Supplementary Material

Multifunctional Zn-Carbon dots enhanced specific recognition and in-situ degradation of tetracycline

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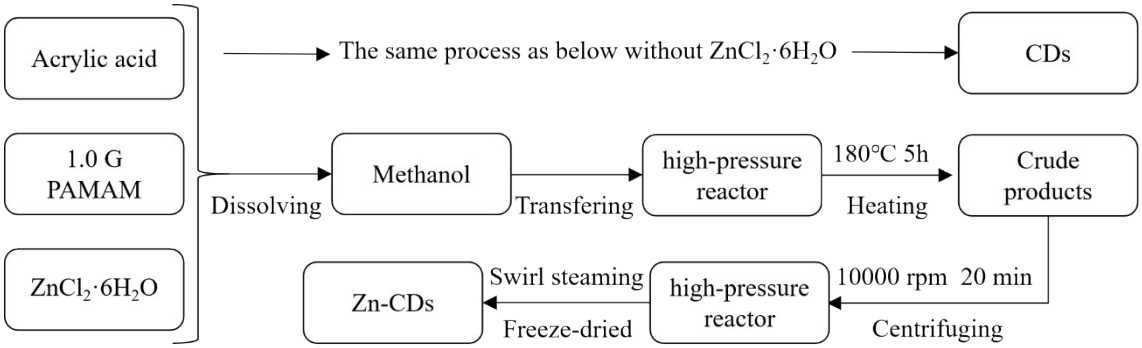

Figure S1. Synthesis flow chart of Zn-CDs.

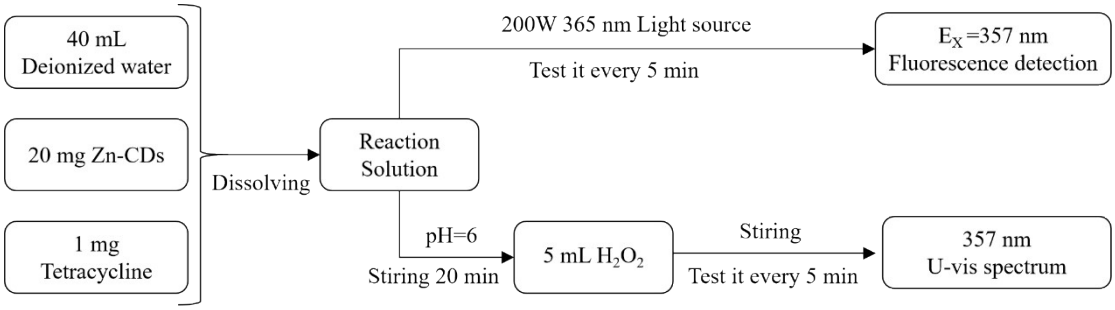

Figure S2. The flow chart of Zn-CDs for photocatalytic and Fenton-like degradation of tetracycline.

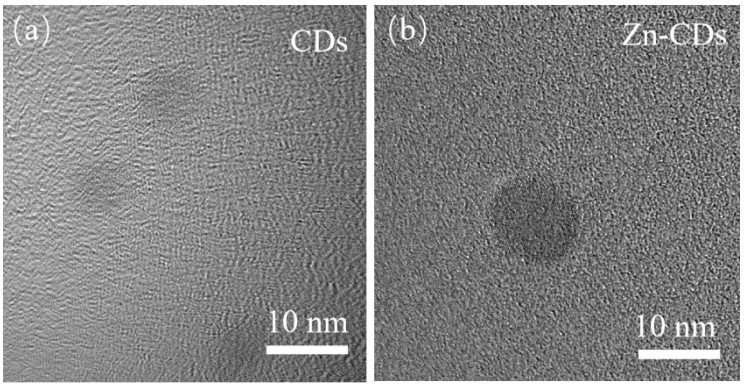

Figure S3. TEM (a) CDs, (b) Zn-CDs

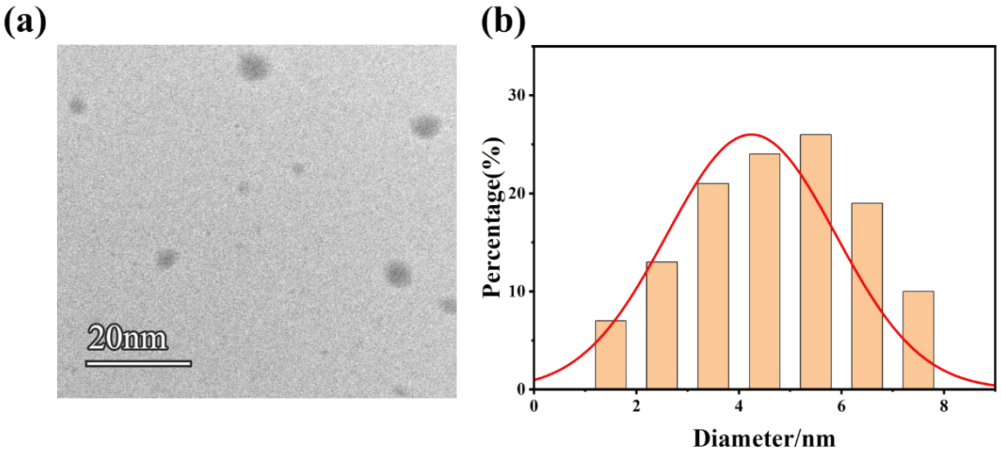

Figure S4. CDs (a) TEM of CDs, (b) Particle size distribution histogram of CDs.

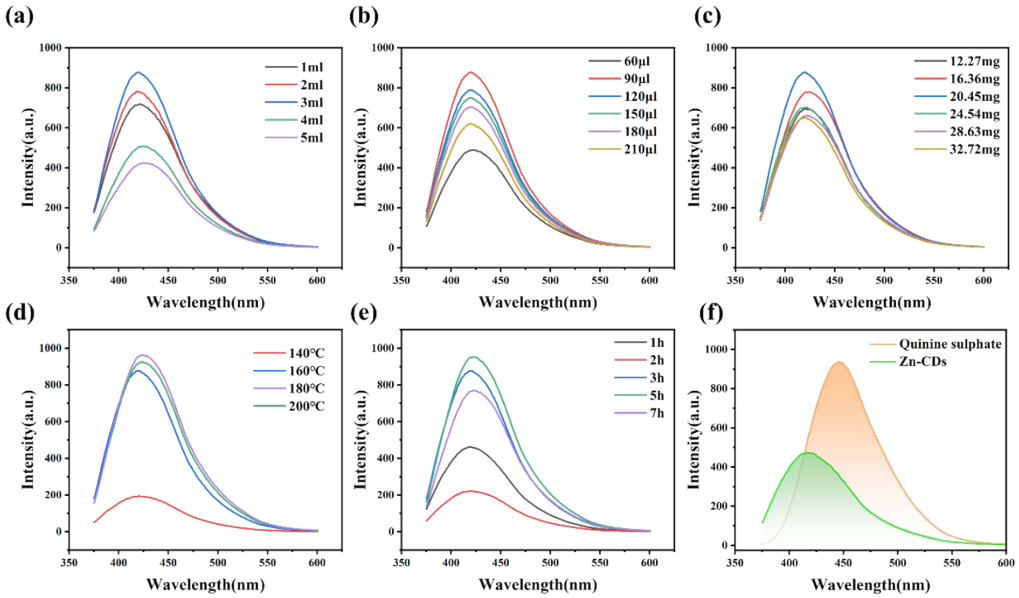

Figure S5. The influence factors of fluorescence properties for Zn-CDs: (a) The concentration of 1.0 G PAMAM; (b) The concentration of acrylic acid; (c) The concentration of ZnCl2. The influence of reaction conditions on the Zn-CDs fluorescence intensity: (d) Temperature; (e) Time. (f) Comparison of fluorescence intensity between Zn-CDs and quinine sulfate standard QY samples.

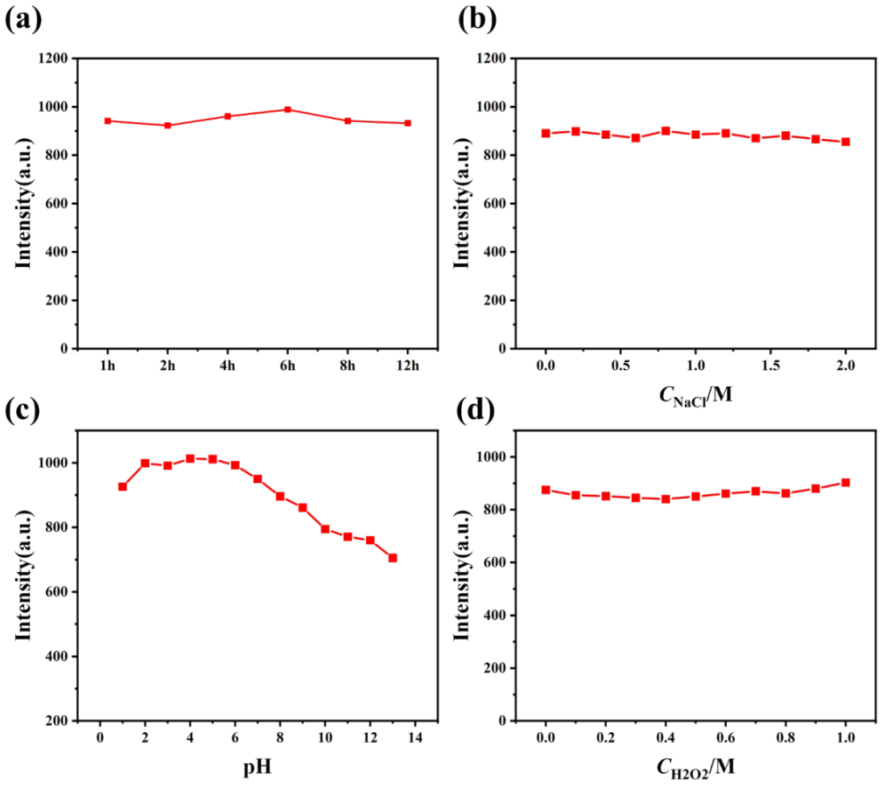

Figure S6. The fluorescence emission intensity of Zn-CDs varies under different environments (a)

ultraviolet irradiation time, (b) NaCl concentrations, (c) pH, and (d) H_2O_2 concentrations.

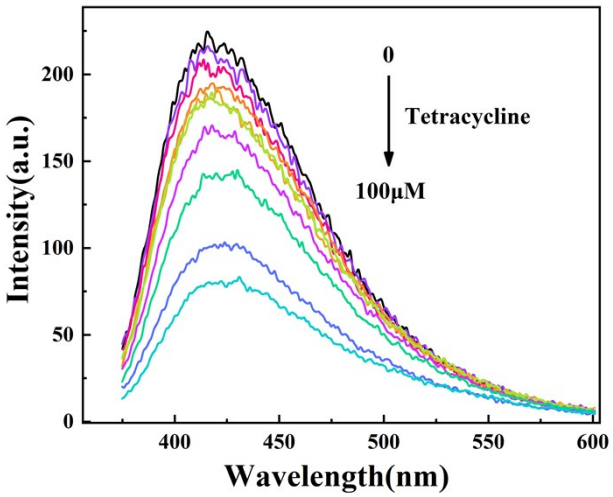

Figure S7. Recognition of tetracycline by pure carbon dots.

Table S1. Comparison of fluorescence detection of Zn-CDs for tetracycline

Name of CDs	Detection limit	Quantum yield	Reference
N-CQDs	60 nM	18 %	S[1]
N-CQDs	0.34 μM	10.97%	S[2]
F -CQD	85 nM	39%	S[3]
CQDs@MSNs	5.19 μM	/	S[4]
Zn-CDs	25 nM	28.6%	This work

S[1] John B K, John N, Korah B K, et al. Nitrogen-doped carbon quantum dots as a highly selective fluorescent and electrochemical sensor for tetracycline[J]. *Journal of Photochemistry and Photobiology A: Chemistry*, 2022, **432**, 114060.

S[2] Wang C, Sun Q, Yang M, et al. Preparation of highly luminescent nitrogen-doped carbon quantum dots and their detection of tetracycline antibiotics[J]. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 2022, **653**, 129982.

S[3] Huang Y, Huang X, Lin H, et al. Room temperature driven highly crystalline fluorine-doped carbon quantum dots for sensitive tetracycline sensing[J]. *Optical Materials*, 2021, **114**, 110967.

S[4] Lu P, Hou X, Lu G A, et al. Determination of tetracycline by FRET fluorescence between chenpi carbon quantum dots and copper nanoparticles[J]. *Chinese Journal of Analytical Chemistry*, 2024, **52**(10), 100440.

Table S2. Composition List of Lake Water [a]

Item	Value [b]	Item	Value [b]
pH	8.60	Dissolved oxygen	6.9 mg/L
Pb^{2+}	0.001 mg/ L	Permanganate	8.1 mg/ L
Cu^{2+}	0.01 mg/ L	Total N	4.31 mg/ L
Zn^{2+}	0.05 mg/ L	NH_3-N	1.35 mg/ L
Hg^{2+}	0 mg/ L	Total F	1.29 mg/L
Cd^{2+}	0.001 mg/ L	Cyanide	0.004 mg/ L
Cr^{6+}	0.004 mg/ L	Volatile phenol	0.001 mg/ L
Total As	0.0003 mg/ L	Sulfide	0.01 mg/ L
Total Se	0.0004 mg/ L	Fecal coliforms	400/ L
Total P	0.62 mg/ L		

[a] The data were obtained from the Daqing Ecological Environment Monitoring Center in 2023.

[b] The data for each item represents the average of the measured values.

Table S3. Comparison of tetracycline detection performance with fluorescence detection materials

	Linear range	LOD	Application	Literature
Atta-CDs-Eu	0.05 ~ 20 μM	8.7 nM	Milk	S[5]
Cu-CDs	2 ~ 32 μM	0.17 μM	Antibiotic tablets, Milk	S[6]
R-CDs	3 ~ 40 μM	38.5 nM	Milk	S[7]
Zn-CDs	50 nM ~ 100 μM	25 nM	Tap water, Lake water	this work

S[5] Y. Sang; Wang, K.; Kong, X.; Cheng, F.; Zhou, C.; Li, W., Color-multiplexing europium doped carbon dots for highly selective and dosage-sensitive cascade visualization of tetracycline and Al^{3+}. *Sensors and Actuators B: Chemical.* 2022**, 362**, 131780.

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