Electronic Supplementary Material

Bacterial recombinant protein-directed synthesis of gold nanoclusters, and its application to paper based detection of mercury ions

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Synthesis of FabI@AuNCs

AuNCs@FabI are stable over several months as tracked by fluorescence measurement (data not shown). Briefly, the HAuCl₄ aqueous (1 mL, 4 mM) was added to FabI aqueous solution (1 mL, 27 mg·mL⁻¹) under vigorous stirring. Two minutes later, NaOH solution (0.2 mL, 1 M) was introduced, and the mixture was incubated at 37 °C for 12 hours. During the synthesis, the solution changes from colorless to pale brown, suggesting the formation of gold nanoparticles. Therefore, the solution after synthesis were dialyzed extensively with a 10 kDa cut-off dialysis bag against doubly distilled water for 24 h with a water change every 4 h to remove the residual NaOH and other salts. The products were freeze-dried and stored.
**Figure S1.** Molecular cloning and production of FabI recombinant protein. a. the map of the FabI-expressing plasmid. b. the SDS-PAGE of purified FabI (arrow).

**Figure S2.** The synthesis process of AuNCs@FabI was monitored using camera (a), SDS-PAGE (b) under UV light and the SDS-PAGE stained by Coomassie Blue (c). Arrow and arrow head point to the position of purified FabI protein before and after synthesis reaction, respectively. 1 and 2 depict for the purified FabI protein and FabI protein mixed with HAuAl₄.
Figure S3. The fluorescence intensity of the AuNCs@FabI was not affected by the presence of the different concentration of EDTA.

Figure S4. The fluorescence intensity of the AuNCs@FabI was not significantly affected by the pH of the assay system.
Figure S5. The relative fluorescent intensity at 627 nm in the absence or presence of metal ions (50 μM). a. To investigate the selectivity of the system, other divalent metal ions (Cu$^{2+}$, Pb$^{2+}$, Co$^{2+}$, Mn$^{2+}$, Ni$^{2+}$, Al$^{3+}$, Fe$^{3+}$, Ca$^{2+}$, Mg$^{2+}$, Zn$^{2+}$, and Fe$^{2+}$) were tested under the same condition. b. 1.0 mM of EDTA as a masking agent was incubated with the assay mixture. To investigate selectivity of the system, other divalent metal ions (Cu$^{2+}$, Pb$^{2+}$, Co$^{2+}$, Mn$^{2+}$, Ni$^{2+}$, Al$^{3+}$, Fe$^{3+}$, Ca$^{2+}$, Mg$^{2+}$, Zn$^{2+}$, and Fe$^{2+}$) as control were tested under the same condition.
Figure S6. A comparison of traditional spectroscopy and paper based approaches for the mercury ions detection concerning environmental samples (a). 1-8 refers to local tap water (1), and water samples (2-8) collected from lakes and rivers in Changchun city (see Figure S3b).