Supplementary Materials

Self-Powered Photoelectrochemical Assay for Hg^{2+} Detection Based on g-C_3N_4-CdS-CuO Composites and Redox Cycle Signal Amplification Strategy

Yonghuan Su [1], Lixia Su [1], Bingqian Liu [1,*], Youxiu Lin [2] and Dianping Tang [3,*]

[1] Guizhou Engineering Laboratory for Synthetic Drugs (Ministry of Education of Guizhou Province), College of Pharmacy, Guizhou University, Guiyang 550025, China; gs.yhsu20@gzu.edu.cn (Y.S.); gs.lxsu20@gzu.edu.cn (L.S.)
[2] Key Laboratory of Modern Analytical Science and Separation Technology of Fujian Province, College of Chemistry, Chemical Engineering and Environment, Minnan Normal University, Zhangzhou 363000, China; lyx1817@mnnu.edu.cn
[3] Key Laboratory of Analytical Science for Food Safety and Biology (MOE & Fujian Province), Department of Chemistry, Fuzhou University, Fuzhou 350108, China
* Correspondence: nqliu@gzu.edu.cn (B.L.); dianping.tang@fzu.edu.cn (D.T.); Tel.: +86-591-22866125 (D.T.)

1. Synthesis of the g-C_3N_4 and CdS

The water-dispersing g-C_3N_4 was prepared according to the literature [1] as follows: 5 g of melamine in a crucible was annealed at 550 °C for 4 h. Then, 1 g of the as-prepared bulk-C_3N_4 powder was refluxed in 100 mL of 5 M HNO_3 at 125 °C for 12 h and kept overnight. The formed light yellow precipitates were isolated by centrifugation and washed with water several times. Afterward, the final product was dried at 60 °C for further use.

Preparation of CdS QDs [2], firstly, 0.1623 g $CdCl_2{\cdot}2.5H_2O$ was mixed with 30 mL of ultrapure water and heated to 70 °C. Next, a freshly prepared Na_2S (30 mL, 0.0627 g/mL) solution was slowly injected into the mixture solution and kept at 70 °C for 3 h with continuous reflux. The color of the reaction solution immediately turned orange-yellow. The collected precipitation was centrifuged and washed twice with absolute ethanol and ultrapure water, respectively. Finally, the CdS QDs were re-dispersed in ultrapure water and stored at 4 °C in the dark for further use.

2. Setting parameters of the EIS and Cyclic Voltammetry(CV)

The electrochemical workstation was used to record the EIS, and the parameter was set for Init E (V) = 0.315, High Frequency (Hz) = 1 MHz, Low Frequency (Hz) = 0.1, Amplitude (V) = 0.005, Quiet Time (sec) = 2, Cycles (.1-1Hz) = 1.

CV uses an electrochemical workstation, Set the parameters to Init E (V) = -0.2, High E (V) = 1, Low E (V) = -0.2, Init P/N = P, Scan Rate (V/s) = 0.02, Segment = 2, Sample Interval (V) = 0.001, Quiet Time (SEC) = 2,Sensitivity (A/V) = 0.001.

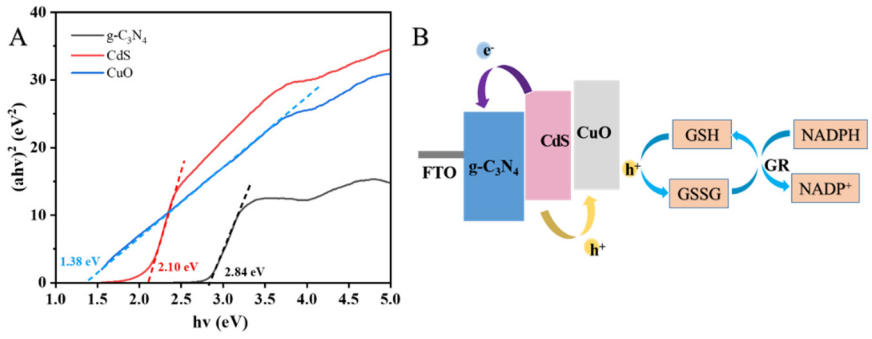

Figure S1. The band gaps of g-C_3N_4, CdS and CuO were measured by the UV-vis diffuse reflection spectra (DRS) (**A**), the picture shows the direction of electrons in the photoelectric sensor under light conditions (**B**).

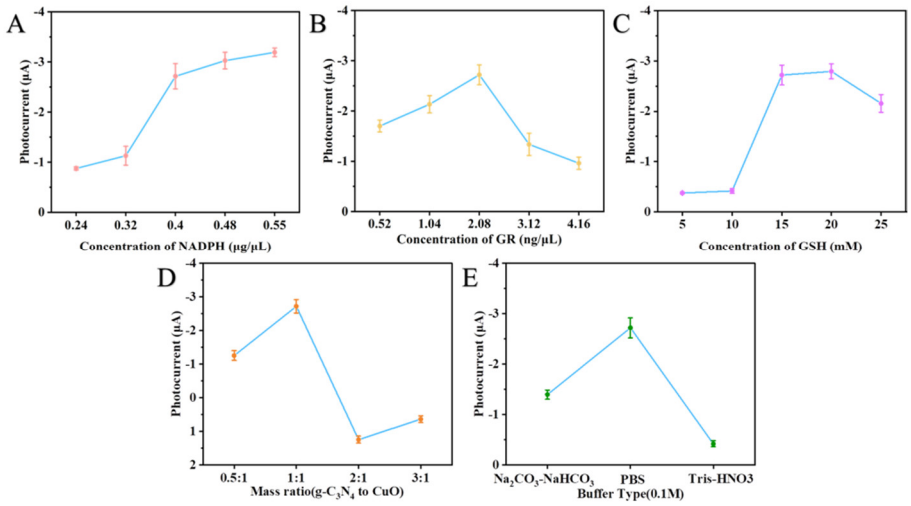

Figure S2. (**A**) Concentration of NADPH; (**B**) Concentration of GR; (**C**) Concentration of GSH; (**D**) Mass ratio of g-C_3N_4 to CuO; (**E**) Different types of buffer solutions (0.1M).

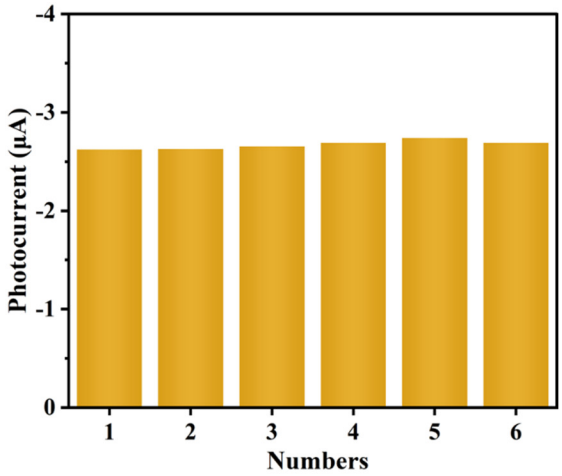

Figure S3. Reproducibility of g-C_3N_4-CdS-CuO at 0.5 nM Hg^{2+}.

Table S1. Comparison of other analysis strategies for Hg^{2+} detection.

Methods	Materials	Linear Ranges	LODs	Refs
Fluorescence	CDs-AgNPs	100–160 μM	22.2 nM	[3]
Colorimetric	Hg-MB	0–400 μM	19.5 nM	[4]
Electrochemical	Cu-MOF	0.1–50 nM	0.063 nM	[5]
Electrochemical	S-rGO	0.125–6 μM	1.6 nM	[6]
Electrochemical	N,S-doped C@Pd	0.00054–5.0 μM	0.18 nM	[7]
Photoelectrochemical	g-C_3N_4@CdS	20–550 nM	12 nM	[8]
Photoelectrochemical	Bi_2MoO_6/CuS-6%	0.5–230 nM	0.23 nM	[9]
Photoelectrochemical	g-C_3N_4-CdS-CuO	0.005–100 nM	0.84 pM	this work

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