

## Supplementary Information

### Sensitivity improvement of Au-nanoparticle based colorimetric probes via surface decoration of carbon quantum dots

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#### S1 Size variation of CQD@AuNPs based on DLS measurements

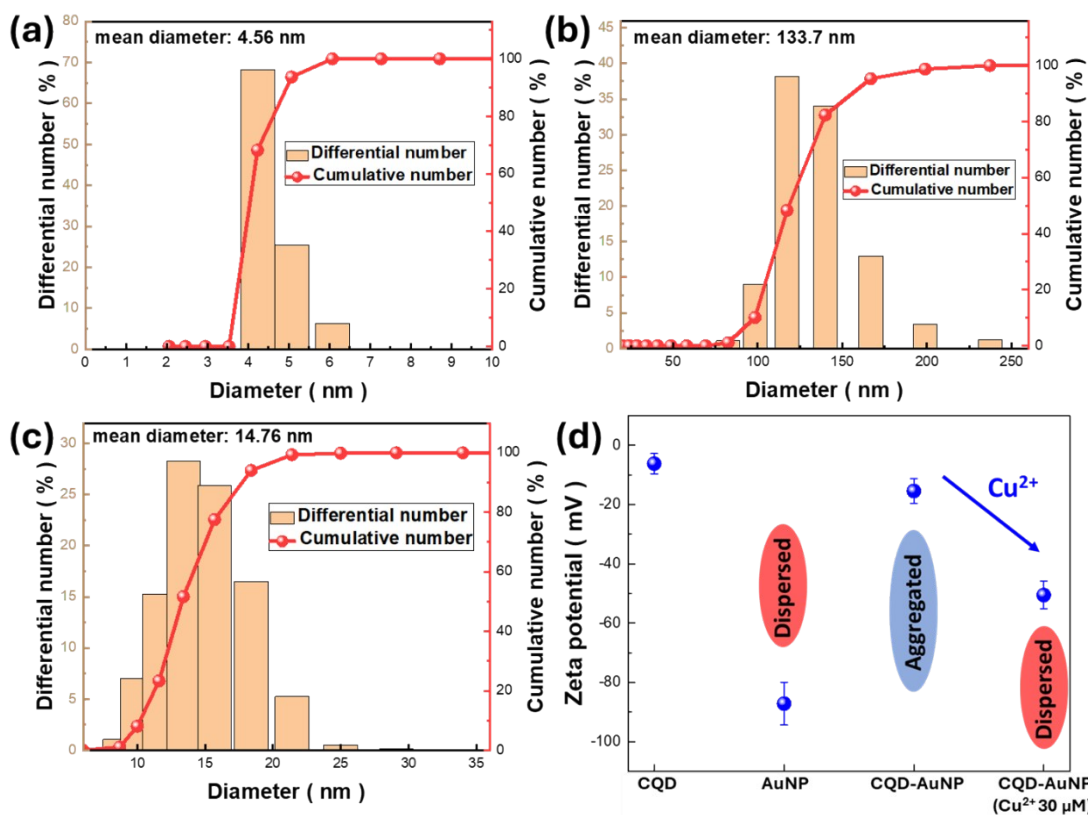


Fig. S1 Dynamic light scattering (DLS) measurements of (a) bare CQDs, (b) pristine CQD@AuNPs and (c) CQD@AuNPs immersed in 30 μM of Cu<sup>2+</sup> ions for 10 min. The

results agreed well with TEM observations shown in Figs. 1(c) and 1(d), respectively. (d) zeta potential of different sample.

## S2 Full survey of XPS spectrum

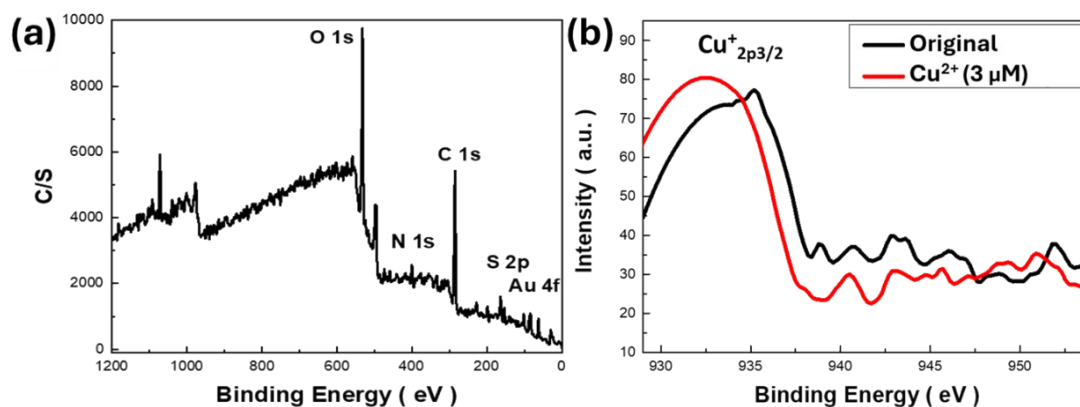


Fig. S2 (a) Full survey of XPS spectrum of CQD@AuNPs and (b) XPS identification of Cu<sup>2+</sup> oxidation when immersing probes in 3 μM of Cu<sup>2+</sup> -ions solutions for 5 min, where the appearance of Cu<sup>+</sup> 2p<sub>3/2</sub> signal revealing that the Cu<sup>2+</sup>/Cu<sup>1+</sup> reaction causes the reduction of thiol groups in CQD@AuNPs.

## S3 Optimal incorporations of CQDs with AuNPs for colorimetric detection

Table S1 Process conditions for synthesizing different Cu<sup>2+</sup>-ion based sensors and the corrected detection limits.

	CQD <sup>NS</sup> wt%	LOD	R <sup>2</sup>
CQD	100	N/A	0.167
AuNPs	0	N/A	0.559
CQD@AuNP 1	2.1×10 <sup>-6</sup>	296 nM	0.955
CQD@AuNP 2	4.2×10 <sup>-6</sup>	18 nM	0.979
CQD@AuNP 3	6.3×10 <sup>-6</sup>	235 nM	0.924

## S4 Examinations of long-term stability and reliability for Cu<sup>2+</sup> detection

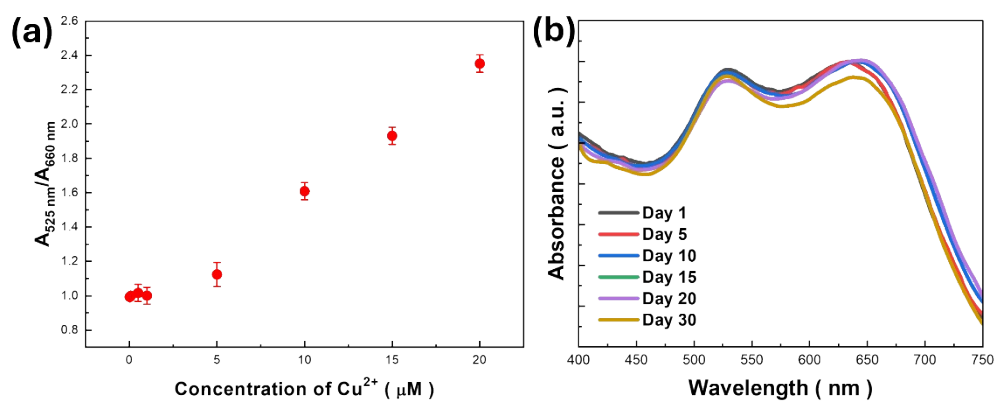


Fig. S3 (a) Measured ratios of  $A_{525\text{ nm}}/A_{660\text{ nm}}$  with respect to the presence of various  $\text{Cu}^{2+}$ -ion concentrations. (b) Examinations of long-term stability of probes for 30 days.