Supplementary Information (SI) for New Journal of Chemistry.

Facile synthesis of carbon quantum dots with yellow-green emission: versatile applications in sunset yellow detection, anti-counterfeiting, and light-emitting diodes

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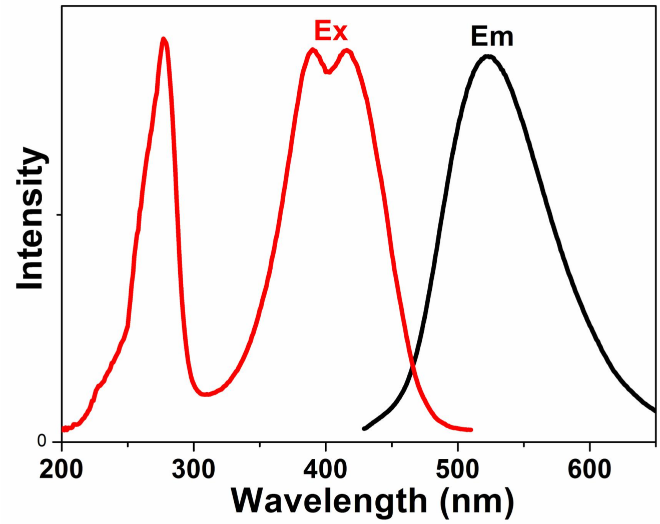

Figure S1. Fluorescence excitation spectrum and emission spectrum at 420 nm of unpurified CQDs prepared from sodium citrate (0.6 g) and urea (1.2 g) at 180 ^{o}C for 1 hour.

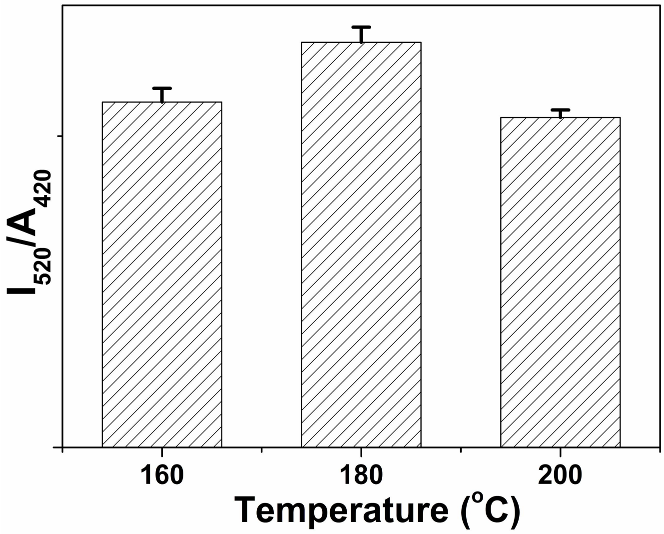

Figure S2. Comparison of I_{520}/A_{420} of CQDs versus reaction temperature (I_{520} is fluorescence intensity of CQDs at 520 nm upon excitation at 420 nm. A_{420} is absorbance of CQDs at 420 nm. The mass of sodium citrate and urea is 0.6 g and 1.2 g, respectively. The reaction time is 1 hour.).

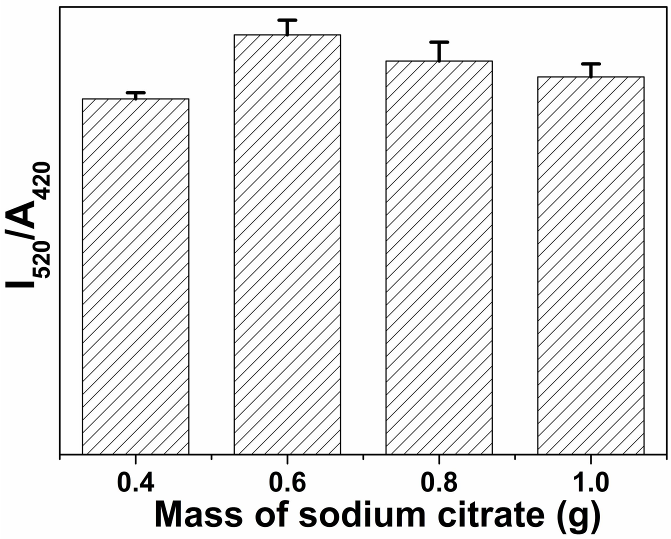

Figure S3. Comparison of I_{520}/A_{420} of CQDs versus mass of sodium citrate (I_{520} is fluorescence intensity of CQDs at 520 nm upon excitation at 420 nm. A_{420} is absorbance of CQDs at 420 nm. The mass of urea is 1.2 g, respectively. The reaction temperature is 180 °C. The reaction time is 1 hour.).

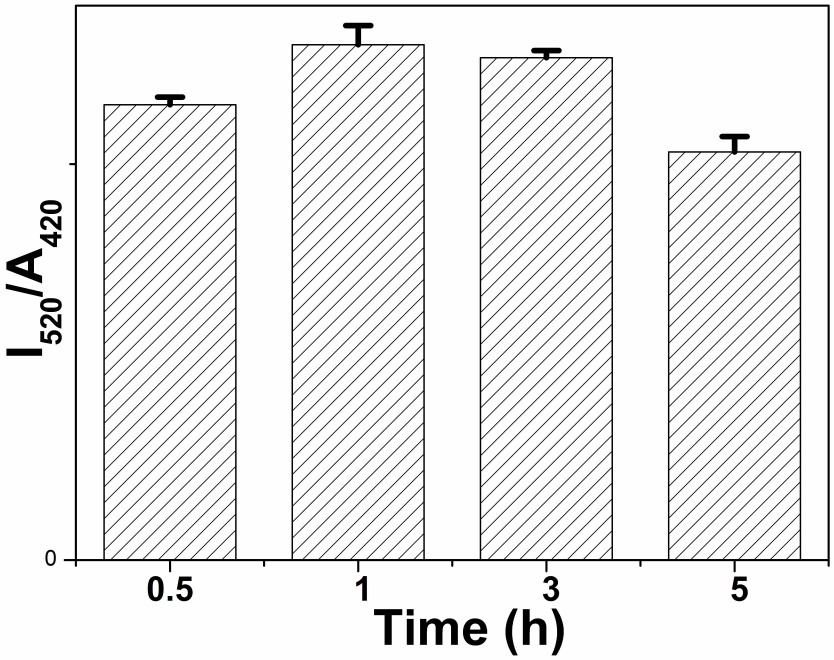

Figure S4. Comparison of I_{520}/A_{420} of CQDs versus reaction time (I_{520} is fluorescence intensity of CQDs at 520 nm upon excitation at 420 nm. A_{420} is absorbance of CQDs at 420 nm. The mass of sodium citrate and urea was 0.6 g and 1.2 g, respectively. The reaction temperature is 180 ^{o}C.).

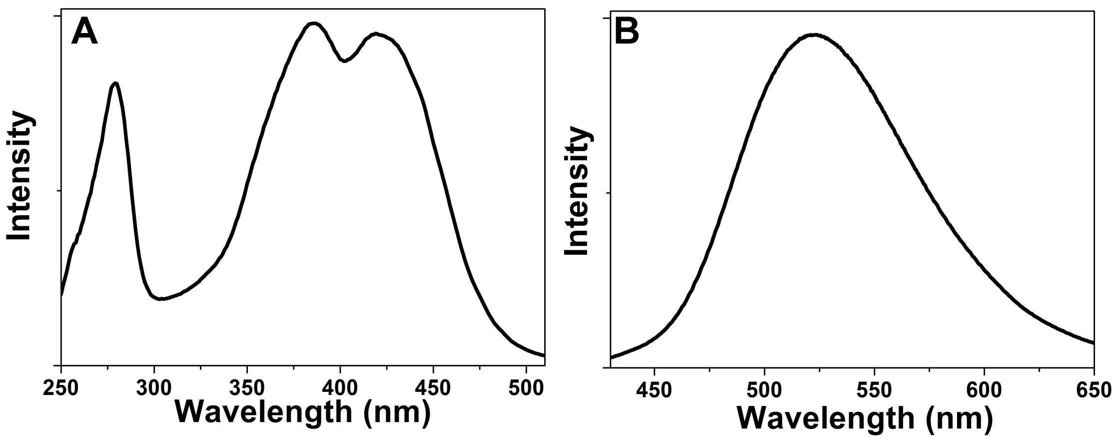

Figure S5. (A) Fluorescence excitation spectrum of CQDs from citric acid and urea under the optimum synthetic conditions. (B) Fluorescence emission spectrum of CQDs from citric acid and urea under the optimum synthetic conditions (λ_{ex}=420 nm).

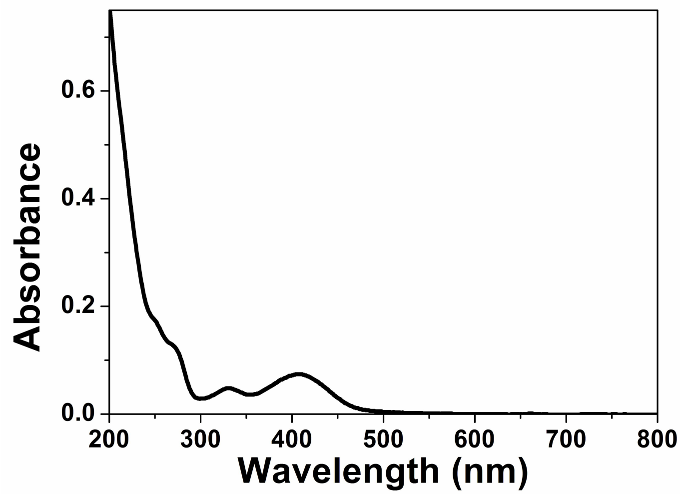

Figure S6. UV-vis absorption spectrum of CQDs.

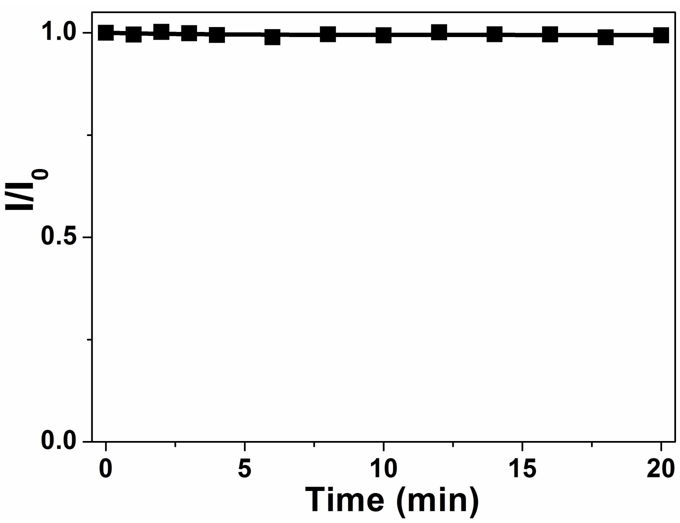

Figure S7. The plot of I/I_0 of CQDs versus 365 nm UV light irradiation time.

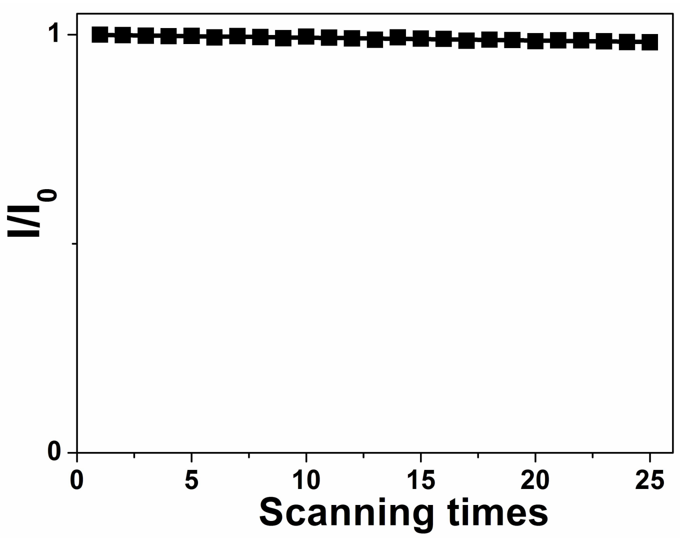

Figure S8. The plot of I/I_0 of CQDs versus scanning times.

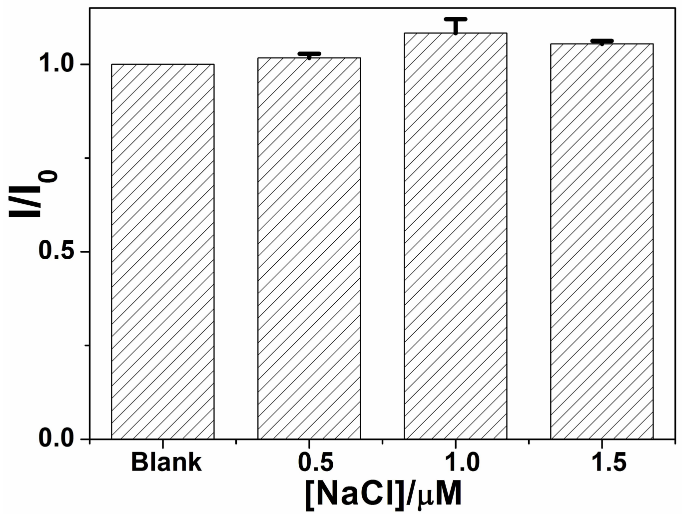

Figure S9. The plot of I/I_0 of CQDs versus the concentration of NaCl.

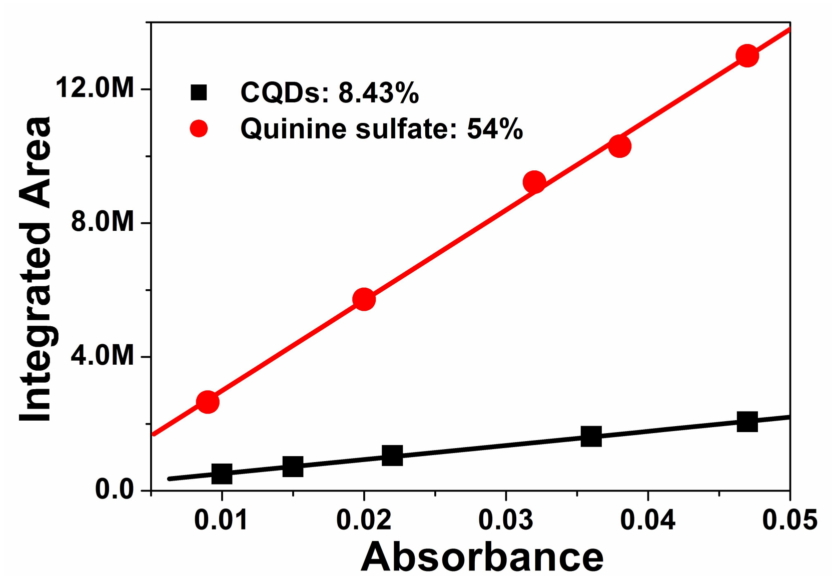

Figure S10. (A) Calculation of fluorescence quantum yield of CQDs by using quinine sulfate as the reference (λ_{ex}=390 nm).

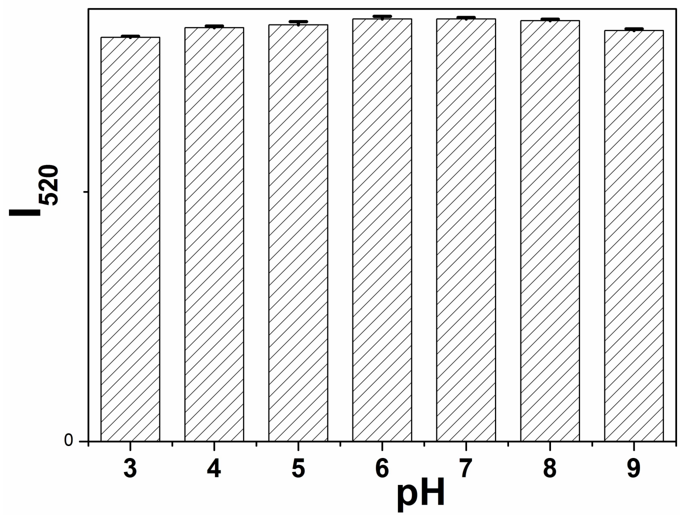

Figure S11. The plot of the fluorescence intensity of CQDs at 520 nm at different pH.

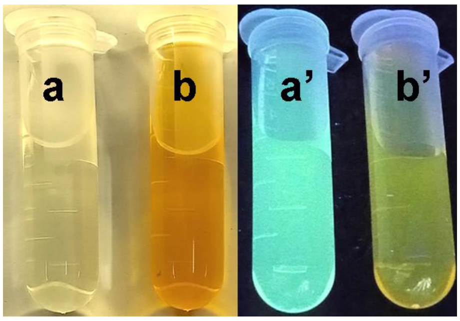

Figure S12. Pictures of CQDs solution in the absence (a and a') and presence (b and b') of 100 μM SY in visible light and 365 UV light.

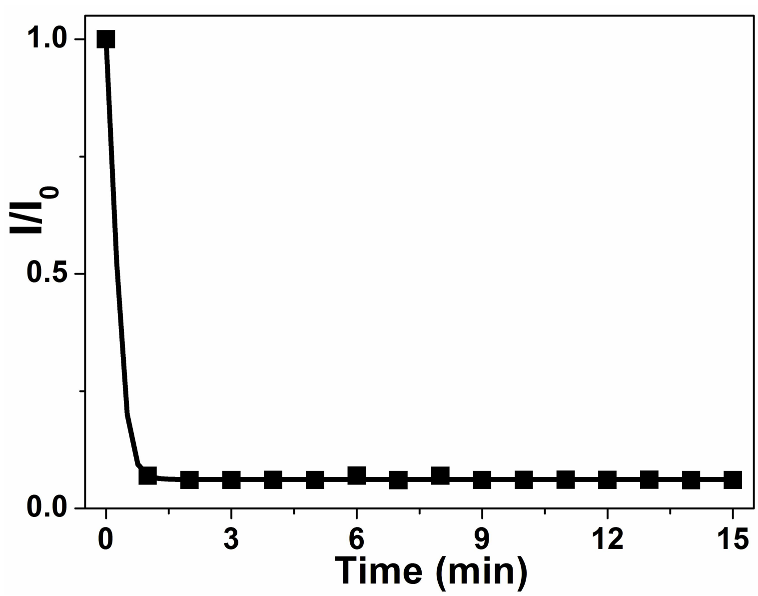

Figure S13. The change of I/I_0 of CQDs with the incubation time of SY (100 μM) and CQDs.

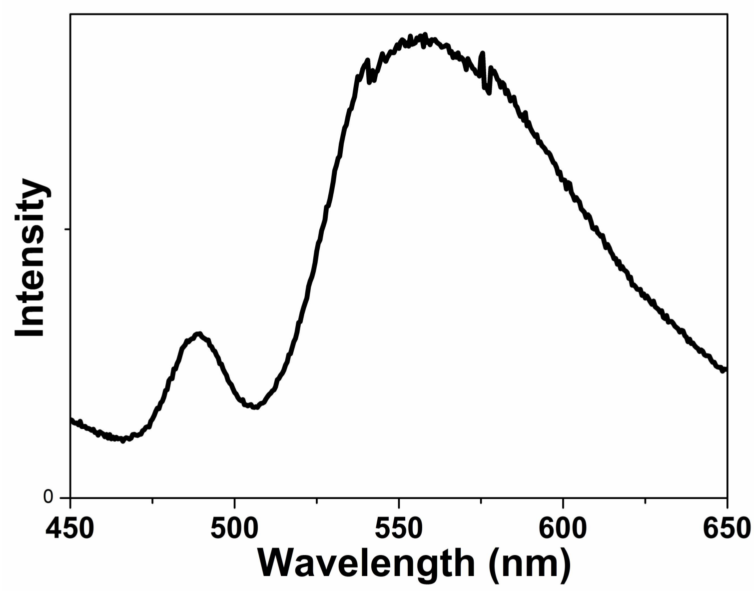

Figure S14. Fluorescence emission spectrum of sunset yellow (conditions: 40 mM phosphate buffer, λ_{ex}=420 nm).

Table S1. Comparison of sensing performance between this work and previous reports.

Methods	Linear range	Limit of detection	Cost	Operation	Reference
Electrochemistry	2-200 μM	0.73 μM	Low-cost	Easy	1
Electrochemistry	0.3-40 μM	0.15 μM	Low-cost	Easy	2
Electrochemistry	0.02-10.0 μM, 0.02-10.0 μM, 0.008-10μM	6.0 nM, 4.0 nM, 2.0 nM	Low-cost	Easy	3
Solid-phase extraction-high performance liquid chromatography	1.0-500 ng/mL (0.0022-1.11 μM)	0.5 ng/mL (1.11 nM)	High-cost	Complex	4
Solid-phase extraction-high performance liquid chromatography	0.05-40.00 μg/mL (0.11-88.42 μM)	0.02 μg/mL (44.21 nM)	High-cost	Complex	5
Fluorescence	0.050-14.0 μg/mL (0.11-30.95 μM)	0.023 μg/mL (50.84 nM)	Low-cost	Easy	6
Fluorescence	0.65-14 μg/mL (1.44-30.95 μM)	0.1 μg/mL (0.22 μM)	Low-cost	Easy	7
Fluorescence	0.5-40 μM	28 nM	Low-cost	Easy	8

Fluorescence	0.26-100 μM	0.078 μM	Low-cost	Easy	9
Fluorescence	0-30 μM	0.195 μM	Low-cost	Easy	10
Fluorescence	0-30 μM	0.22 μM	Low-cost	Easy	This work

Table S2. Sensing results of CQDs for SY assay in tap water and rainbow candies.

Samples	Spiked/μM	Found/μM	Recovery/%	RSD/%
Tap water	0	/	/	/
	10.0	8.36	83.6	3.2
	20.0	18.74	93.7	3.9
Rainbow candies	0	0.42	/	6.0
	10.0	9.14	87.2	1.6
	20.0	20.48	100.3	0.9
Baverage	0	/	/	/
	10.0	11.94	119.4	1.2
	20.0	21.12	105.6	0.64

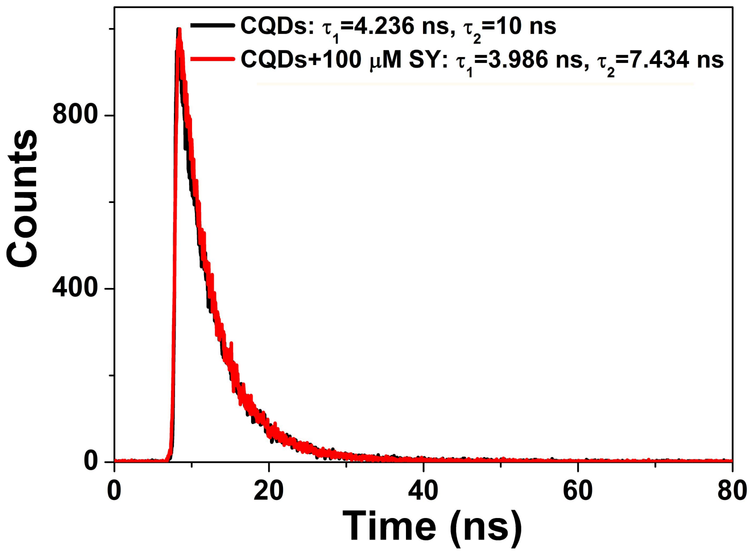

Figure S15. Fluorescence decay curves of CQDs in the absence and presence of SY (conditions: 40 mM phosphate buffer, λ_{ex}=373.4 nm).

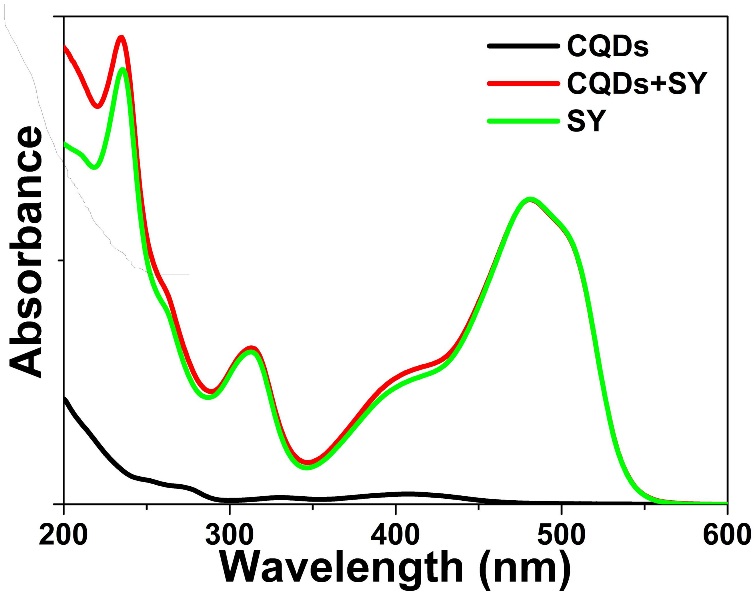

Figure S16. UV-vis absorption spectra of CQDs, in the absence and presence of SY, and SY (conditions: 40 mM phosphate buffer, the concentration of SY is 100 μM.).

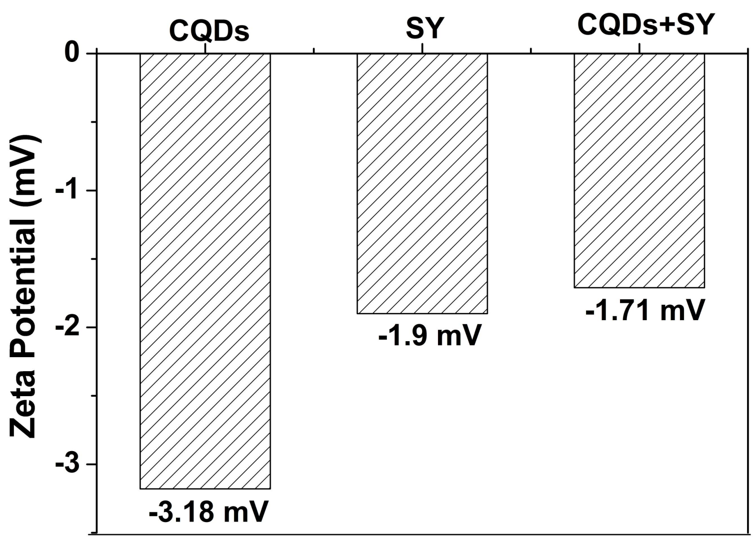

Figure S17. Zeta potential of CQDs, SY and the mixture of CQDs and SY. (conditions: pH=6.0 40 mM phosphate buffer, the concentration of SY is 100 μM.).

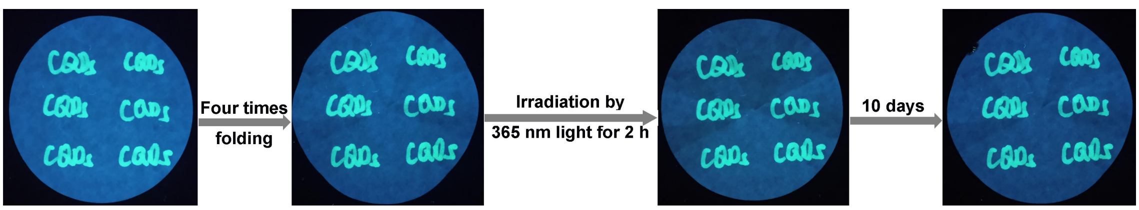

Figure S18. Pictures of "CQDs" letters under 365 nm light in different conditions.

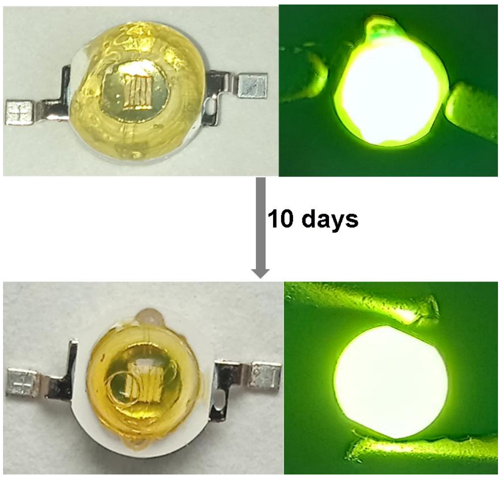

Figure S19. Pictures of a gelatin chip with CQDs coated on a UV LED chip without and with 3.2 V voltage.

References:

1. S. Zhao, J. Wang, X. Bai, T. Liu and T. Li, *Microchem. J.*, 2024, **200**, 110349.

2. J. Li, D. Zhu, H. Huang, S. Xie, J. Xu, R. Yue and X. Duan, *Electrochim. Acta*, 2023, **462**, 142732.

3. L. Li, H. Zheng, L. Guo, L. Qu and L. Yu, *Electroanal. Chem.*, 2019, **833**, 393-400.

4. X. Zhang, Y. Yang, P. Qin, L. Han, W. Zhu, S. Duan, M. Lu and Z. Cai, *Chinese Chem. Lett.*, 2022, **33**, 903-906.

5. J. Wu, S. Wan, O. Xu, H. Song, J. Yang and X. Zhu, *RSC Adv.*, 2022, **12**, 30928-30935.

6. F.-X. Yang, X.-T. Ma and S.-Y. Han, *Anal. Sci.*, 2021, **37**, 1749-1755.

7. M. BİLKAY, B. KARATAŞ and H. E. ŞATANA KARA, *Turk. J. Chem.*, 2024, **48**, 218-228.

8. K. Su, G. Xiang, X. Jin, X. Wang, X. Jiang, L. He, W. Zhao, Y. Sun and C. Cui, *Luminescence*, 2022, **37**, 118-126.

9. J. Zhang, H. Qi, T. Yi, T. Jing, M. Zhao, J. Li, M. Ran, X. Zhu and C. Luo, *Talanta*, 2024, **277**, 126341.

10. Y. Guo, J. Shi, C. Wei, T. Fang and T. Tao, *Dyes Pigments*, 2023, **212**, 111102.