Supporting Information

One-step facile preparation of carbon dots with high fluorescence quantum yield and application in rapid latent fingerprint detection

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S1. The PLQY of GCDs-starch powder measured with 395 nm excitation and an integrating sphere was approximately 41.25%, which is much higher than the PLQYs of many other solid-state CDs and fingerprint detection powders (Table S1).

Table S1. Comparison of solid carbon dots and dispersed LFP

powders from the literature.

Refs	Solution CDs-PLQY（%）	State CDs-PLQY（%）	State LPFs composites-PLQY（%）	Feature points
This work	35.65	19.25	41.75	√
Ref1[1]			21	√
Ref2[2]	19.6		19.6	√
Ref3[3]				×
Ref4[4]	27.1			×
Ref5[5]		24.4		√
Ref6[6]	34			√
Ref7[7]	4.81			√
Ref8[8]	14		11	√
Ref9[9]	6.9			×
Ref10[10]	6			√
Ref11[11]	48.7	20.5	20.5	√
Ref12[12]	34			√

Note: "/" in Table 1 indicates that the result was not reported in the original article, "√" indicates that the feature points can be observed, and "×" indicates that the feature points cannot be clearly observed.

S2. The relative quantum yields for different ratios of GCDs-starch

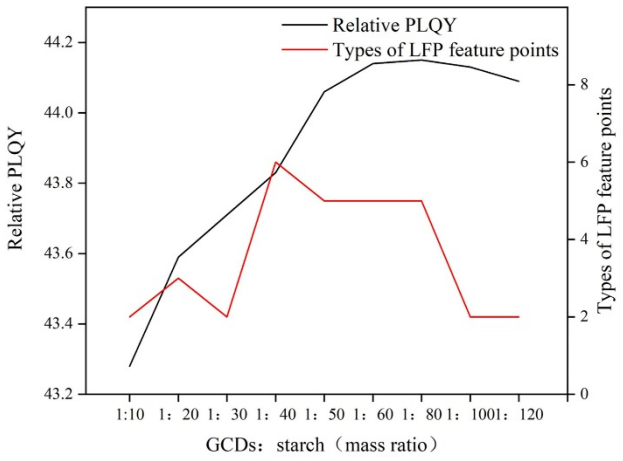
powder were obtained by the reference method, and the different ratios were calculated by comparing the integrated photoluminescence intensities and optical densities of GCDs and 0.1 M quinine sulfate (EX=380 nm, FLQY=0.54). Relative quantum yields of GCDs-starch: GCD-starch was dissolved in ethanol (refractive index 1.36), and its fluorescence emission spectrum (EX=380 nm) was recorded using an F97XP fluorescence spectrophotometer. The integrated area of the emission spectrum was determined between 400−750 nm, and the PLQY was calculated accordingly.

The formula is as follows:

$$QY_x = QY_{st} \times (\frac{F_x}{F_{st}}) \times (\frac{A_{st}}{A_x}) \times (\frac{\eta_x^2}{\eta_{st}^2})$$

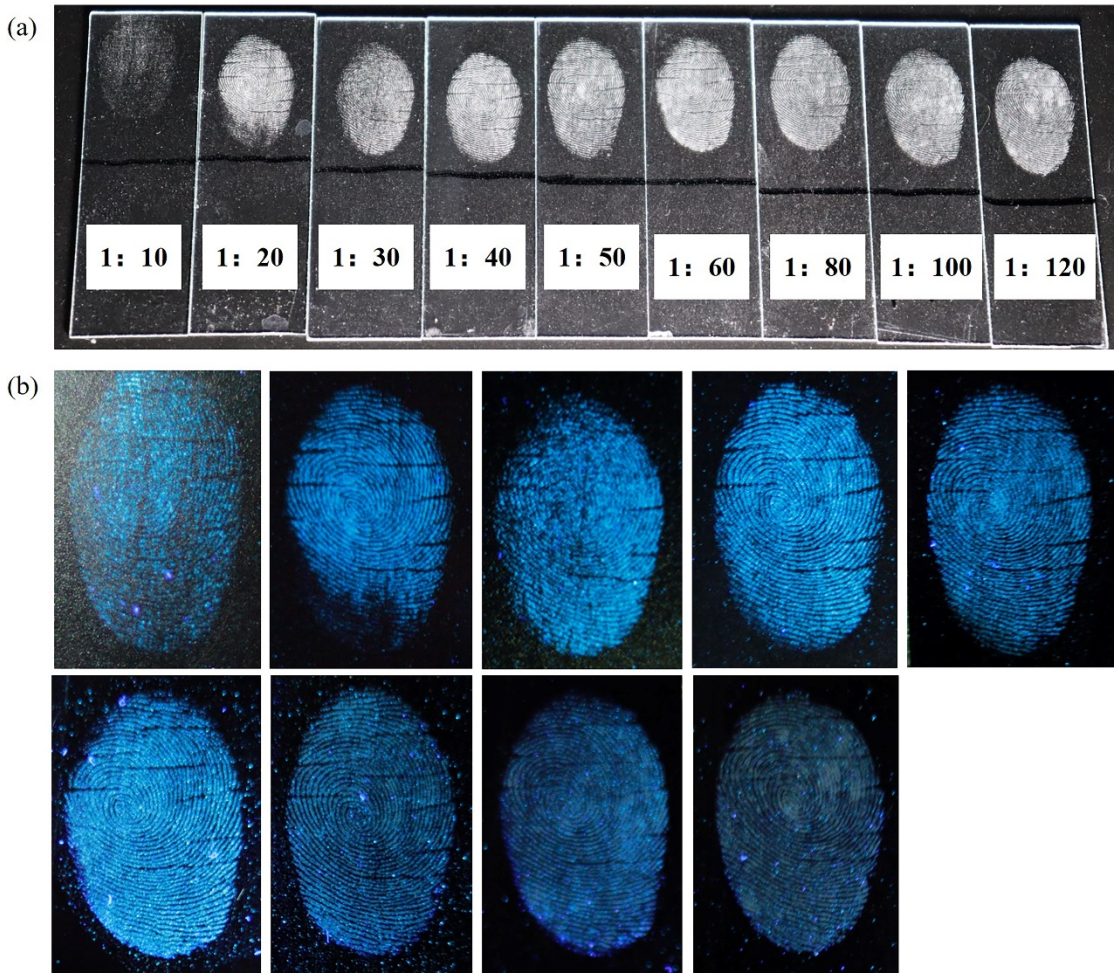
where QY is the quantum yield, F is the integrated area of the emission spectrum between 400 and 750 nm, A is the absorbance, and η is the refractive index of the solvent. The subscript 'st' indicates the standard, and 'x' represents the sample to be tested.

S3.



S3. Optimization of the GCDs and starch ratio.

S4. Different ratios of GCD-starch were used for LFPs and pictures of the results were taken with a camera. The fingerprint images were for various ratios, as follows: 1:10, 1:20, 1:30, 1:40, 1:50, 1:60, 1:80, 1:100, and 1:120.



S4. (a): Under sunlight, different ratios of GCD-starch LFPs (from left to right: 1:10, 1:20, 1:30, 1:40, 1:50, 1:60, 1:80, 1:100, 1:120); (b): LFPs with different ratios of GCD-starch under UV light (the first row from left to right is 1:10, 1:20, 1:30, 1:40, 1:50, the second row from left to right is 1:60, 1:80, 1:100, 1:120)

S5. We used the same fingerprint donor, washed the same finger of the fingerprint donor, and took fingerprint photographs [9] with the same camera used for benchmarking and comparisons.

S5. Fingerprint picture of the fingerprint provider.

References

1. X. Y. Dong, X. Q. Niu, Z. Y. Zhang, J. S. Wei and H. M. Xiong, *ACS Appl Mater Interfaces*, 2020, **12**, 29549-29555.

2. D. Zhao, W. Ma and X. Xiao, *Nanomaterials (Basel)*, 2018, **8**.
3. G. Li, X. Wang and J. Zhang, *CrystEngComm*, 2018, **20**, 5056-5060.
4. Y. Wang, W. Ju, J. Chen, Z. Liu and J. Wang, *ChemistrySelect*, 2020, **5**, 8915-8923.
5. Q. Feng, Z. Xie and M. Zheng, *Sensors and Actuators B: Chemical*, 2022, **351**.
6. R. Bandi, H. g. Kannikanti, R. dadigala, B. r. Gangapuram, J. r. Vaidya and V. Guttena, *Optical Materials*, 2020, **109**.
7. L. Yang, Q. Zhang, Y. Han, H. Li, S. Sun and Y. Xu, *Nanoscale*, 2021, **13**, 13057-13064.
8. Y. Zhai, F. Shen, X. Zhang, P. Jing, D. Li, X. Yang, D. Zhou, X. Xu and S. Qu, *J Colloid Interface Sci*, 2019, **554**, 344-352.
9. L. Li, L. Shi, Y. Zhang, G. Zhang, C. Zhang, C. Dong, H. Z. Yu and S. Shuang, *Talanta*, 2019, **196**, 109-116.
10. I. Milenkovic, M. Algarra, C. Alcoholado, M. Cifuentes, J. M. Lázaro-Martínez, E. Rodríguez-Castellón, D. Mutavdžić, K. Radotić and T. J. Bandosz, *Carbon*, 2019, **144**, 791-797.
11. H.-J. Wang, W.-Y. Hou, T.-T. Yu, H.-L. Chen and Q.-Q. Zhang, *Dyes and Pigments*, 2019, **170**.
12. S. Kainth, V. Sharma, M. Bhagat and S. Basu, *Materials Today Chemistry*, 2022, **23**.