Electronic SupplementaryInformation for

"Turn on" and pinhole-free ultrathin core-shell Au@SiO_2 nanoparticles-based metal-enhanced fluorescent chemodosimeter for Hg^{2+}

Ying Cui[ab#]&Shanji Fan[c#], Yunran Zhai [a] ,Yingjie Liu[c], Junhua Li[b], Jiawen Hu[a] and Lijia Wang[d]*

[a]Hunan Key Laboratory of Two-Dimensional Materials, Advanced Catalytic Engineering Research Center of the Ministry of Education, and College of Chemistry and Chemical Engineering, Hunan University, Changsha 410082, China

[b]Key Laboratory of Functional Metal-Organic Compounds of Hunan Province, College of Chemistry and Materials Science, Hengyang Normal University, Hengyang, 421001, PR China

[c]Department of Thyroid Breast Surgery, The First Afffliated Hospital of University of South China, Hengyang, 421001, China.

1. Quantification the metal-enhanced fluorescence at the presence of Au@SiO_2 NPs

To quantitatively estimate the fluorescence enhancement of the Au@SiO_2 NPs, their fluorescence enhancement factor (EF) is calculated using the following formula

$$\mathrm{EF} = \frac{F_S/N_S}{F_0/N_0}$$

Here, F_S and F_0 are the fluorescence intensities contributed by the fluorescence molecules adsorbed on Au@SiO_2 NPs (N_S) and free molecules in solution (N_0), respectively.N_A (~$5.94 \times 10^{15}$for Au@SiO_2 NPs) can be estimated by measuring the UV-Vis spectra for the fluorescence probe solution before and after theirimmobilization onto the Au@SiO_2 NPs (Fig. S1). N_0 (~1.3×10^{16})can be calculated by knowing the concentration of a bulk solution and its volume.

2. Supplementary Figures

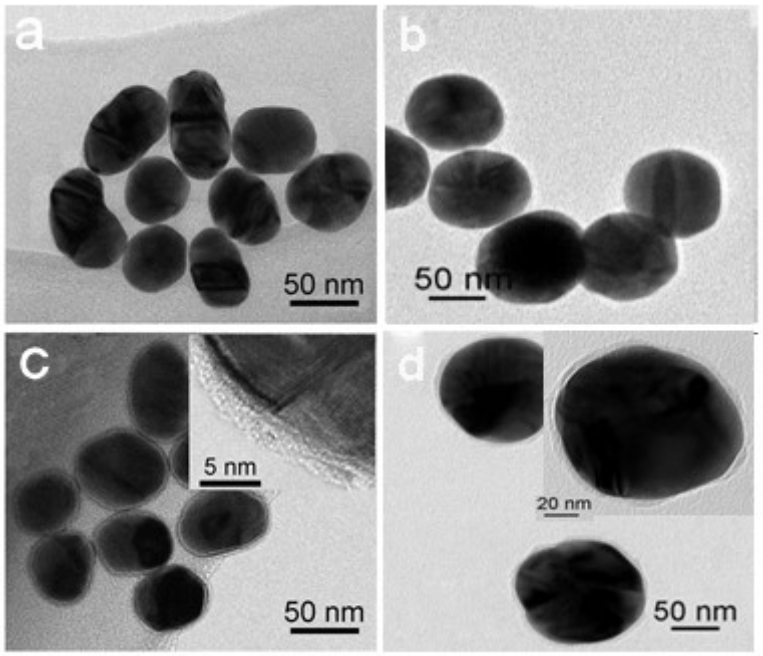

Fig. S1 TEM images for the (a) 55 and (b) 80 nm Au NPs and (c and d) their corresponding Au@SiO_2 NPs with an external 4-5 nm SiO_2 shell.

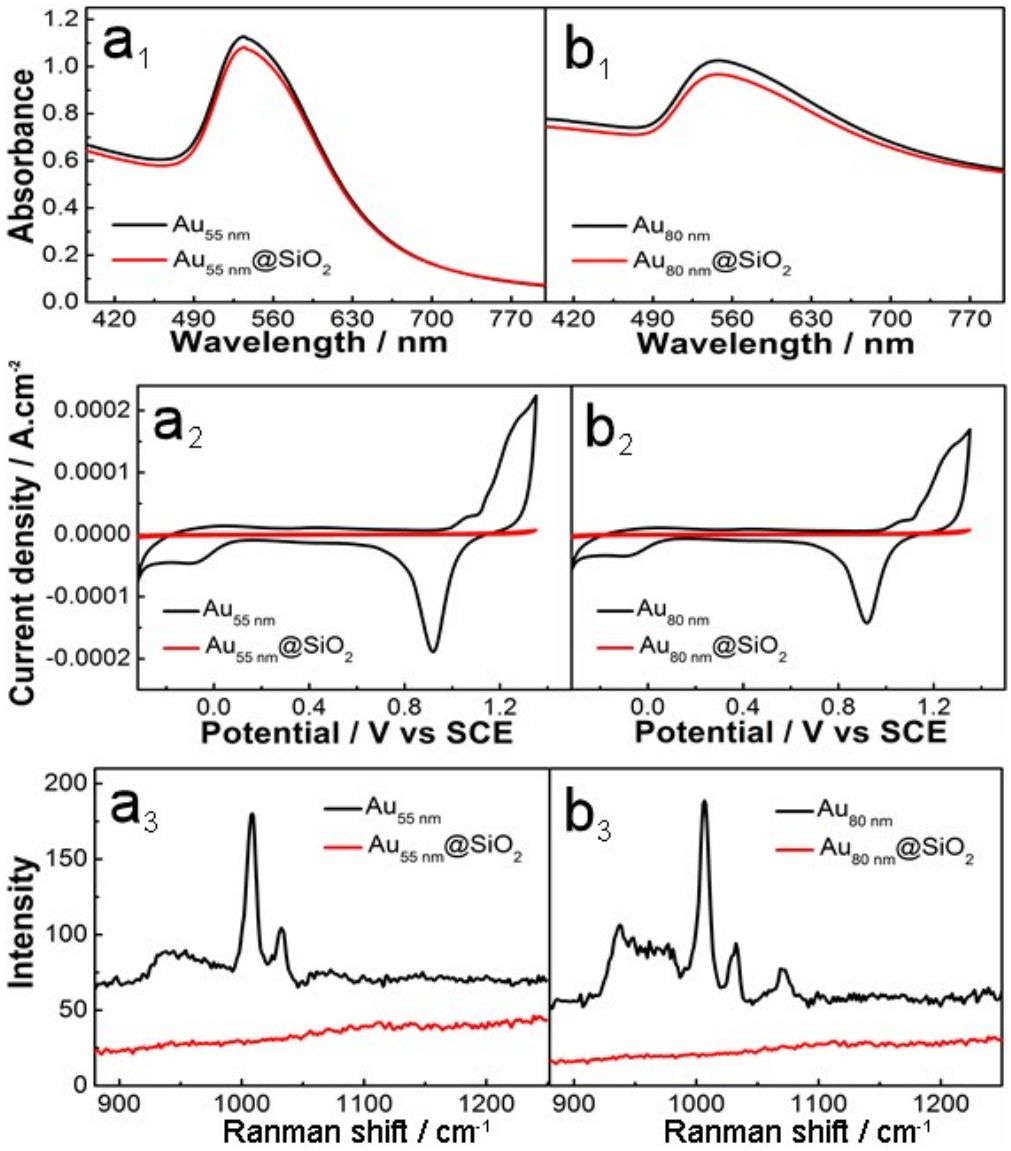

Fig. S2 UV-Vis spectra (a_1, b_1), cyclic voltammograms (a_2, b_2), and SERS spectra (a_3, b_3) of 55 nm Au NPs $Au_{55\ nm}@SiO_2$, the SERS spectra were obtained for a single 10 s accumulation The characterizations for $Au_{55\ nm}@SiO_2$ and $Au_{80\ nm}@SiO_2$ NPs using UV-vis spectra, in 0.5 M H_2SO_4 solution, scan rate: 0.1 V/s., and.

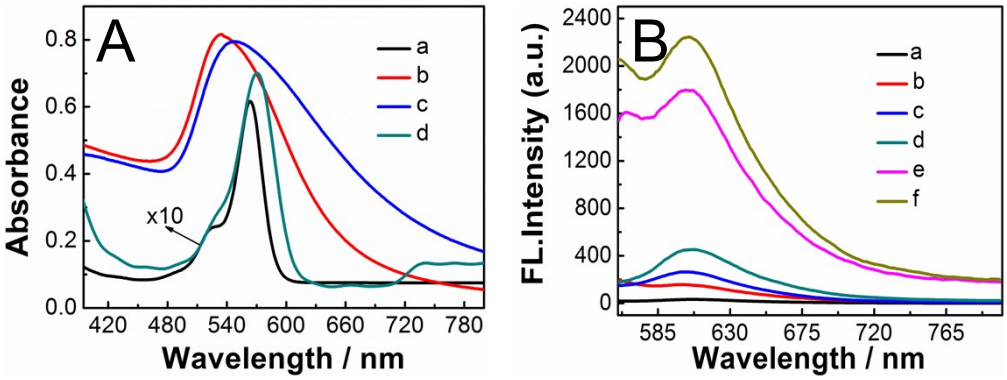

Fig. S3 (A) The UV-vis spectra for the 0.5 μM free fluorescence probe (a), $Au_{55\ nm}$@SiO_2 NPs (b), $Au_{80\ nm}$@SiO_2 NPs (c) and addition Hg^{2+} into free fluorescence probe (d), respectively. (B) The fluorescence spectra for free probe (a), fluorocore-labeled $Au_{55\ nm}$@SiO_2 probe (b), $Au_{80\ nm}$@SiO_2 probe (c) and the corresponding changes in fluorescence intensity after addition Hg^{2+} (d-f). The concentration of probe and Hg^{2+} are all 0.5 μM.

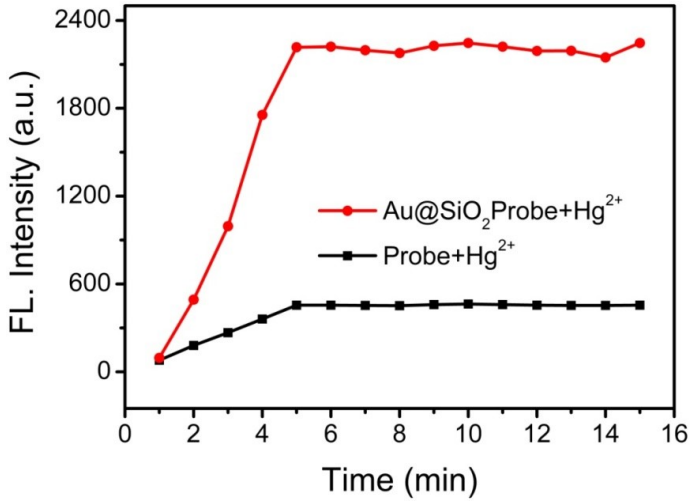

Fig. S4. Reaction time profiles of probe and Au@SiO_2 probe (0.5 μM) upon addition of 1 equiv Hg^{2+} in pH 7.4 PBS/EtOH (v/v, 7/3). Excitation at 560 nm.

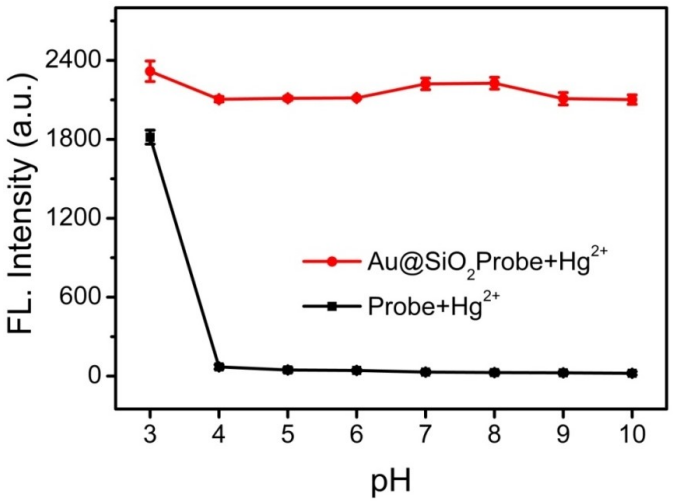

Fig. S5. Fluorescence intensity changes after additions of probe and $Au@SiO_2$ probe (0.5 μM) and Hg^{2+}(1.0 equiv). The mixture were kept for 10 min at room temperature before the fluorescence intensity of the probe solution was measured. Excitation at 560 nm.

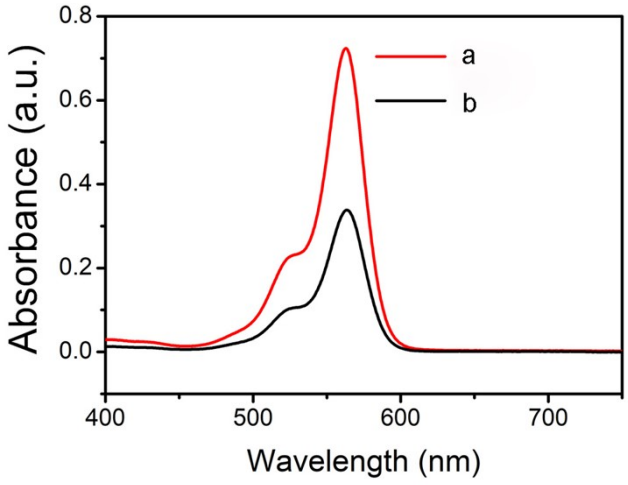

Fig. S6. UV-Vis spectra for the solution of the fluorescence probes(5 μM) before（a）and after（b）their immobilization onto the $Au@SiO_2$ NPs. For the later case, the $Au@SiO_2$ NPs were removed from the solution by centrifugation after immobilization of the fluorescence probes.

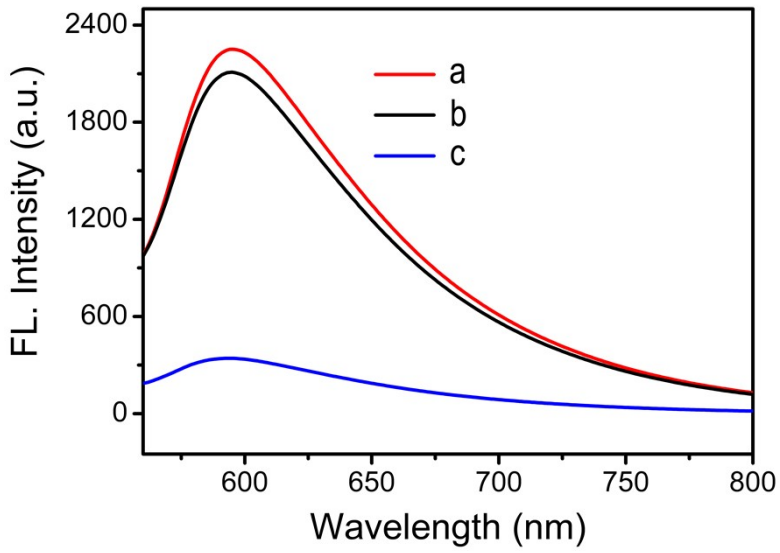

Fig. S7. Fluorescence spectra for the fluorophore-labeled Au@SiO_2 (a); Fluorescence spectra of Fluorescence spectra(b); Fluorescence intensity changes after additions of 1.0 equiv of the mixing solution with other heavy metal ions (Co^{2+}, Fe^{3+}, Cd^{2+}, Fe^{2+}, K^{+}, Cr^{2+}, Cu^{2+}, Pb^{2+}, Mg^{2+}, Ag^{+}, Ba^{2+}, Ni^{2+}) to the solution of Au@SiO_2 probe (0.5 μM) and Hg^{2+}(1.0 equiv)(c).

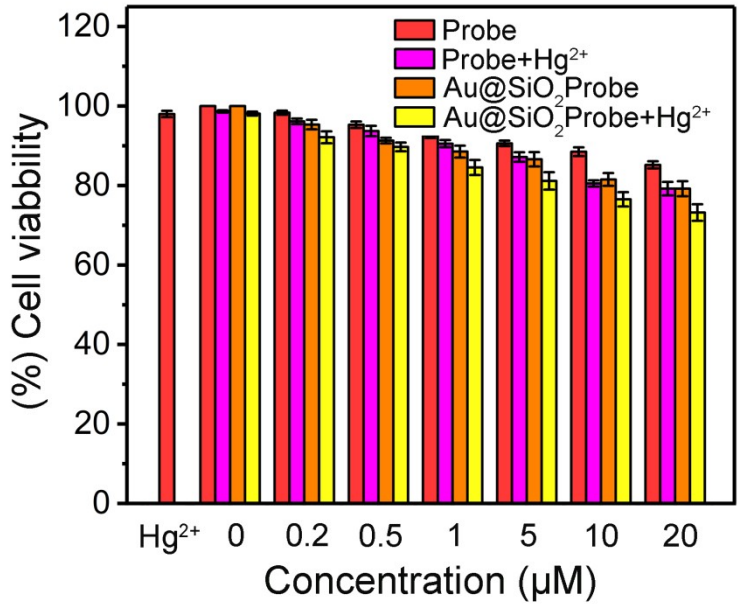

Fig. S8. Cytotoxicity assay of probe and Au@SiO_2 probe with 1.8 equiv Hg^{2+} at different concentrations for HCT116 Colon cancer cells.