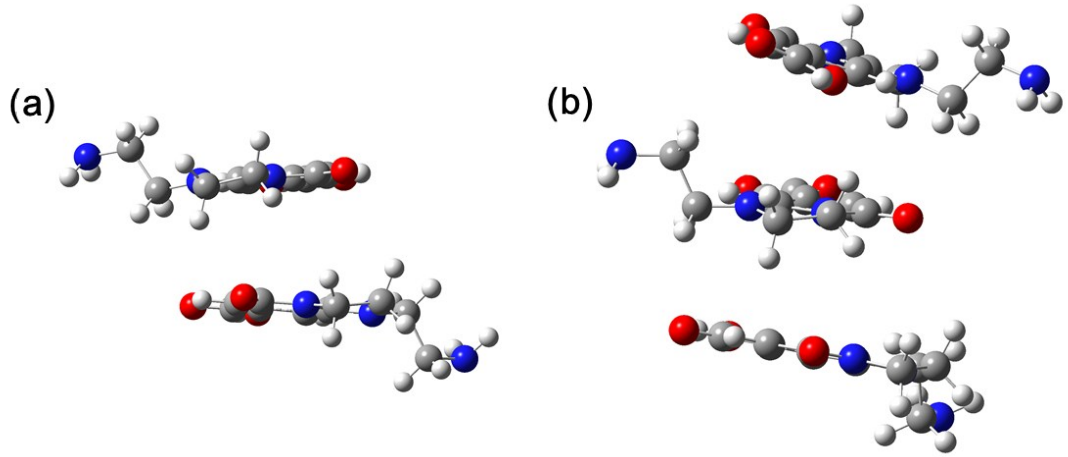

Figure S8. The simulated optimized molecular structures for AIEOP dimer (a) and trimer (b) system through π-π stacking interactions.

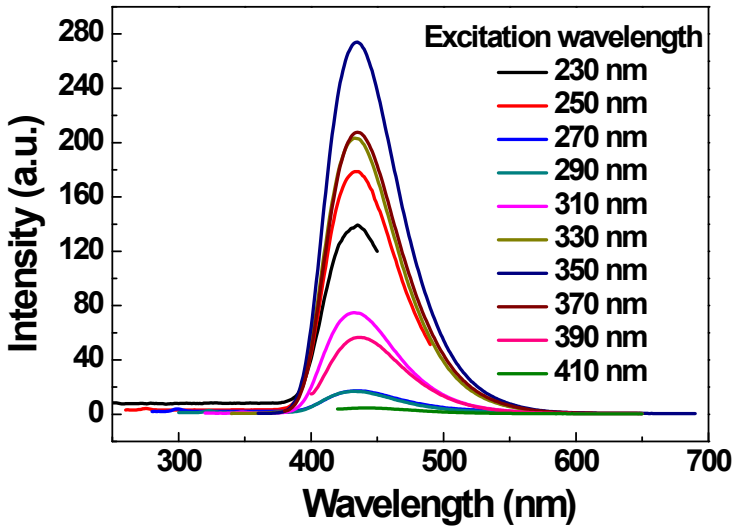

Figure S9. Emission spectra of the CACDs with excitation of different wavelength.

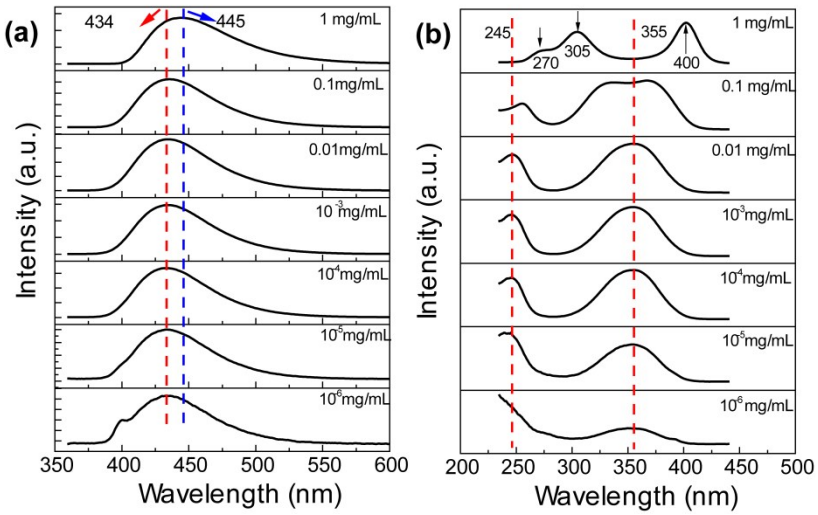

Figure S10. PL spectra of CACDs with different concentrations.

Quantum Yield Measurements.

The quantum yield was determined by the slope method.

$$\emptyset_x = \emptyset_s\left(K_x/K_s\right)\left(\eta_x/\eta_s\right)^2$$

Where Φ is the relative quantum yield, K is the slope determined by the curves between the measured integrated emission intensity and the optical density, η is the refractive index of the solvent. For the aqueous solutions, η_x/η_s=1. The subscript "s" refers to quinine sulfate dissolved in 0.5 M H_2SO_4 with absolute quantum yield (0.54), and "x" for the sample. To minimize re-absorption effects, absorption in the 1.0 cm fluorescence cuvette was kept below 0.10 at the excitation wavelength (360 nm).

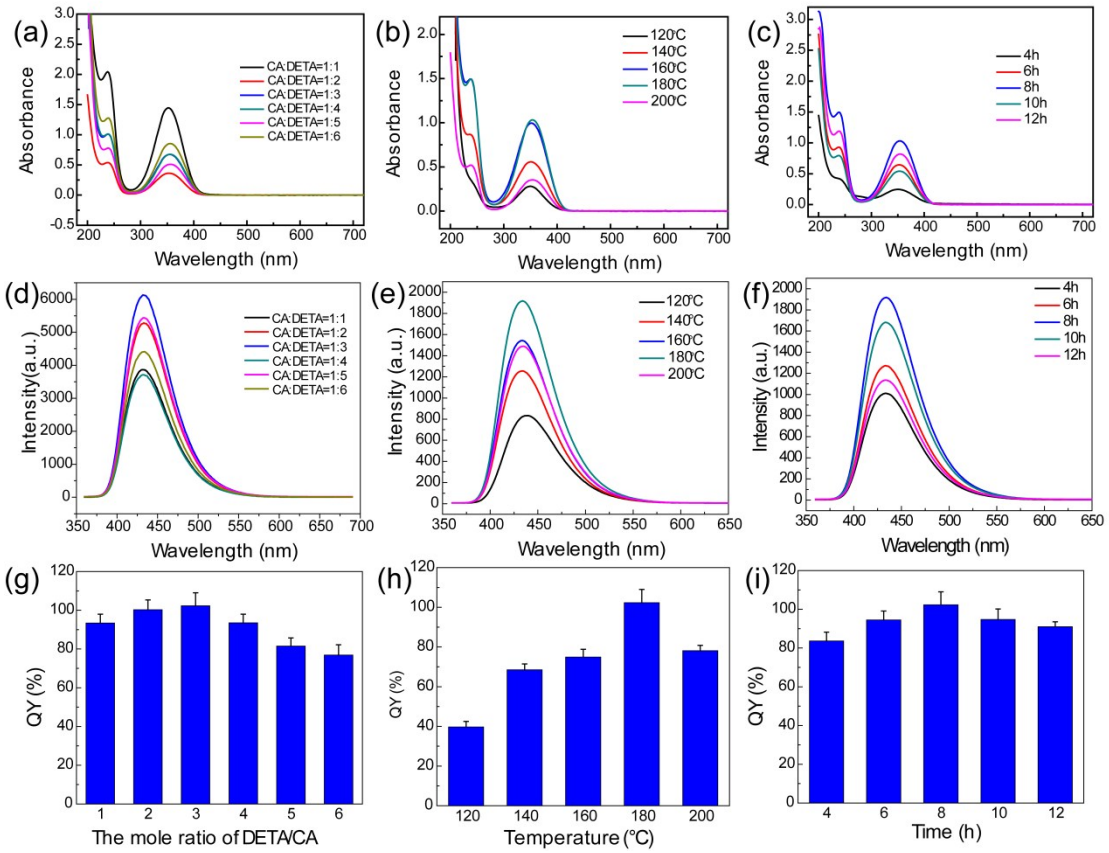

Figure S11. (a-c) Absorbance, (d-f) fluorescence spectra and (g-i) QYs versus (a, d, g) molar at 180 °C for 8h, (b, e, h) tempertures with the CA/DETA molar ratio of 1/3 for 8 h, and (c, f, i) time with the CA/DETA molar ratio of 1/3 at 180 °C, respectively.

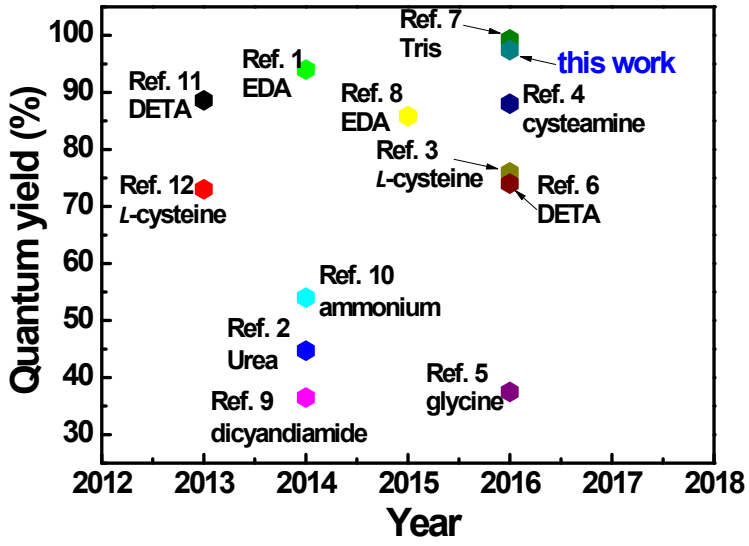

Figure S12. PL quantum yield of CACDs-DETA measured by the slope method. The values reported for other CA derived CDs are added for comparison.[1-12]

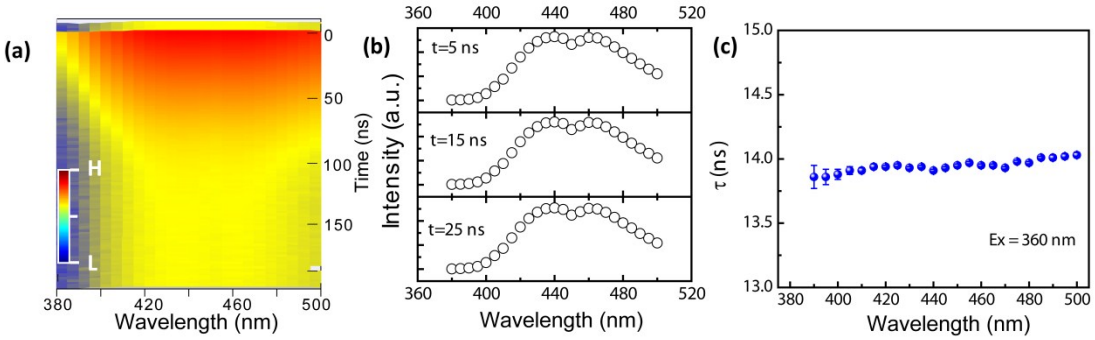

Figure S13. Time resolved photoluminescence spectra (TRPL) analyses of CACDs. (a) Contour plot of TRPL. (b) Sliced PL spectra at different time delays. (c) The fitted lifetime as a function of emission wavelengths.

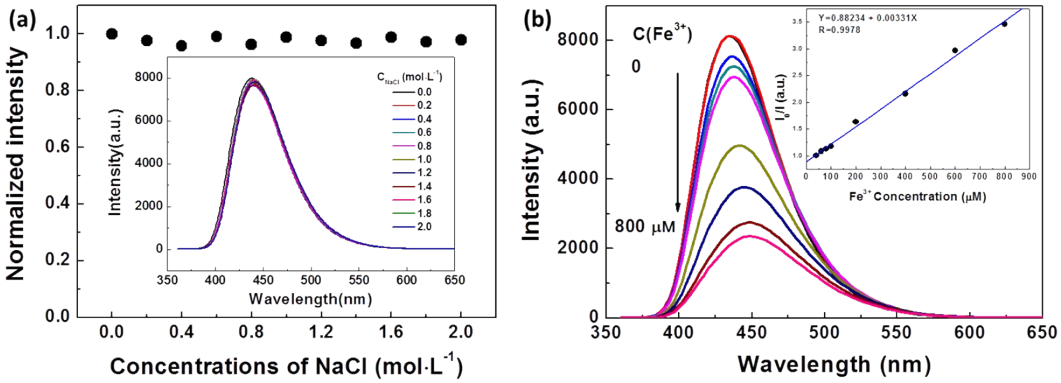

Figure S14. (a) Effect of ionic strengths on the fluorescence intensity of CACDs (ionic strengths are controlled by various concentrations of NaCl). (b) Typical PL quenching of CACDs-180 in the presence of Fe^{3+} ions. Inset: the curve of the fluorescence quenching values (I_0/I) *vs.* Fe^{3+} ion concentration in the range from 50 μM to 800μM.

References

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