

Supplementary information

Fruit Waste-Derived Carbon Dots with Rhodamine B for Ratiometric Detection of Fe³⁺ and Cu²⁺

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Table list:

Table. S1 F/F₀ under pH 6.0 in the presence of metal ions (0.1 mol•L⁻¹).

Table. S2. spiked recovery of ratiometric probes in different real water samples.

Table. S3. Comparison of the LOD for the detection of Fe³⁺ and Cu²⁺ with the earlier literature reports.

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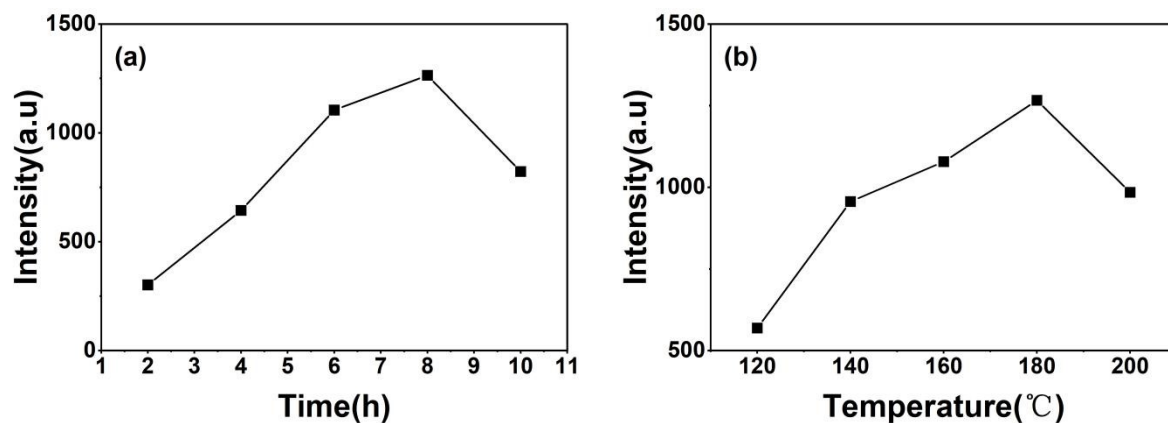


Fig.S1(a) The fluorescence intensity of CQDs under different reaction times (concentrations of CQDs were different for each point during measurement). (b) The fluorescence intensity of CQDs synthesized under different HT temperatures (concentrations of CQDs were different for each point during measurement)

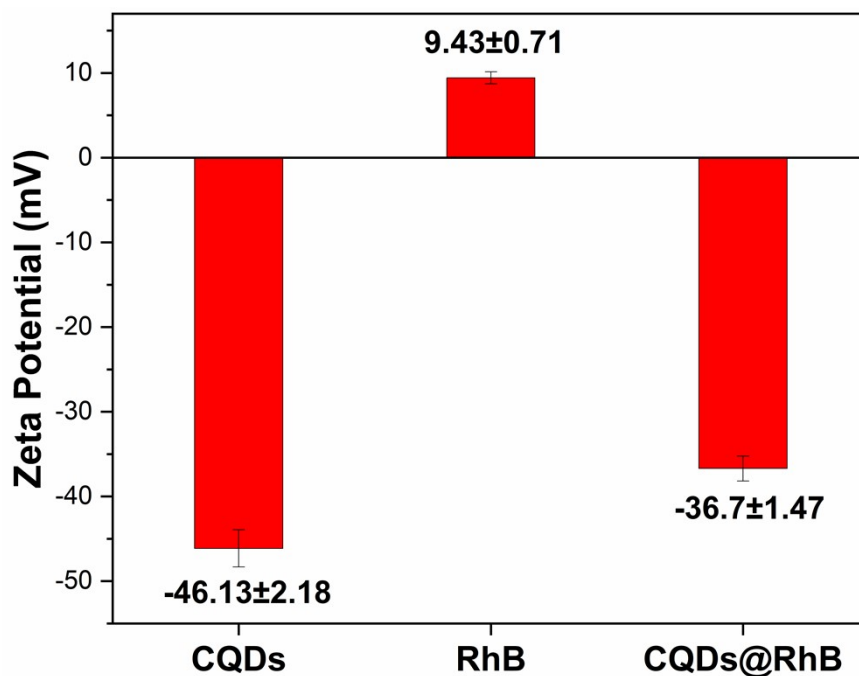


Fig.S2 Zeta potentials of CQDs, RhB and CQDs@RhB.

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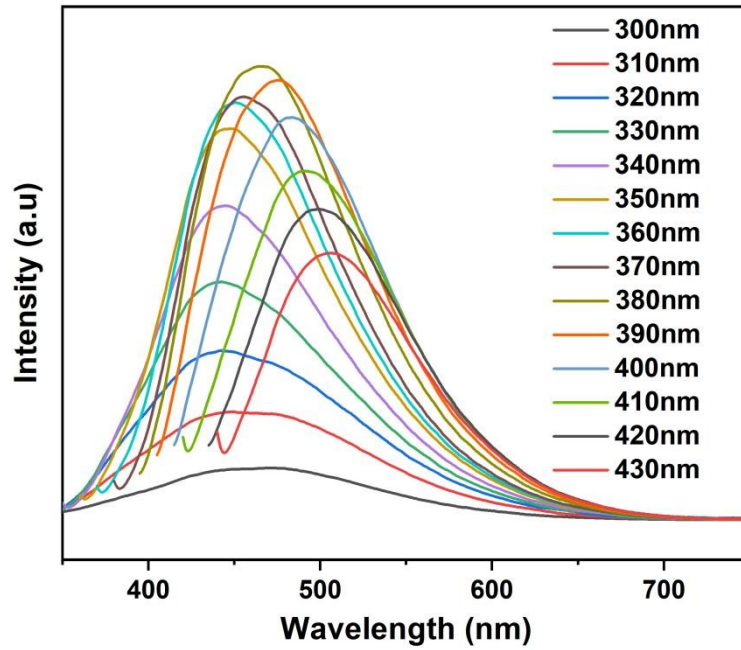


Fig.S3 PL emission spectra with different excitation wavelengths from 300 to 430 nm.

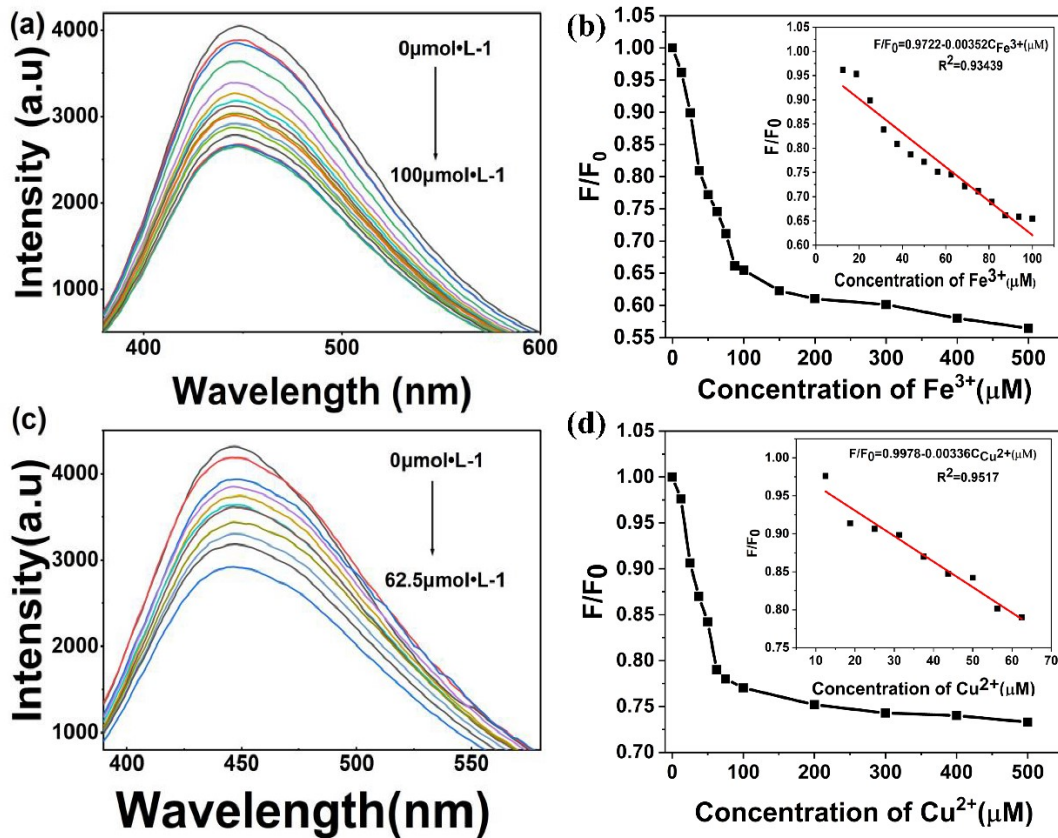


Fig.S4 (a and c) Fluorescence emission spectra of CQDs solution at different concentrations of Fe^{3+} and Cu^{2+} by 350 nm excitation wavelength. (b and d) Relationship between F/F_0 and the concentration of Fe^{3+} and Cu^{2+} .

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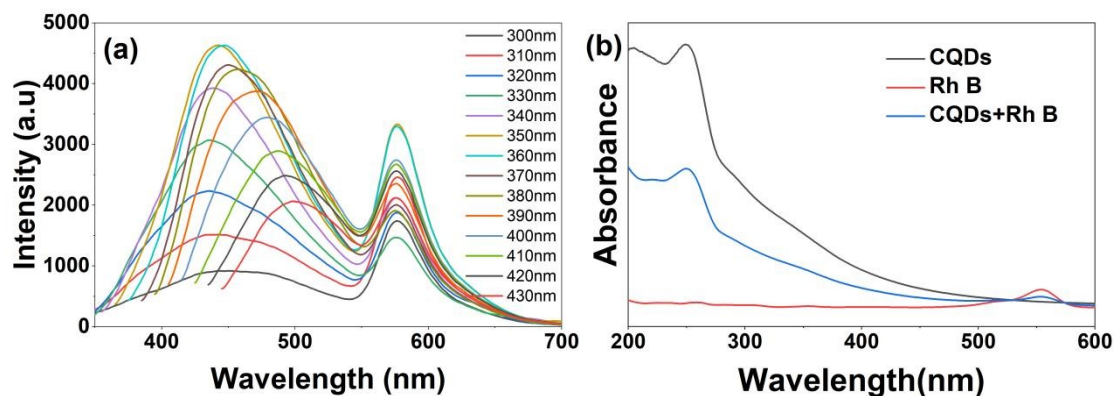


Fig. S5 (a) PL emission spectra with different excitation wavelengths from 300 to 430 nm of the ratiometric probe. (b) UV-vis spectrum of the ratiometric probe.

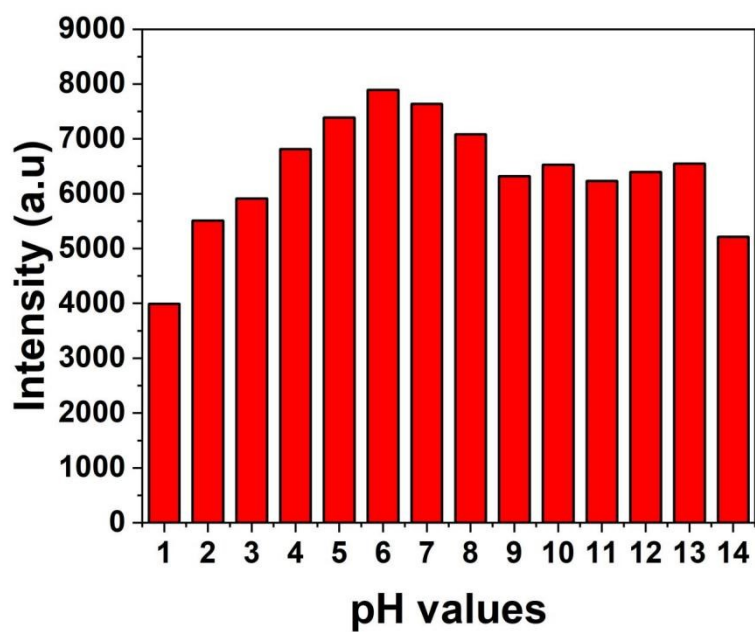


Fig. S6. Effect of pH values on rhodamine B.

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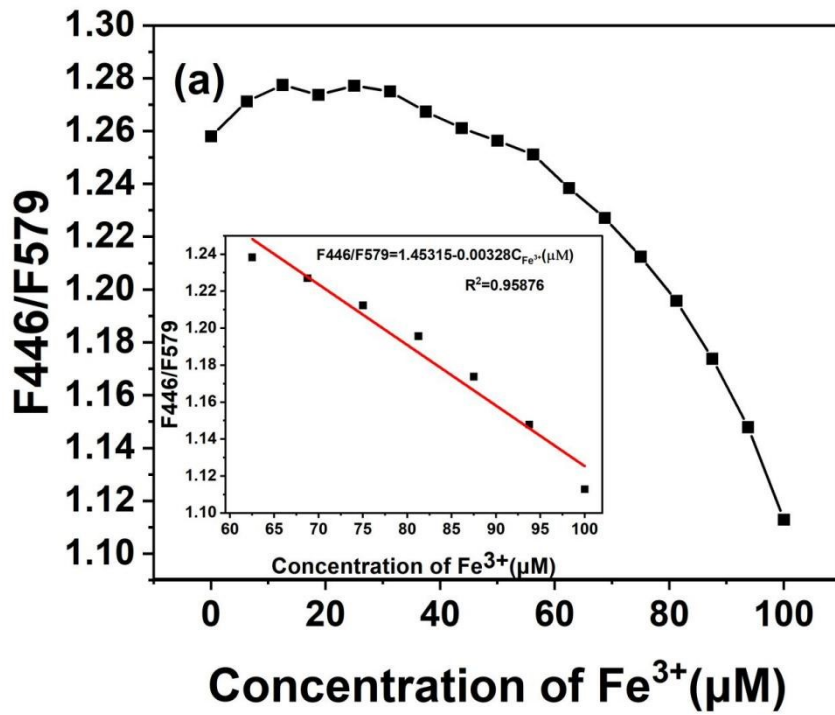


Fig. S7. Relationship between F_{446}/F_{579} and the concentration of Fe^{3+}

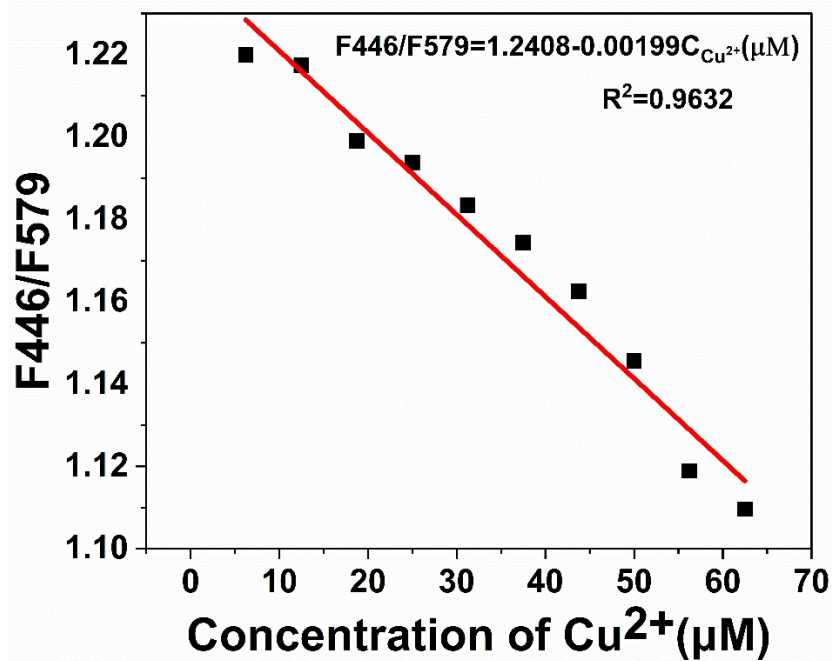


Fig. S8. Relationship between F_{446}/F_{579} and the concentration of Cu^{2+}

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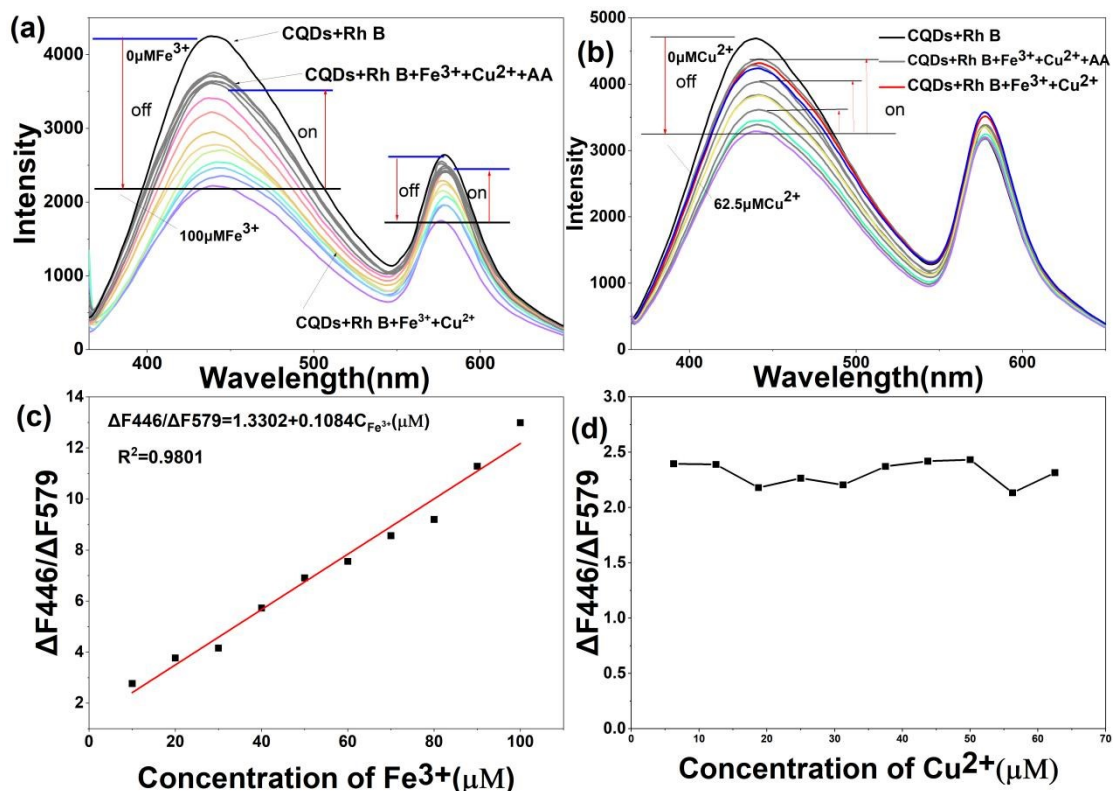


Fig. S9 (a) Fluorescence recovery of ratiometric probes quenched by different concentration of Fe^{3+} (0-100 μM) and Cu^{2+} (25 μM) (b) Fluorescence recovery of ratiometric probes quenched by different concentration of Cu^{2+} (0-62.5 μM) and Fe^{3+} (40 μM) (c and d) Linear relationship between $(F_{446}^1 - F_{446}^2) / (F_{579}^1 - F_{579}^2)$ and the concentration of Fe^{3+} and Cu^{2+} .

Table. S1. F/F_0 under pH 6.0 in the presence of metal ions (0.1 mol·L⁻¹).

Ions and amino acids	F/F_0
Fe^{3+}	0.490
Cu^{2+}	0.635
Na^+	1.001
Mg^{2+}	0.905
Mn^{2+}	0.960
Ca^{2+}	1.036
Fe^{2+}	0.802
Cd^{2+}	0.993
Ag^+	0.949

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Table. S2. spiked recovery of ratiometric probes in different real water samples.

Ions	Sample	Original (μM)	Added (μM)	*Found (μM)			Recovery (%)	RSD%(n=3)
Fe³⁺	Tap water	14.52	2.00	2.27	2.25	2.28	113.33	0.67
			4.00	3.97	3.90	4.01	99.00	1.41
			6.00	5.53	5.59	5.51	92.39	0.75
			12.00	12.16	12.09	12.56	102.25	2.07
			24.00	23.89	23.22	23.65	98.28	1.44
	River water	23.58	2.00	2.15	2.21	2.03	106.5	4.30
			4.00	3.59	3.48	3.63	89.17	2.18
			6.00	5.16	5.23	5.19	86.56	0.68
			12.00	12.39	12.15	11.83	101.03	2.32
			24.00	24.87	23.52	22.95	99.08	4.15
Cu²⁺	Tap water	0.35	1.00	1.09	1.07	1.12	109.33	2.30
			2.00	1.87	1.79	1.95	93.50	4.28
			3.00	2.65	2.55	2.79	88.78	4.53
	River water	1.85	1.00	1.14	1.06	1.15	111.67	4.42
			2.00	1.95	1.70	2.09	95.67	10.33
			3.00	2.57	2.47	2.98	89.11	10.11

*: Found (μM) This column of data has been deducted from the original concentration.

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Table. S3. Comparison of the LOD for the detection of Fe³⁺ and Cu²⁺ with the earlier literature reports.

Materials	Analytes	Linear range ($\mu\text{mol}\cdot\text{L}^{-1}$)	LODs ($\mu\text{mol}\cdot\text{L}^{-1}$)	Refs
CQDs-C	Fe ³⁺	0~500	5.23	(Ding et al., 2021)
CQDs	Fe ³⁺	10~100	2.10	(Nagaraj et al., 2022)
CQDs	Fe ³⁺	0~45	2.5	(Siahcheshm & Heiden, 2023)
OP-CQDs-FA system	Fe ³⁺	5~80	4.91	(Zhao et al., 2023)
N-CQDs	Fe ³⁺	3~100	3	(Gu et al., 2022)
Ni-CQDs	Cu ²⁺	300~900	7.88	(Sun et al., 2023)
Nitrogen-CQDs	Cu ²⁺	0~280	4.74	(X. Liu et al., 2020)
N-CQDs	Cu ²⁺	10~1000	0.455	(G. Liu et al., 2018)
NBU-CDs	Cu ²⁺	0.5~5	0.83	(Cui et al., 2023)
CQD	Cu ²⁺	0~400	0.42	(Kamarol Zaman et al., 2021)
ratiometric probes	Fe ³⁺	0~100	1.75	This work
	Cu ²⁺	0~62.5	0.43	

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