Electronic Supplementary Information

On-site, rapid and visual method for nanomolar Hg^{2+} detection based on the thymine-Hg^{2+}-thymine triggered "double" aggregation of Au nanoparticles enhancing the Tyndall effect

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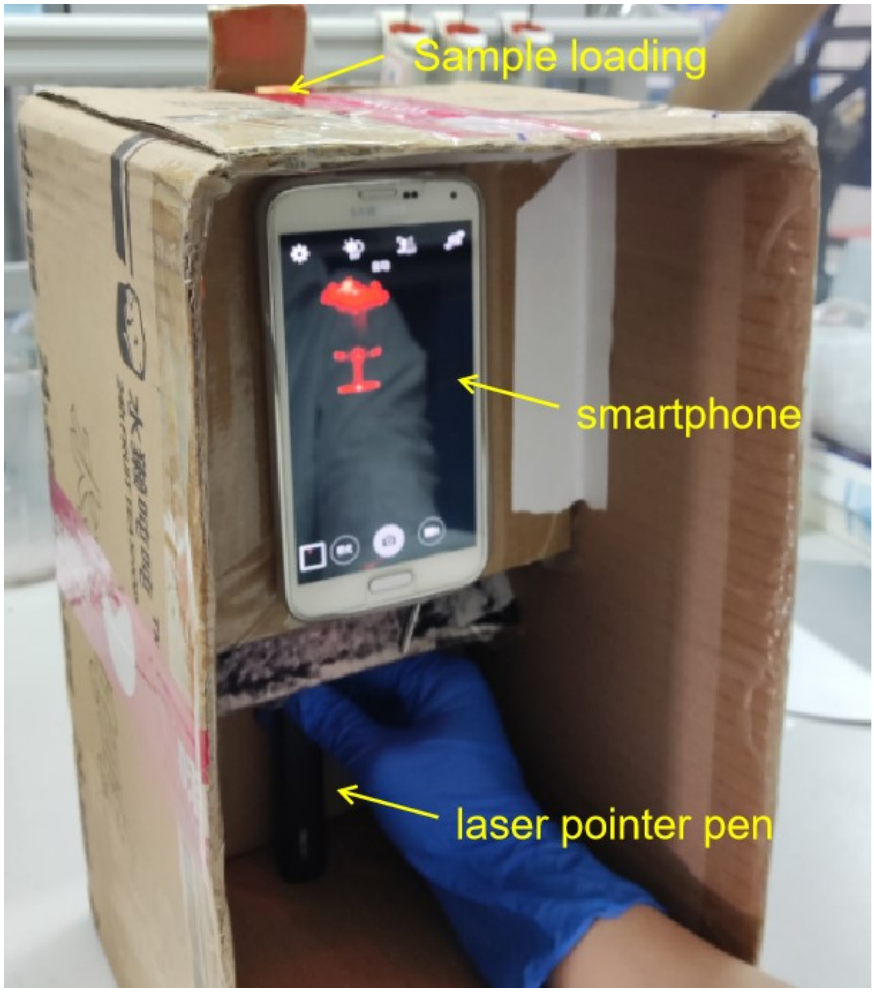

Fig. S1 The photograph of the home-made fully-enclosed device providing stable "black"environmental condition.

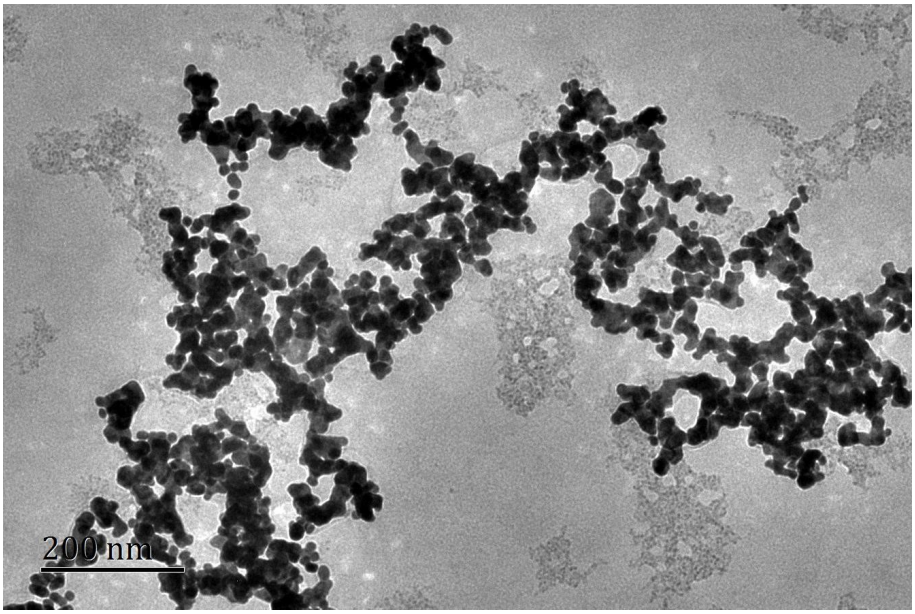

Fig. S2 Transmission electron microscope image obtained from the freshly-prepared AuNPs in the buffer containing 450 mM NaCl and three types of ssDNAs in the presence of 10 μM Hg^{2+}.

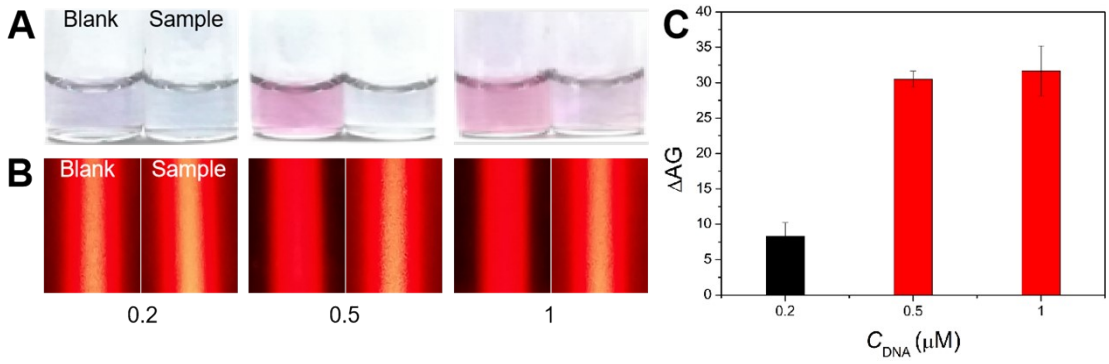

Fig. S3 (A) SPR-related colorimetric results obtained from the assays of 10 μM Hg^{2+} (right) and blank samples (buffer without the analyte; left) with different concentrations of the three types of ssDNAs (μM). Other experimental conditions: NaCl concentration, 450 mM; incubation time for the reactions between the ssDNA and Hg^{2+} sample, 10 min; time for the AuNPs' incubation, 0 min; incubation temperature, room temperature. (B) TE images recorded for the mixture solutions shown in (A). (C) AG changes (ΔAGs) between the Hg^{2+} samples and blank samples shown in (B). Each error bar represents a standard deviation across three replicate experiments. The results show that no significant difference was observed between the ΔAG values obtained with0.5 and 1.0 μM ssDNA. Therefore, the ssDNA level of 0.5 μM was chosen as the optimal concentration for all of the following experiments.

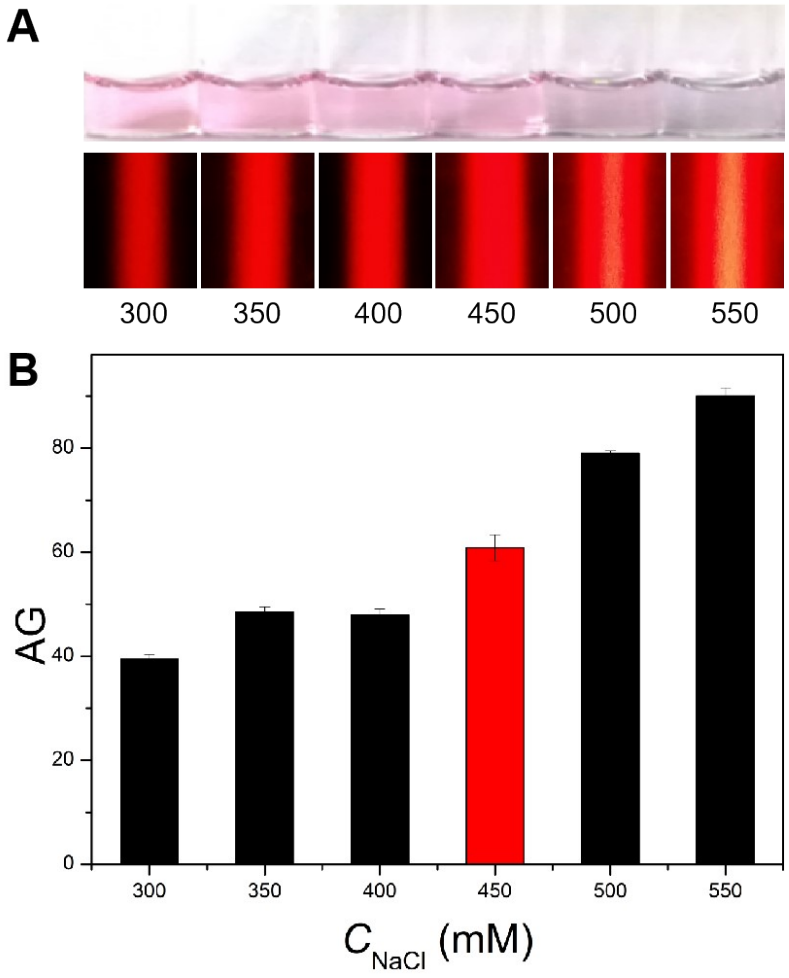

Fig. S4 (A) SPR-related colorimetric results (top) and TE images obtained from the reactions between the three types of ssDNAs (0.5 μM each) and the AuNPs in buffer containing different NaCl concentrations (mM). Other experimental conditions: incubation time for the reactions between the ssDNA and Hg^{2+} sample, 10 min; time for the AuNPs' incubation, 0 min; incubation temperature, room temperature. (B) AG values measured form the mixture solutions shown in (A). Each error bar represents a standard deviation across three replicate experiments. The results show that as the NaCl concentration increases, the degree of the AuNPs' aggregation increased and the TE intensity gradually increased. The AuNP solution was able to remain red (relatively dispersed) when the NaCl concentration reached 450 mM, which was chosen as the optimal concentration for all of the following experiments.

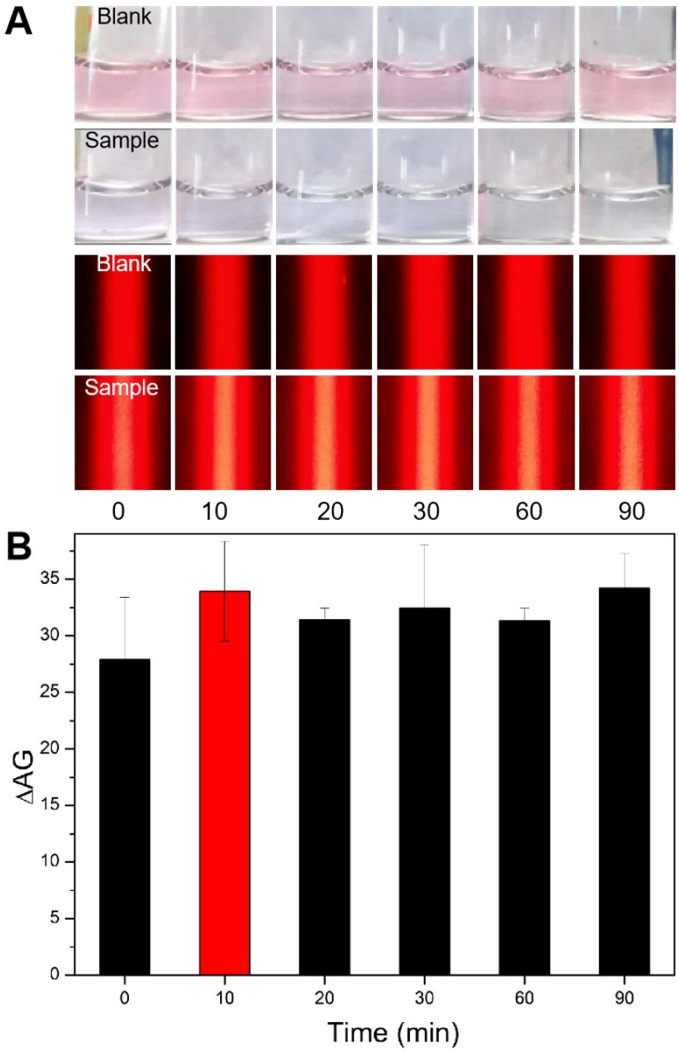

Fig. S5 (A) SPR-related colorimetric results (top) and TE results obtained from the assays of 10 μM Hg^{2+} and blank samples (buffer without the analyte) with different incubation time for the reactions between the ssDNA and Hg^{2+} sample (min). Other experimental conditions: ssDNA concentration, 0.5 μM; NaCl concentration, 450 mM; time for the AuNPs' incubation, 0 min; incubation temperature, room temperature. (B) AG changes (ΔAGs) between the Hg^{2+} samples and blank samples shown in (A). Each error bar represents a standard deviation across three replicate experiments. The results show that no significant ΔAG difference was observed when the incubation time increased to 10 min, which was thus chosen as the optimal condition for all of the following experiments.

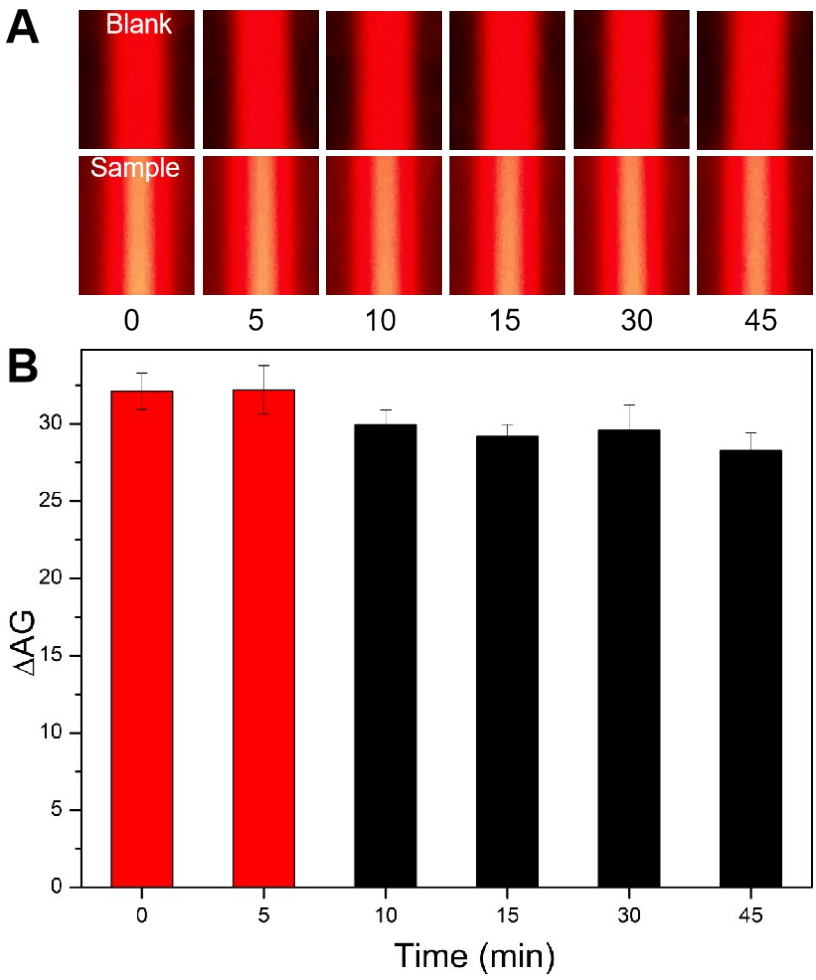

Fig. S6 (A) TE results obtained from the assays of 10 μM Hg^{2+} and blank samples (buffer without the analyte) with different time for the AuNPs' incubation (min). Other experimental conditions: ssDNA concentration, 0.5 μM; NaCl concentration, 450 mM; incubation time for the reactions between the ssDNA and Hg^{2+} sample, 10 min; incubation temperature, room temperature. (B) AG changes (ΔAGs) between the Hg^{2+} samples and blank samples shown in (A). Each error bar represents a standard deviation across three replicate experiments. The results show that the highest ΔAG values were achieved with the incubation time of 0 and 5 min. Thus, for all of the following experiments, the TE signal was immediately recorded after the mixing of AuNPs with each reaction solution of the ssDNA and Hg^{2+} sample.

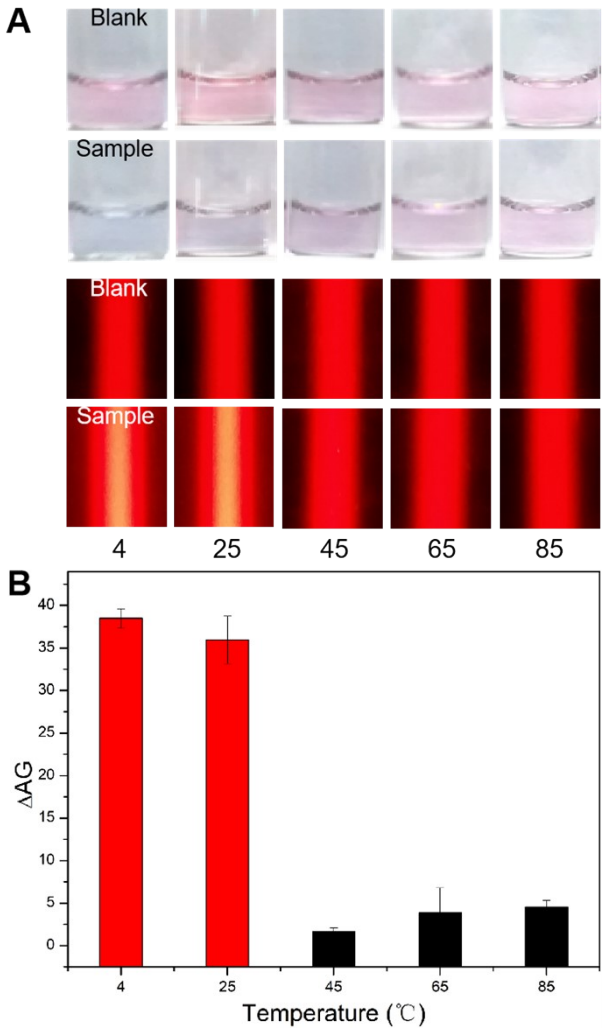

Fig. S7 (A) SPR-related colorimetric results (top) and TE results obtained from the assays of 10 μM Hg^{2+} and blank samples (buffer without the analyte) at different incubation temperatures (°C). Other experimental conditions: ssDNA concentration, 0.5 μM; NaCl concentration, 450 mM; incubation time for the reactions between the ssDNA and Hg^{2+} sample, 10 min; time for the AuNPs' incubation, 0 min. (B) AG changes (ΔAGs) between the Hg^{2+} samples and blank samples shown in (A). Each error bar represents a standard deviation across three replicate experiments. The results show that relatively high ΔAG values were achieved at the incubation temperatures of 4 and 25 °C. Thus, the room temperature of 25 °C was chosen as the optimal incubation temperature, as it was quite convenient for the experiment operation.

Table S1 Recovery of Hg^{2+} ions in several real water samples.

Sample	Found (nM)	Added (nM)	Total found (nM)	Recovery (%)	RSD[a] (%, *n*=3)
Tap water	0.00	500	536	107.19	6.46
	0.00	1500	1498	99.84	6.99
	0.00	2500	2609	104.37	1.37
Drinking water	0.00	500	529	105.88	6.64
	0.00	1500	1405	93.68	4.75
	0.00	2500	2552	102.07	0.85
Pond water	0.00	500	544	108.71	5.91
	0.00	1500	1545	103.01	1.86
	0.00	2500	2642	105.69	2.53

[a]RSD, relative standard deviation.