Supporting Information

Sensitive and Selective Colorimetric Detection of Hg\textsuperscript{2+} by Hg\textsuperscript{2+} Induced Dual Signal Amplification Strategy Based on Cascade-Type Catalytic Reactions

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EXPERIMENTAL SECTION

Chemicals and Materials. 3,3',5,5'-Tetramethylbenzidine dihydrochloride, HgSO$_4$, and HAuCl$_4$·4H$_2$O were obtained from Sinopharm Chemical Reagent Co. Ltd. (Shanghai, China). Cetyltrimethylammonium bromide (CTAB) and ascorbic acid (AA) were purchased from Fluka (Switzerland) and Beijing Chemical Reagent Company, respectively. All reagents were of analytical reagent grade, and used as received. All the aqueous solutions were prepared with distilled water.

Apparatus. Absorption spectra were recorded on a Unico UV-2802PCUV-Vis Spectrophotometer. Absorbance at 652 nm was used for quantitative analysis. Scanning electron microscopy (SEM) images were taken by using an FEI XL30 ESEM FEG scanning electron microscope operated at 25 kV. Energy-dispersive X-ray spectroscopy (EDX) images were taken by using a Hitachi S-4800 scanning electron microscope operated at 20 kV.

Determination of Hg$^{2+}$. A stock solution of Hg$^{2+}$ (0.1 mM) was prepared in distill water and various concentrations of Hg$^{2+}$ was obtained by serial dilution of the stock solution. The colorless Au$^+$ solution was produced by mixing 1 mL of 3 mM HAuCl$_4$, 2 mL of 50 mM CTAB and 2.1 mL of 3 mM AA. For the detection of Hg$^{2+}$, 100 μL of 1 mM TMB, 20 μL of prepared Au$^+$ solution and 10 μL of Hg$^{2+}$ solutions with different concentrations were added sequentially in 370 μL of 50 mM NaAc buffer solutions (pH 4.2). After that, the mixture was vortex mixed thoroughly and transferred for UV–vis scanning after incubating for 5 min at RT. To elevate the selectivity of the proposed method, 100 μL of 1 mM TMB, 20 μL of prepared Au$^+$ solution and 10 μL 100 μM of 11 kinds of metal cations including Ca$^{2+}$, Cd$^{2+}$, Co$^{2+}$, Mg$^{2+}$, Mn$^{2+}$, Ni$^+$, Pb$^{2+}$, Zn$^{2+}$, Cu$^{2+}$, Fe$^{3+}$, Ag$^+$ and 10 μL 10 μM Hg$^{2+}$ were added.
sequentially in 370 μL of 50 mM NaAc buffer solutions (pH 4.2). Photographs and UV–vis spectroscopy were recorded after incubating for 5 min at RT.

**Fig. S1.** EDX of in situ synthesized Au NPs.

**Fig. S2.** Effect of pH on the ΔA. 100 μL of 1 mM TMB, 20 μL of Au\(^+\) solution, and 10 μL of 10 μM Hg\(^{2+}\) in 370 μL 50 mM of different pH NaAc buffer solution; incubation temperature, RT; incubation time, 5 min. The maximum point in curve was set as 100%. (Relative activity=ΔA/ΔA\(_{\text{max}}\) × 100%)
Fig. S3. Effect of pH on the (A) $A_0$ and (B) $A$. 100 µL of 1 mM TMB, 20 µL of Au$^+$ solution, and without and with 10 µL of 10 µM Hg$^{2+}$ in 370 µL 50 mM of different pH NaAc buffer solution; incubation temperature, RT; incubation time, 5 min. The maximum point in curve was set as 100%. (Relative activity=$A/A_{\text{max}} \times 100\%$).
**Fig. S4.** Effect of reaction time on the ΔA. 100 μL of 1 mM TMB, 20 μL of Au⁺ solution, and 10 μL of 10 μM Hg²⁺ in 370 μL 50 mM pH 4.2 NaAc buffer solution; incubation temperature, RT. The maximum point in curve was set as 100%. (Relative activity=ΔA/ΔA_{max} × 100%)
Fig. S5. Effect of incubation temperature on the \( \Delta A \). 100 µL of 1 mM TMB, 20 µL of Au\(^+\) solution, and 10 µL of 10 µM Hg\(^{2+}\) in 370 µL 50 mM pH 4.2 NaAc buffer solution; incubation time, 5 min. The maximum point in curve was set as 100%. (Relative activity=\( \Delta A/\Delta A_{\text{max}} \times 100\%\))
Fig. S6. Effect of incubation temperature on the (A) A₀ and (B) A. 100 µL of 1 mM TMB, 20 µL of Au⁺ solution, without and with 10 µL of 10 µM Hg²⁺ in 370 µL 50 mM pH 4.2 NaAc buffer solution; incubation time, 5 min. The maximum point in curve was set as 100%. (Relative activity = A/Aₘₐₓ × 100%)
Fig. S7. Effect of the concentration of TMB on the ΔA (ΔAbs). 100 µL of different concentrations of TMB, 20 µL of Au⁺ solution, and 10 µL of 10 µM Hg²⁺ in 370 µL 50 mM pH 4.2 NaAc buffer solution; incubation temperature, RT; incubation time, 5 min. The maximum point in curve was set as 100%. (Relative activity=ΔA/ΔA_{max} × 100%)
Fig. S8. Time dependent absorbance changes of Au$^+$-TMB detection system with different concentration of Hg$^{2+}$. 100 μL 1 mM TMB + 20 μL Au$^+$ solution in 370 μL 50 mM pH 4.2 NaAc buffer solution with different concentration of Hg$^{2+}$; incubation temperature, RT.