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## Supporting Information

### Sensitive and Selective Colorimetric Detection of $\text{Hg}^{2+}$ by $\text{Hg}^{2+}$ Induced Dual Signal

#### Amplification Strategy Based on Cascade-Type Catalytic Reactions

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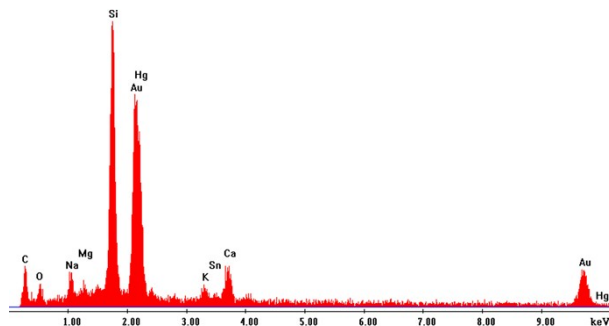
## EXPERIMENTAL SECTION

**Chemicals and Materials.** 3,3',5,5'-Tetramethylbenzidine dihydrochloride, HgSO<sub>4</sub>, and H<sub>2</sub>AuCl<sub>4</sub>·4H<sub>2</sub>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.

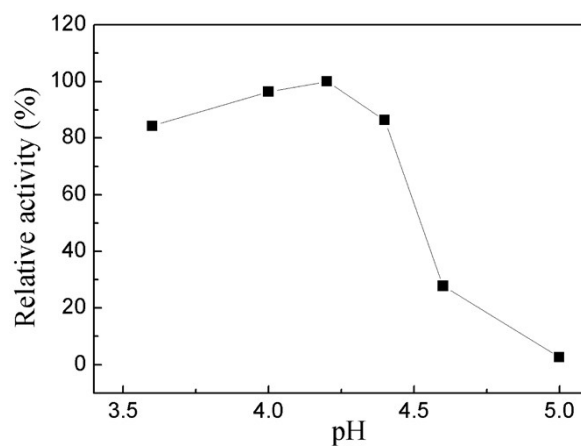
**Apparatus.** Absorption spectra were recorded on a Unico UV-2802PCUV-Vis Spectrophotometer. Absorbance at 652 nm was used for quantitative analysis. Scanning electron microscopy (SEM) images were taken by using an FEI XL30 ESEM FEG scanning electron microscope operated at 25 kV. Energy-dispersive X-ray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

**Determination of Hg<sup>2+</sup>.** A stock solution of Hg<sup>2+</sup> (0.1 mM) was prepared in distilled water and various concentrations of Hg<sup>2+</sup> were obtained by serial dilution of the stock solution. The colorless Au<sup>+</sup> solution was produced by mixing 1 mL of 3 mM H<sub>2</sub>AuCl<sub>4</sub>, 2 mL of 50 mM CTAB and 2.1 mL of 3 mM AA. For the detection of Hg<sup>2+</sup>, 100 μL of 1 mM TMB, 20 μL of prepared Au<sup>+</sup> solution and 10 μL of Hg<sup>2+</sup> 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 evaluate the selectivity of the proposed method, 100 μL of 1 mM TMB, 20 μL of prepared Au<sup>+</sup> solution and 10 μL of 100 μM of 11 kinds of metal cations including Ca<sup>2+</sup>, Cd<sup>2+</sup>, Co<sup>2+</sup>, Mg<sup>2+</sup>, Mn<sup>2+</sup>, Ni<sup>2+</sup>, Pb<sup>2+</sup>, Zn<sup>2+</sup>, Cu<sup>2+</sup>, Fe<sup>3+</sup>, Ag<sup>+</sup> and 10 μL of 10 μM Hg<sup>2+</sup> were added

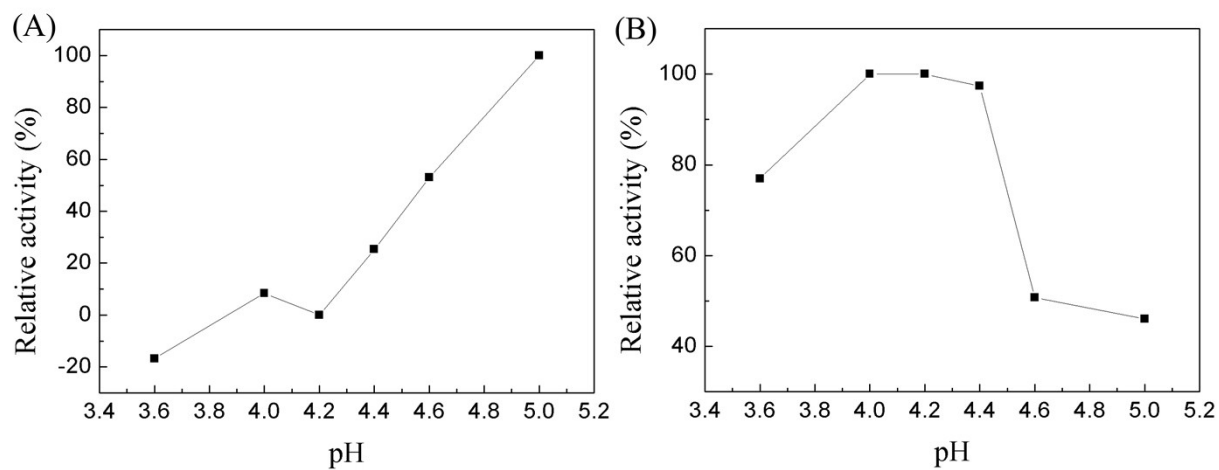
sequentially in 370  $\mu\text{L}$  of 50 mM NaAc buffer solutions (pH 4.2). Photographs and UV-vis spectroscopy were recorded after incubating for 5 min at RT.



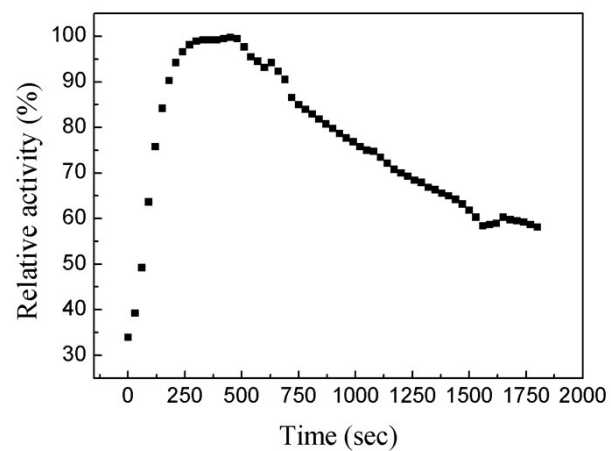
**Fig. S1.** EDX of in situ synthesized Au NPs.



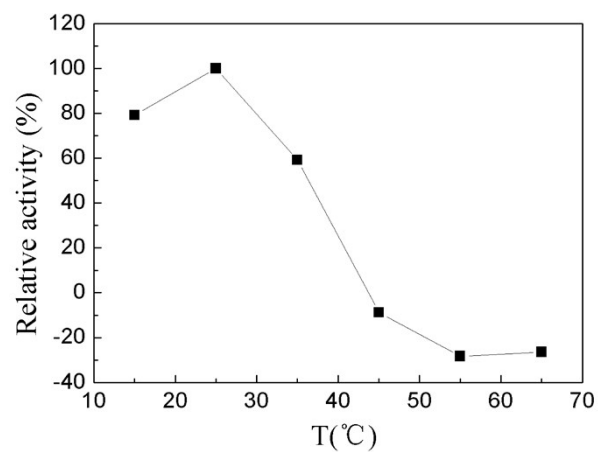
**Fig. S2.** Effect of pH on the  $\Delta A$ . 100  $\mu\text{L}$  of 1 mM TMB, 20  $\mu\text{L}$  of  $\text{Au}^+$  solution, and 10  $\mu\text{L}$  of 10  $\mu\text{M}$   $\text{Hg}^{2+}$  in 370  $\mu\text{L}$  50 mM of different pH NaAc buffer solution; incubation temperature, RT; incubation time, 5 min. The maximum point in curve was set as 100%. (Relative activity= $\Delta A/\Delta A_{\text{max}} \times 100\%$ )



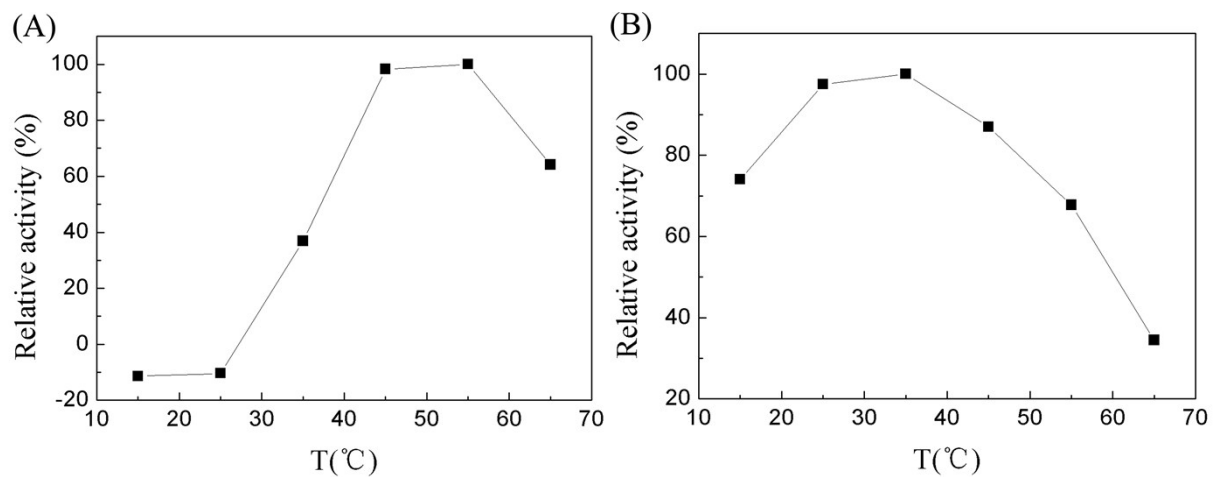
**Fig. S3.** Effect of pH on the (A)  $A_0$  and (B)  $A$ . 100  $\mu\text{L}$  of 1 mM TMB, 20  $\mu\text{L}$  of  $\text{Au}^+$  solution, and without and with 10  $\mu\text{L}$  of 10  $\mu\text{M}$   $\text{Hg}^{2+}$  in 370  $\mu\text{L}$  50 mM of different pH NaAc buffer solution; incubation temperature, RT; incubation time, 5 min. The maximum point in curve was set as 100%. (Relative activity= $A/A_{\text{max}} \times 100\%$ ).



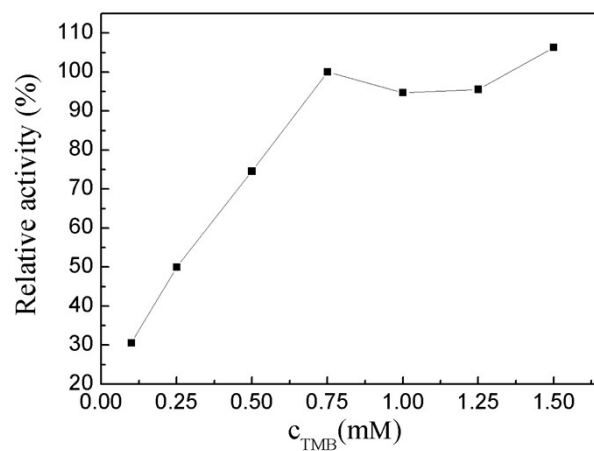
**Fig. S4.** Effect of reaction time on the  $\Delta A$ . 100  $\mu\text{L}$  of 1 mM TMB, 20  $\mu\text{L}$  of  $\text{Au}^+$  solution, and 10  $\mu\text{L}$  of 10  $\mu\text{M}$   $\text{Hg}^{2+}$  in 370  $\mu\text{L}$  50 mM pH 4.2 NaAc buffer solution; incubation temperature, RT. The maximum point in curve was set as 100%. (Relative activity= $\Delta A/\Delta A_{\text{max}} \times 100\%$ )



**Fig. S5.** Effect of incubation temperature on the  $\Delta A$ . 100  $\mu\text{L}$  of 1 mM TMB, 20  $\mu\text{L}$  of  $\text{Au}^+$  solution, and 10  $\mu\text{L}$  of 10  $\mu\text{M}$   $\text{Hg}^{2+}$  in 370  $\mu\text{L}$  50 mM pH 4.2 NaAc buffer solution; incubation time, 5 min. The maximum point in curve was set as 100%. (Relative activity= $\Delta A/\Delta A_{\text{max}} \times 100\%$ )

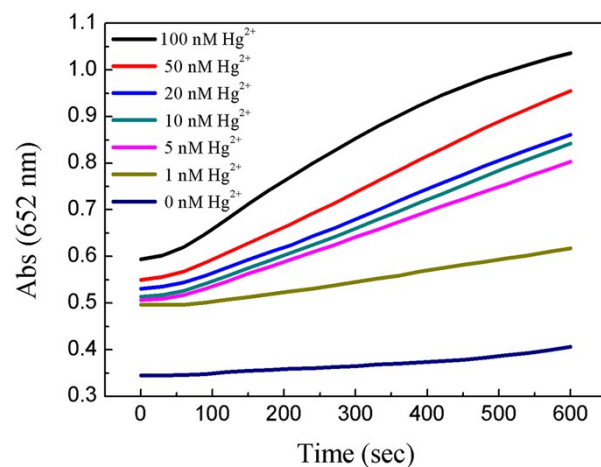


**Fig. S6.** Effect of incubation temperature on the (A)  $A_0$  and (B)  $A$ . 100  $\mu\text{L}$  of 1 mM TMB, 20  $\mu\text{L}$  of  $\text{Au}^+$  solution, without and with 10  $\mu\text{L}$  of 10  $\mu\text{M}$   $\text{Hg}^{2+}$  in 370  $\mu\text{L}$  50 mM pH 4.2 NaAc buffer solution; incubation time, 5 min. The maximum point in curve was set as 100%.  
(Relative activity= $A/A_{\text{max}} \times 100\%$ )



**Fig. S7.** Effect of the concentration of TMB on the  $\Delta A$  ( $\Delta\text{Abs}$ ). 100  $\mu\text{L}$  of different concentrations of TMB, 20  $\mu\text{L}$  of  $\text{Au}^+$  solution, and 10  $\mu\text{L}$  of 10  $\mu\text{M}$   $\text{Hg}^{2+}$  in 370  $\mu\text{L}$  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= $\Delta A/\Delta A_{\text{max}} \times 100\%$ )





**Fig. S8.** Time dependent absorbance changes of Au<sup>+</sup>-TMB detection system with different concentration of Hg<sup>2+</sup>. 100  $\mu$ L 1 mM TMB + 20  $\mu$ L Au<sup>+</sup> solution in 370  $\mu$ L 50 mM pH 4.2 NaAc buffer solution with different concentration of Hg<sup>2+</sup>; incubation temperature, RT.