Supplementary Material

Concentration-tuned Multicolor Carbon Dots: Microwave-assisted Synthesis, Characterization, Mechanism and Applications

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1. Photoluminescence spectra of F-CDs with various concentrations.

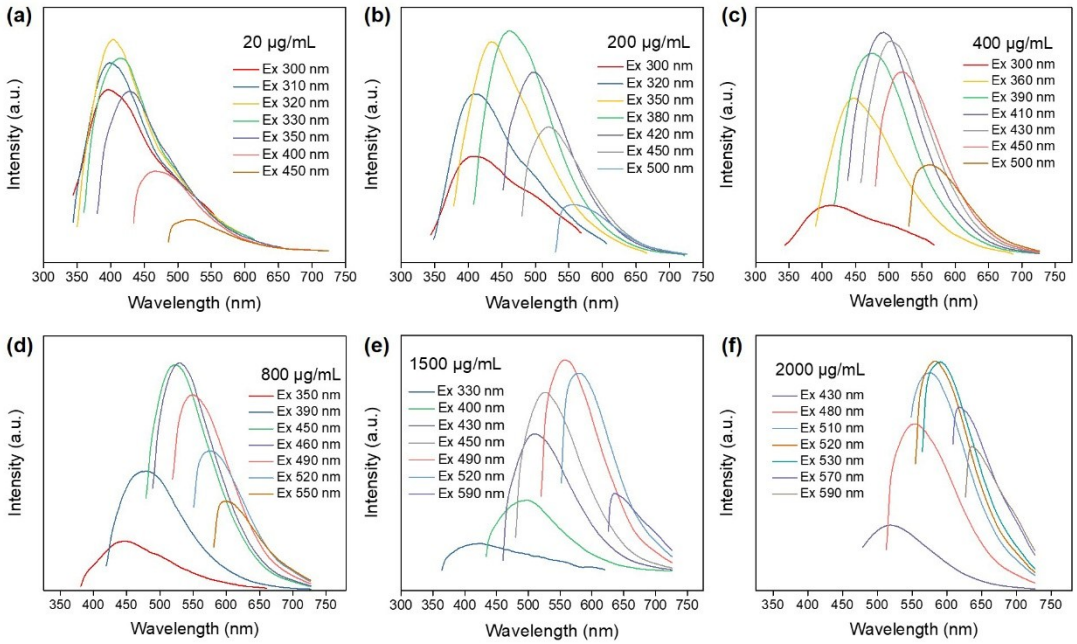

Fig. S1 Photoluminescence spectra of F-CDs under (a) 20 μg/mL, (b) 200 μg/mL, (c) 400 μg/mL, (d) 800 μg/mL, (e) 1500 μg/mL, (f) 2000 μg/mL.

2. Photographs of F-CDs under daylight and 365 nm UV lamp.

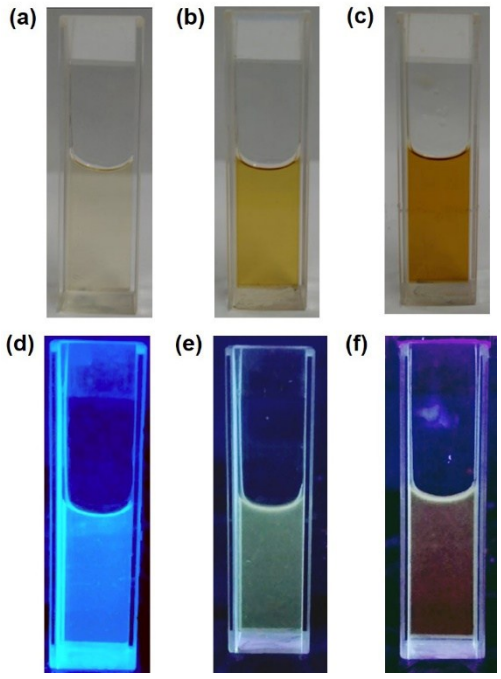

Fig. S2 Photographs of F-CDs under (a), (b), (c) daylight and (d), (e), (f) 365 nm UV irradiation lamp with 200μg/mL, 1mg/mL, 2mg/mL.

3. Calculation of quantum yield.

The quantum yield of A-CDs was measured by reference method, using quinine

sulfate (QS) in 0.1 M H_2SO_4 as reference. The quantum yield calculation of F-CDs was according to the equation below:

$$Q = Q_R \cdot \frac{I}{I_R} \cdot \frac{A_R}{A} \cdot \frac{n^2}{n_R^2} \quad (1)$$

In the equation, Q means the quantum yield, I is the integrated emission intensity measured by FL emission spectroscopy, A represents the UV-vis absorbance at PL excitation wavelength, n stands for the refractive index, and R is the reference.

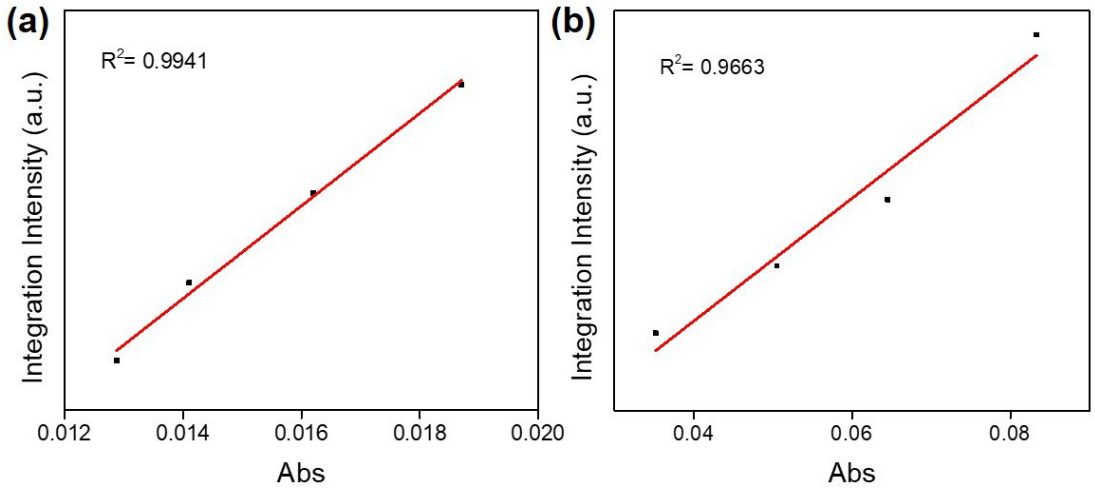

Fig. S3 Liner fitting of integrated emission intensity and absorbance of Quinine Sulfate (a) and F-CDs (b).

Table S1 Quantum yield of F-CDs.

Sample	Integrated emission Intensity (*I*)/ Absorbance (*A*)	Refractive index of solvent (*n*)	Quantum yield (*Q*)
Quinine Sulfate	6958820	1.34	55.7%
F- CDs	916942	1.34	7.1%

4. Morphological change of F-CDs with different concentrations.

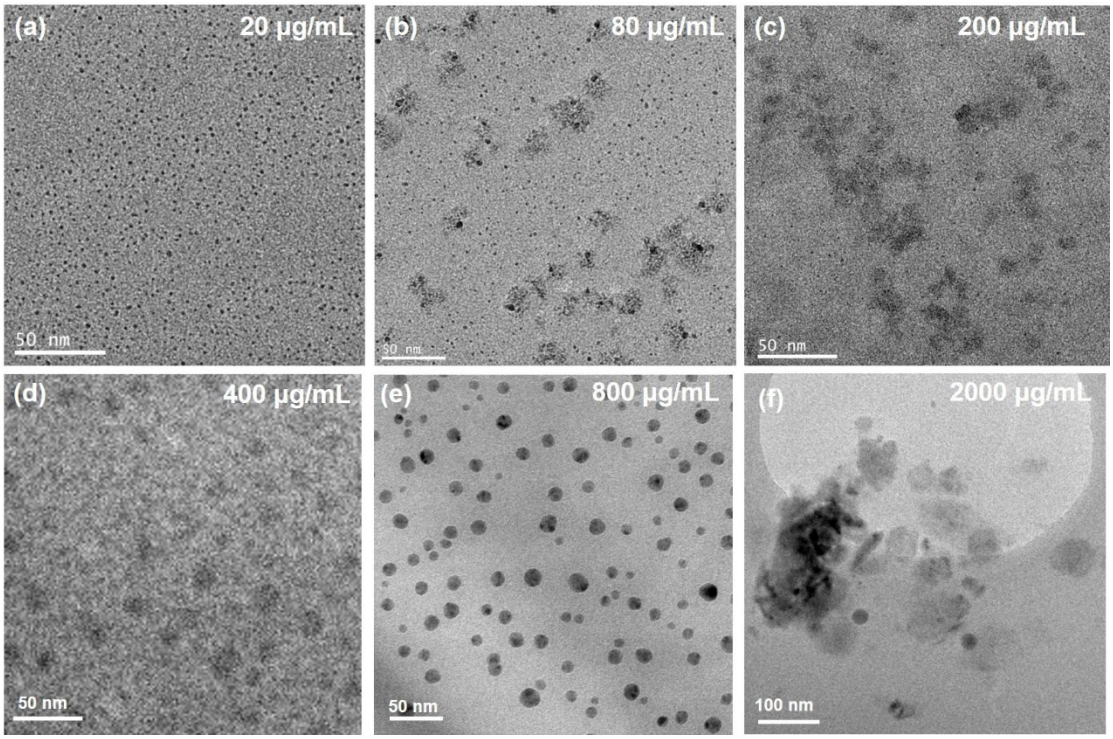

Fig. S4 TEM images of F-CDs in concentration of (a) 20 μg/mL, (b) 80 μg/mL, (c) 200 μg/mL, (d) 400 μg/mL, (e) 800 μg/mL and (f) 2000 μg/mL.

5. PL lifetime of F-CDs with different concentrations.

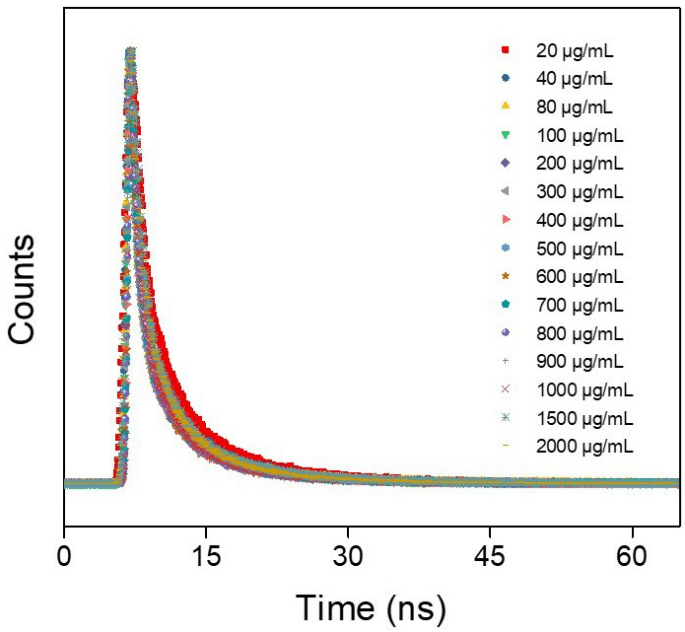

Fig. S5 Time-correlated single photon counting (TCSPC) spectra of F-CDs with various concentrations.

Table S2 Fluorescence lifetimes of F-CDs with different concentrations.

Concentration /μg·mL^{-1}	τ_1/ns	τ_2/ns	$\tau_{average}$/ns	P_1/%	P_2/%
20	1.76	7.43	2.23	91.78	8.22
40	0.99	5.81	1.03	99.01	0.99
80	0.85	5.55	0.86	99.66	0.34
100	0.82	5.51	0.84	99.73	0.27
200	0.76	5.26	0.77	99.86	0.14
300	0.75	5.25	0.76	99.87	0.13
400	0.75	5.22	0.76	99.88	0.12
500	0.82	5.42	0.83	99.77	0.23
600	0.83	5.30	0.83	99.77	0.23
700	0.83	5.31	0.84	99.74	0.26
800	0.86	5.39	0.88	99.68	0.32
900	0.90	5.43	0.92	99.57	0.43
1000	0.93	5.48	0.95	99.48	0.52
1500	1.2	6.06	1.32	97.91	2.09
2000	1.27	5.89	1.41	97.05	2.95

6. PL stability of F-CDs.

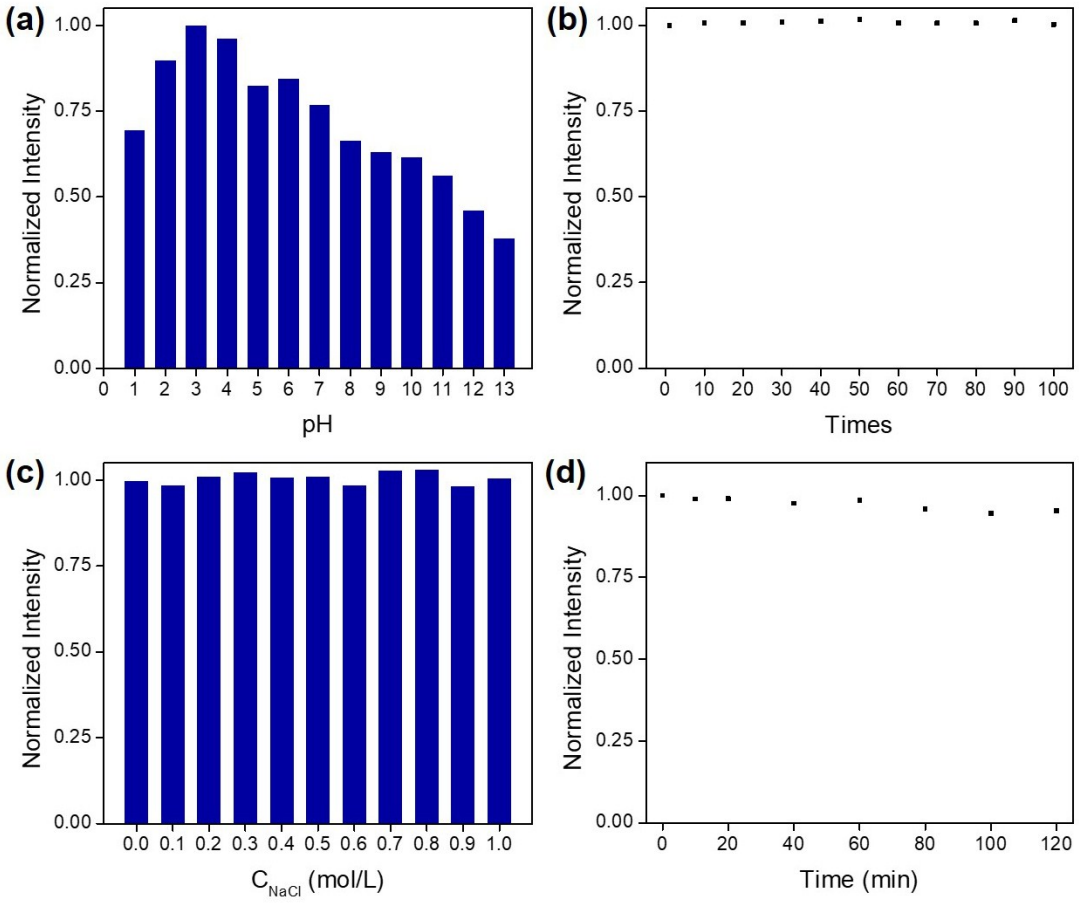

Fig. S6 Effects of (a) different pH, (b) repeated excitation times, (c) ionic strengths (ionic strengths were controlled by various concentrations of NaCl) and (d) irradiation time with 365 nm UV lamp on the PL intensity of F-CDs.

7. Fluorescent ink application of F-CDs.

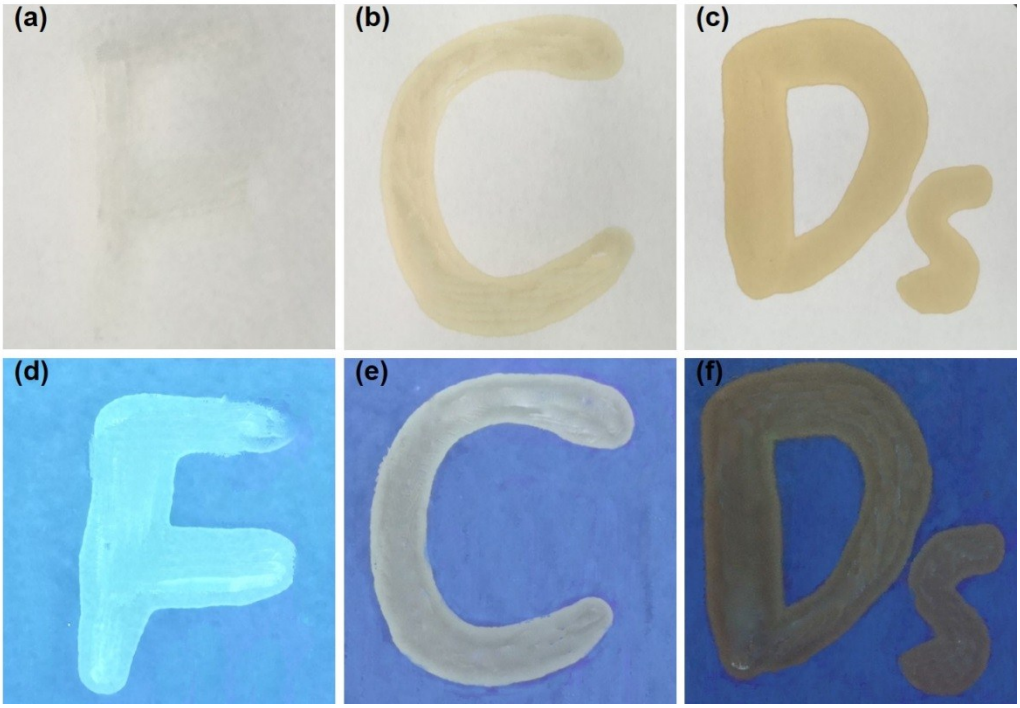

Fig. S7 Photographs of F-CDs mixed with 1g/mL starch under (a), (b) and (c) daylight, and (d), (e), (f) 365 nm UV lamp with concentration of 1 mg/mL, 5 mg/mL and 10 mg/mL.

8. Comparison of confocal fluorescence images of HeLa cells with and without incubation of F-CDs.

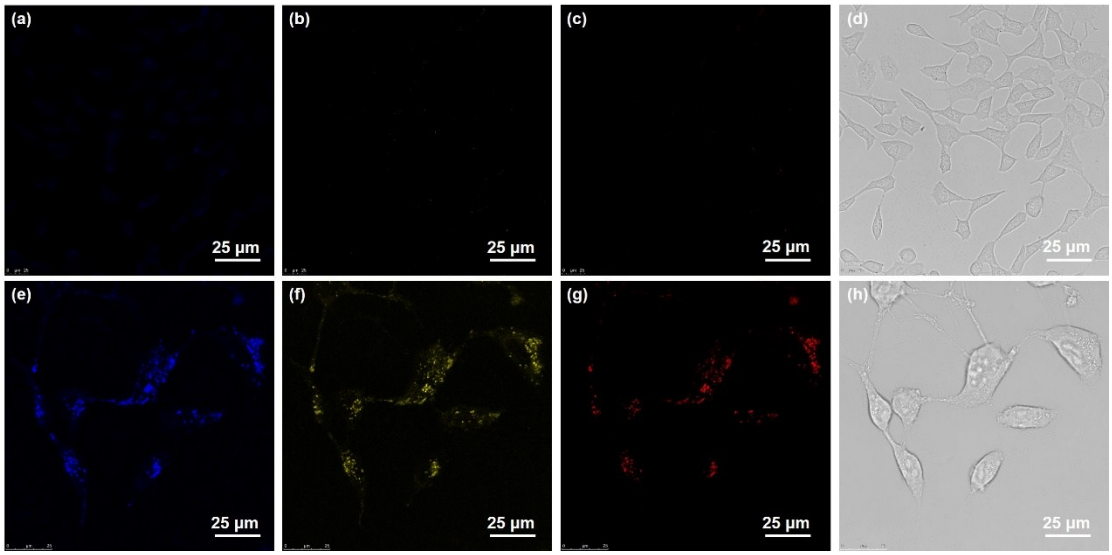

Fig. S8 Confocal fluorescence images of HeLa cells incubated with (a) to (d) 0 μg/mL, (e) to (h) 400 μg/mL F-CDs for 12 h. (d) and (h) are the bright-field images of HeLa cells. (a) to (c) are taken under excitation of 408, 488 and 543 nm,

and so are the (e) to (g).

9. Three-dimensional fluorescence imaging of cells.

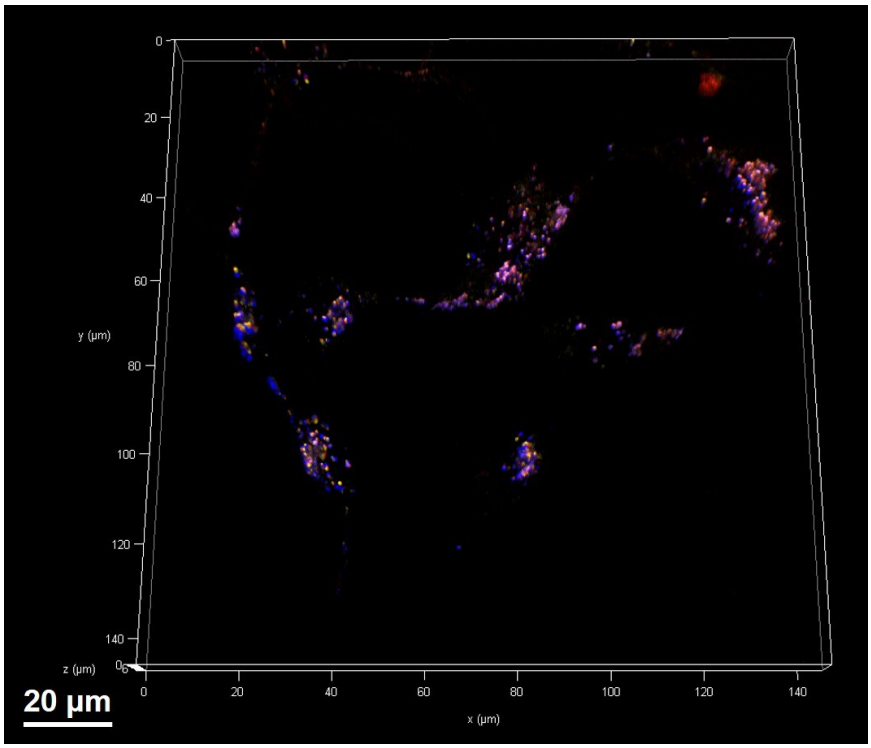

Fig. S9 Three-dimensional fluorescence image of cells with incubation of 400 μg/mL F-CDs for 12 h.