

Supporting Information

1 Materials and reagents

The Autolab PGSTAT302N electrochemical workstation was purchased from Metrohm (Switzerland) and the CHI832C electrochemical workstation was purchased from Shanghai Chenhua Instrument Co., Ltd. (Shanghai, China). The MGCE (diameter 3 mm) was supplied by Tianjin Incole Union Technology Co., Ltd. (Tianjin, China). Pt wire electrode, Ag/AgCl electrode and Au electrode (AuE, diameter 2 mm) were supplied by Chenhua Instruments Co., Ltd. (Shanghai, China). Graphene oxide (GO) and chloroauric acid trihydrate ($\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$) were procured from Macklin Biochemical Co., Ltd. (Shanghai, China). MCH, Tris and Tris(2-carboxyethyl)phosphine (TCEP) were supplied by Shanghai Titan Scientific Co., Ltd. (Shanghai, China). Ethylenediamine (EDA), Glucose, Anhydrous sodium acetate (NaAc) and Ethylene glycol (EG) were bought from Sinopharm Chemical Reagent Co., Ltd. (Shanghai, China). Tetrapotassium hexacyanoferrate trihydrate ($\text{K}_4[\text{Fe}(\text{CN})_6] \cdot 3\text{H}_2\text{O}$) and Red prussiate ($\text{K}_3[\text{Fe}(\text{CN})_6]$) were procured from Qiaoyi Biotechnology Co., Ltd (Shanghai, China). Hg^{2+} standard solution was obtained from Shanghai Bailingwei Chemical Technology Co., Ltd. (Shanghai, China). Exo III and the synthesis, purification, and modification of oligonucleotides were supported by Sangon Biotech Co., Ltd. (Shanghai, China). The sequences and modifications of oligonucleotides are detailed in the Table S1. All reagents applied in this study are analytical grade.

2 Electrochemical testing

The CV and EIS were tested on the Autolab PGSTAT302N electrochemical workstation and the SWV was tested on the CHI832C electrochemical workstation. And, a three-electrode system was applied for electrochemical testing, namely, Ag/AgCl, MGCE and platinum wire were used as reference, working and counter electrodes, respectively. The SWV was performed in PBS buffer (20 mmol/L, pH = 7.5, 5 mmol/L MgCl_2 , 100 mmol/L NaCl), the frequency, amplitude and potential increment were 20 Hz, 25 mV and 4 mV, respectively. The EIS was tested in $[\text{Fe}(\text{CN})_6]^{3-/4-}$ (5 mmol/L), the frequency and amplitude were 0.1 Hz to 100 kHz and 5 mV.

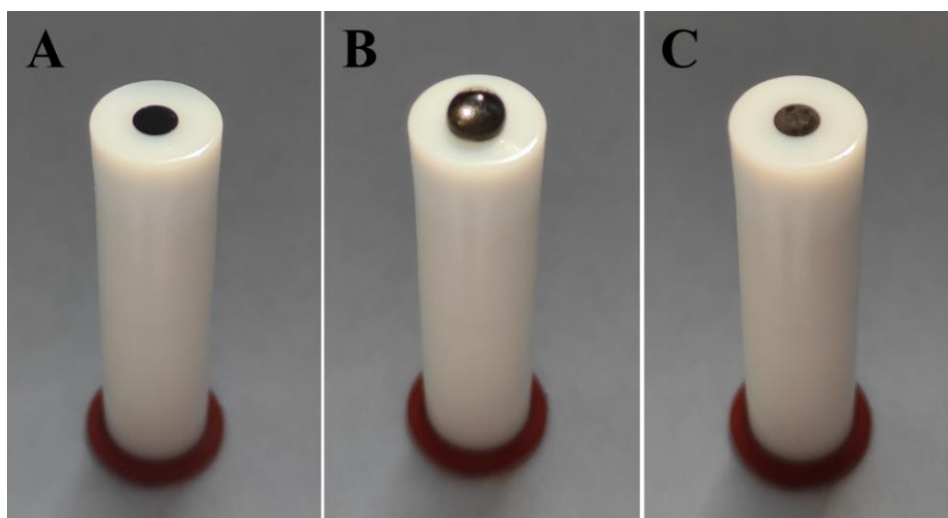


Fig. S1 (A) photograph of bare MGCE, (B) photograph of SP solution being transferred to MGCE, (C) photograph of SP being magnetically adsorbed onto MGCE.

A	Capture probe	Water sample
Set 1	-	-
Set 2	+	-
Set 3	-	+

“-” Without humic acid treatment

“+” With humic acid treatment

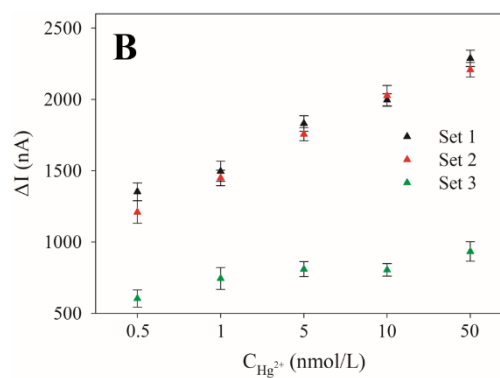


Fig. S2 Influence of substrate physical and chemical properties. (A) Specific information on the three sets of experiments with and without humic acid (1 mg/L) treatment of capture probe and water sample, (B) plots of the results of three sets of comparative experiments at different concentrations of Hg^{2+} .

Table S1 The sequences and modifications of oligonucleotides employed in this work.

Name	Sequence and modification
cDNA	HS -5'-GATTGTTTCTTCAGTCTAGGATTCGGCGTGGGTTAAGCCGAATC CTAGACTGTTGTTTCTTTC-3'
HP1	5'-TTAACCCACGCCGAATCCTAGACTCAAAGTAGTCTAGGATTCGGC GTG-3'- MB
HP2	5'-AGTCTAGGATTCGGCGTGGGTTAACACGCCGAATCCTAGACTACT TTG-3'- MB

Table S2 Performance comparison of the proposed assay with some reported methods.

Method	Linear Range	LOD	References
colorimetry	1–400 nmol/L	0.33 nmol/L	Cui et al., 2019
colorimetry	25–800 nmol/L	30 nmol/L	Chen et al., 2016
colorimetry	10–700 nmol/L	5.18 nmol/L	Luo et al., 2022
colorimetry	0.01–100 μ mol/L	2.7 nmol/L	Feng et al., 2022
fluorescence	25–5000 nmol/L	0.55 nmol/L	Bi et al., 2023
fluorescence	40–300 nmol/L	0.75 nmol/L	Wang et al., 2023
fluorescence	0.05–100 μ mol/L	6.24 nmol/L	Ahmed et al., 2021
fluorescence	0–375 nmol/L	8.5 nmol/L	Zhou et al., 2021
electrochemical	0.02–149 μ mol/L	5.0 nmol/L	Sakthi Priya et al., 2022
electrochemical	0–80 nmol/L	0.136 nmol/L	Hu et al., 2022
electrochemical	0.005–3 μ mol/L	2 nmol/L	Lu et al., 2019
electrochemical	0.01–7 μ mol/L	5.2 nmol/L	Xia et al., 2022
electrochemical	0.005–100 nmol/L	3.14 pmol/L	This work

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