Electronic Supplementary Information

Cu^{2+}-mediated turn-on fluorescent assay for sulfide ions using glutathione-protected gold nanoclusters: Enhanced sensitivity, good reusability, and cell imaging

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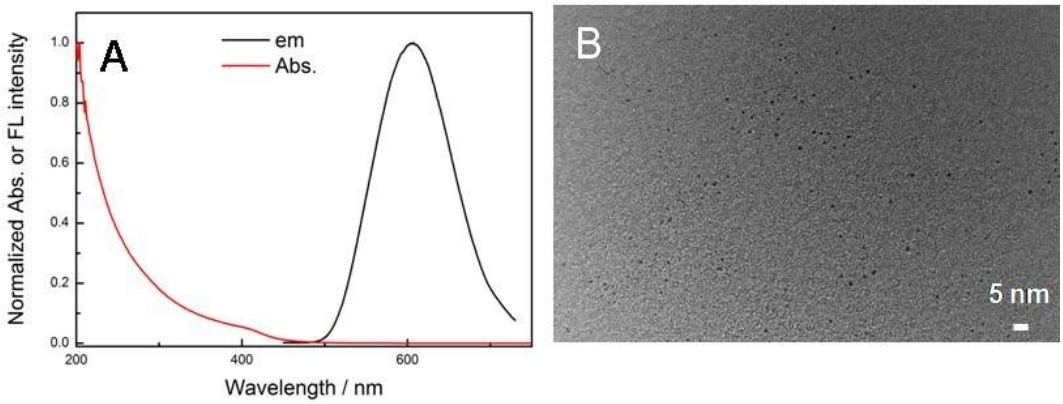

Fig. S1. (A) UV-vis absorption (red line) and fluorescence (black line) spectra of the GSH-Au NCs aqueous solution. (B) TEM image of the GSH-Au NCs.

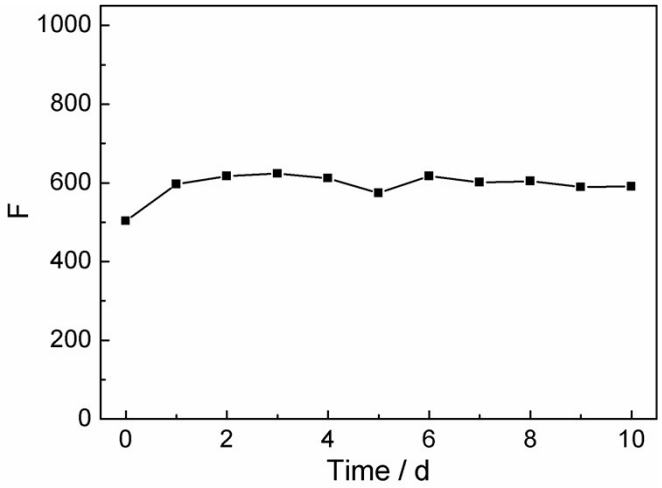

Fig. S2. The change of fluorescence intensities at 610 nm of the GSH-Au NCs stored at 4 °C within a few days.

Fig. S1A shows the optical property of the obtained Au NCs. It can be seen that there were a shoulder peak at 400 nm in the UV-vis absorption spectrum and a maximum emission peak at 610 nm upon 370-nm excatation in the fluorescence spectrum. The TEM image illustrated that the Au NCs were well dispersed and had an ultrasmall size with the mean diameter of 1.7 nm (Fig. S1B). In addition, the Au NCs were very stable stored at 4 °C, as shown in Fig. S2.

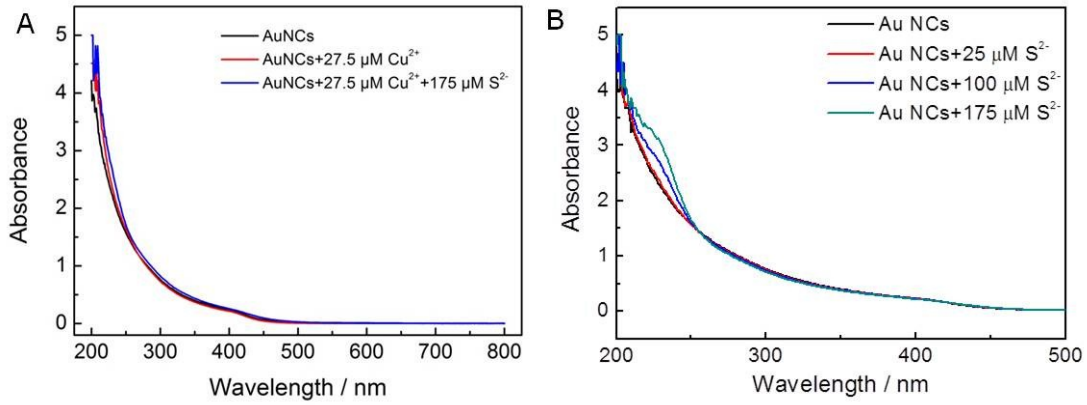

Fig. S3. UV-vis absorption spectra of the GSH-Au NCs (0.125 mg/mL, 2mL) at pH 7.4: (A) upon addition of Cu^{2+} followed by S^{2-}, and (B) upon addition of S^{2-}, respectively.

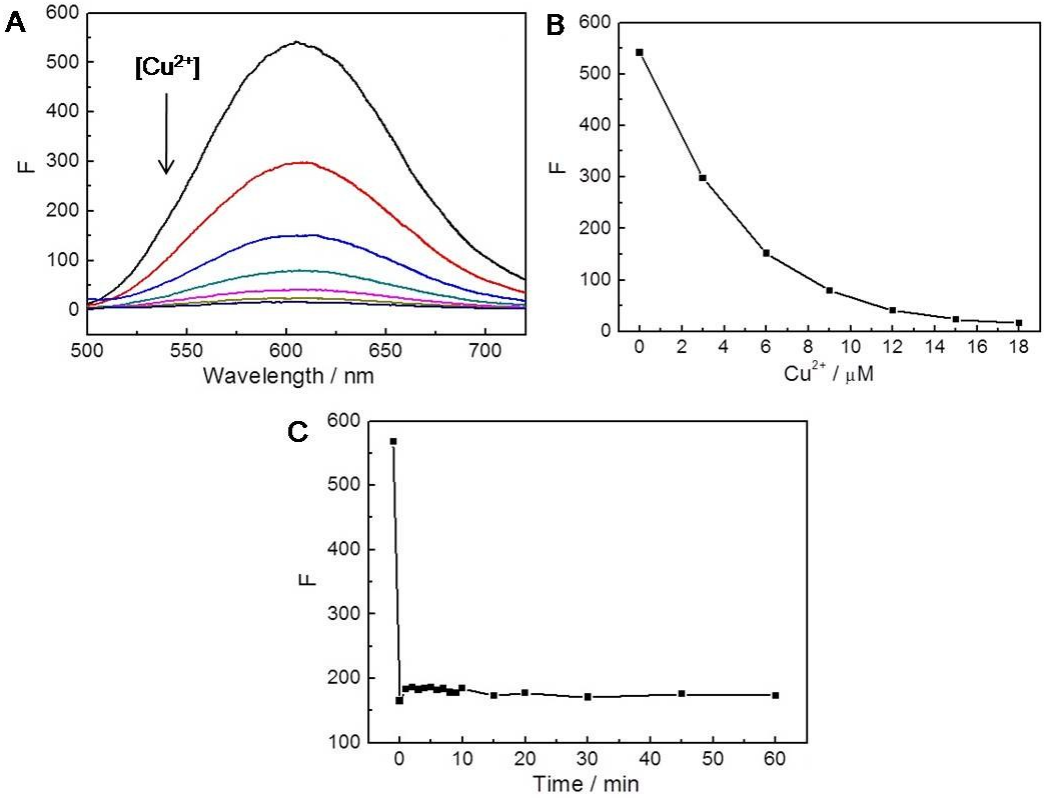

Fig. S4. (A) Fluorescence spectra of the Au NCs (0.125 mg/mL) upon addition of Cu^{2+} with different concentrations (0, 3, 6, 9, 12, 15, and 18 μM). (B) Changes of fluorescence intensities at 610 nm of the Au NCs as a function of Cu^{2+} concentrations. (C) Temporal profile of the fluorescence intensity at 610 nm of the Au NCs upon addition of Cu^{2+} (8 μM).

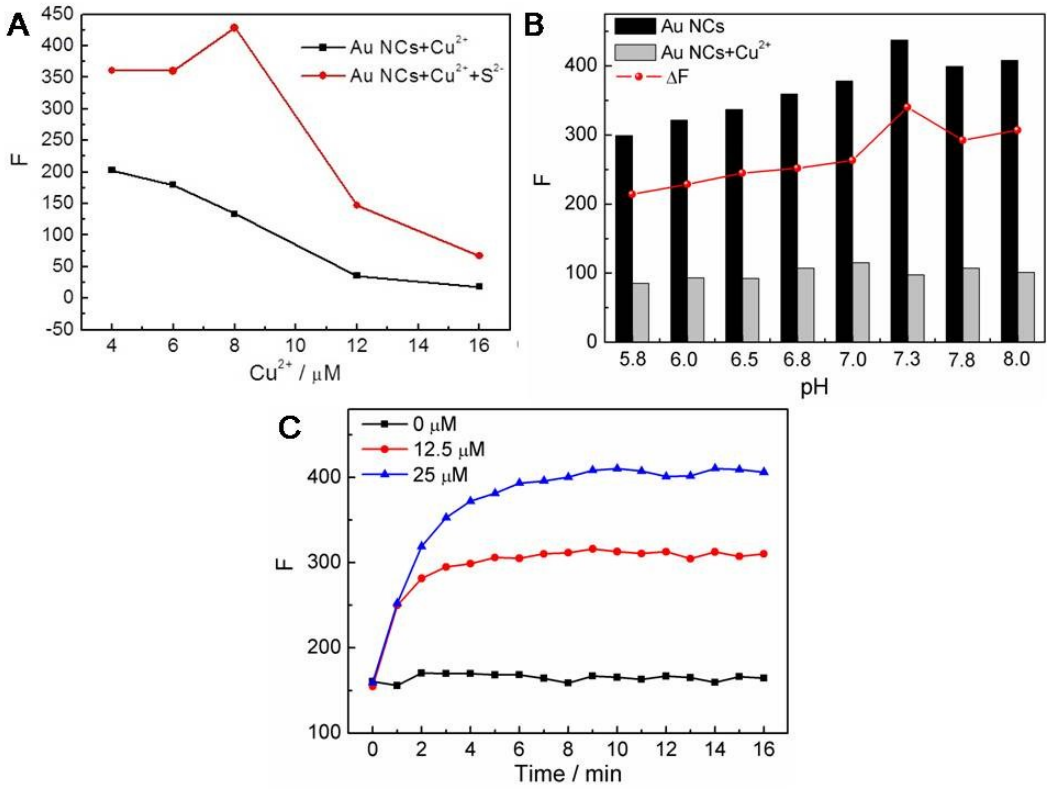

Fig. S5. (A) Changes of fluorescence intensity at 610 nm of the Au NCs by adding the same concentration of S^{2-} (25 μM) in the presence of various concentrations of Cu^{2+} (4, 6, 8, 12, and 16 μM). (B) The decrement of the fluorescence intensity at 610 nm of the GSH-Au NCs (0.125 mg/mL) under different pH values (5.8-8.0) after the addition of Cu^{2+} (8 μM). (C) Time dependence of the fluorescence intensity at 610 nm of the GSH-Au NCs-Cu^{2+} (8 μM) upon addition of different concentrations of S^{2-} (0, 12.5, 25 μM), respectively.

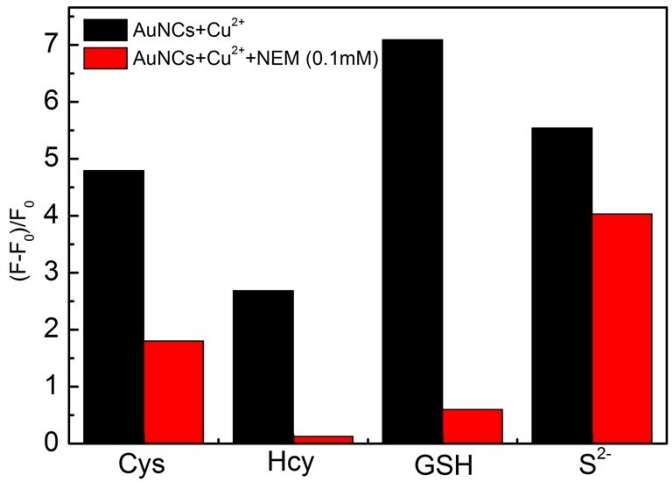

Fig. S6. Fluorescence enhancement ratio ($(F-F_0)/F_0$) at 610 nm of the GSH-AuNC-Cu^{2+} ensemble in the presence of Cys, Hcy, GSH, and S^{2-} (25 μM). F_0 and F are the maximum fluorescence intensities at 610 nm of the GSH-AuNC-Cu^{2+} solution in the absence and presence of tested substances, respectively. Black and red bars represent $(F-F_0)/F_0$ in the absence and presence of NEM, respectively.

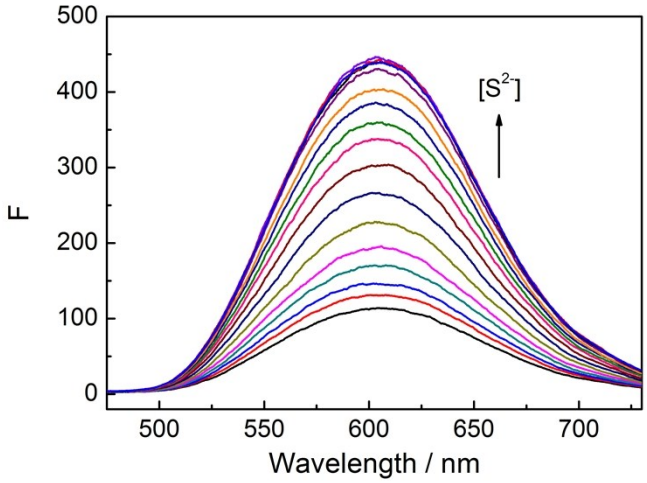

Fig. S7. Fluorescence spectra of the GSH-Au NCs-Cu^{2+} (8 μM) after adding S^{2-} with different concentrations (0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, and 32 μM).

Table S1 Comparison of sensing performance of recently reported fluorescence sensors for S^{2-}.

Sensor	Readout mode	Media	Linear range (μM)	LOD (μM)	Ref.
OPD	On	DMSO/H_2O(7:3)	1.0-30	0.052	15
FEPO	Off	H_2O/MeOH(99:1)	0-80	14	16
NBD-NH_2	On	CH_3CN/H_2O(9:1)	NA	NA	17
Fluorescein derivative	On	EtOH/H_2O(1:1)	2.5-1000	2.5	18
Penicillamine-Cu NCs	Off	H_2O	1-100	0.5	34
TSH-MUA-Au NCs	On	H_2O	0.5-157	0.5	35
Papain-Au NCs	Off	H_2O	0.5-80.0	0.38	36
Au@Ag NCs	Off	H_2O	0-700	0.3	37
PMAA–AgNCs	Off	H_2O	8.57-2290	6.10	38
GSH-Ag NCs	Off	H_2O	0.01-0.09, 0.1-1.5	0.002	39
Fluorescein derivative/ Cu^{2+}	On	H_2O/CH_3CN(1:1)	NA	NA	42
BINOL-Benzimidazole Ligands/Cu^{2+}	On	H_2O/DMF(4:1)	0-10	0.11	47
Rhodamine derivative/ Cu^{2+}	Off	CH_3CN/H_2O	NA	NA	48
Fluorescein-DPA conjugate/Cu^{2+}	On	H_2O	NA	0.42	49
Macrocyclic compound/Cu^{2+}	On	H_2O/CH_3OH(3:1)	NA	0.7	50
GSH-Au NCs/Cu^{2+}	On	H_2O	2-24	0.7	This work