Supporting information

Dual Mode Ultra-sensitive Detection of Nucleic Acids via An Aqueous "Seesaw" Strategy by Combining Aggregation-induced Emission and Plasmonic Colorimetry

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Synthesis of TPE-TA

TPE-TA was synthesized following our previous work.[1]

Synthesis of gold nanoparticle

Au NPs were synthesized and characterized according to the previous reports with minor modification.[2] Briefly, in a 250 mL round-bottom flask equipped with a condenser, 1 mL 1% (w/v) HAuCl4 was brought to 99 ml deionized water, the mixtures was heated to boiling under intense stirring. A quick addition of 3.5 mL of 1% (w/v) sodium citrate to the vortex of the solution resulted in a color change from pale yellow to burgundy. The boiling was continued for 30 min and then the heating mantle was removed, after that, stirring was continued for an additional 15 min. After the solution reached the room temperature, it was filtered through a 0.22 μm Gelman membrane filter. The size of the resulting colloidal AuNPs was inspected by UV-vis spectroscopy with an absorption band around 518 nm (corresponding to particle diameter ~15 nm).

Sequence of DNA for selectivity test.

Target:AGTCTAGGATTCGGCGTGGGTTAA

delete:AGTCTAGGATTCG_CGTGGGTTAA

insert:AGTCTAGGATTCAGGCGTGGGTTAA

random: TCCATGACGTTCCTGACGTTGCAT

mismatch(1):AGTCTAGGATTAGGCGTGGGTTAA

mismatch(2):AGTCTAAGATTCGGCGTGGGTTAA

mismatch(3):AGTCTAGGATTCGGCGTGAGTTAA

TEM characterization:

Two samples that were protected with medium DNA density were prepared. One was incubated with 0.5 μM TPE-TA while the other was incubated with 5 μM one. After 5 min incubation, two samples were drop-casted on the copper grids for TEM characterization.

Calculation of limit of detection:

The calculation of limit of detection is based on a signal-to-noise approach. Briefly, the linear relation between target concentration and fluorescence intensity can be described as following:

$$y = ax + b$$

where a is the calibrated slope, b is intercept, x is the concentration of target and y is the measured fluorescence signal. For the calculation of LOD, where the value of y is defined as $y=y_{(blank)}+3*SD$, where SD is the standard deviations of $y_{(blank)}$. Then the calculated x is used as the LOD value.

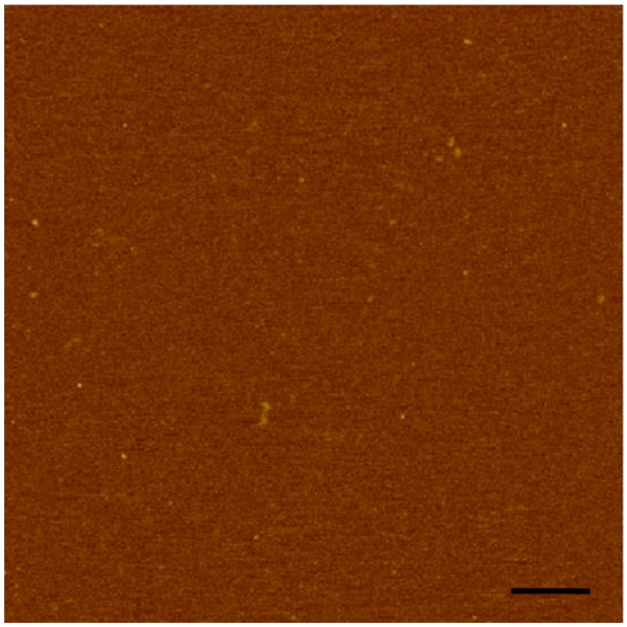

Figure S1. AFM image of H1 and H2 mixtures. The scale bar is 100 nm.

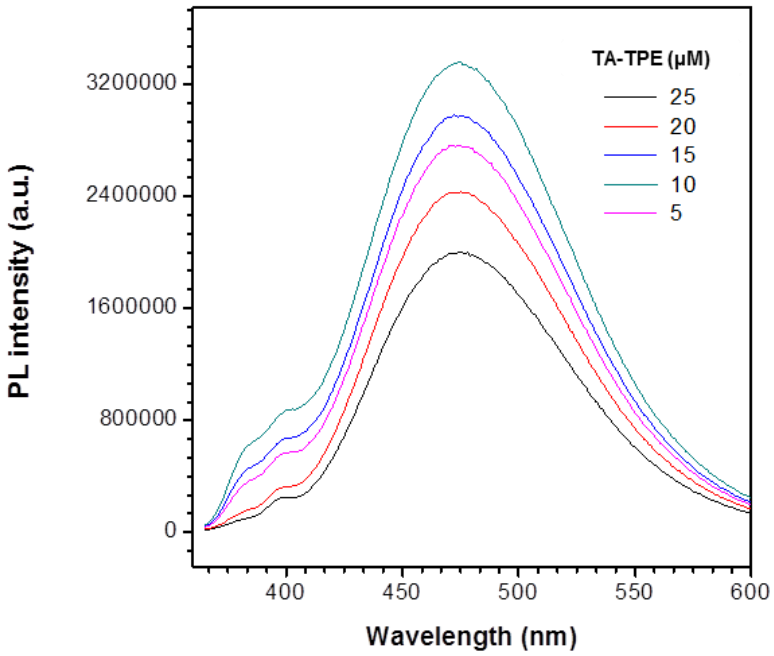

Figure S2. PL spectra of HCR products mixed with different amount of TPE-TA.

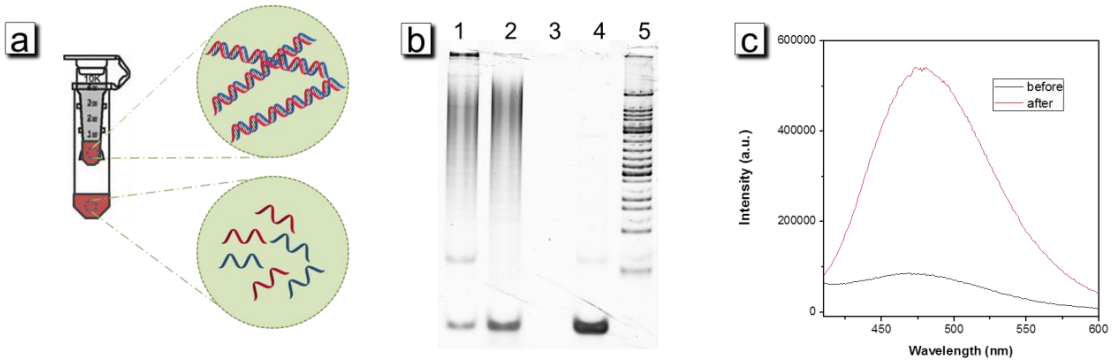

Figure S3. The effects of ultrafiltration operation in removing the un-reacted H1 and H2. a) The schematic illustration of the operation mechanism. b) The gel electrophoresis characterization of DNA before and after ultrafiltration operation. Lane 1 and lane 2 are the HCR products after (1) and before (2) ultrafiltration, lane 3 and lane 4 are mixture of H1 and H2 after (3) and before (4) ultrafiltration, lane 5 is DNA marker. c) PL spectra of H1 and H2 mixture before and after ultrafiltration.

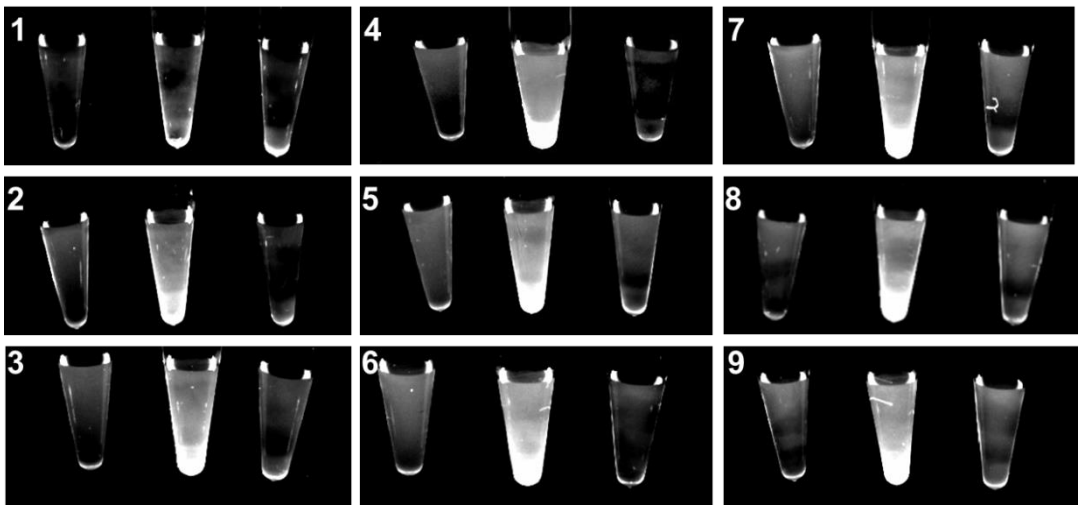

Figure S4. The optimization of TPE-TA concentration to achieve the best signal-to-noise ratio. In each figure, from left to right, were the solution of PBS buffer, HCR product and mixture of H1 and H2, respectively. Each tube was added with the same amount of TPE-TAs. From 1 to 9, the concentration is 1, 2, 3, 4, 5, 7, 8, 9, 10 μM, respectively.

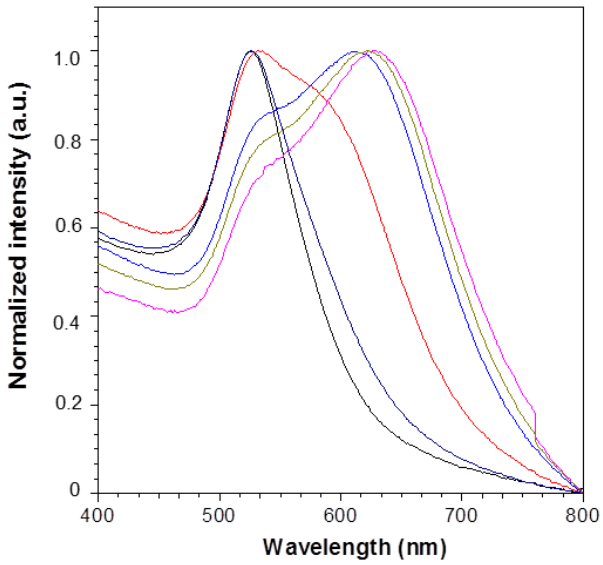

Figure S5. UV-vis spectra of Au NPs solution passivated with medium DNA density in the existence of different amount of TPE-TA. From left to right, the concentration of TPE-TA is 0.5, 1, 2, 3, 4, 5 μM, respectively.

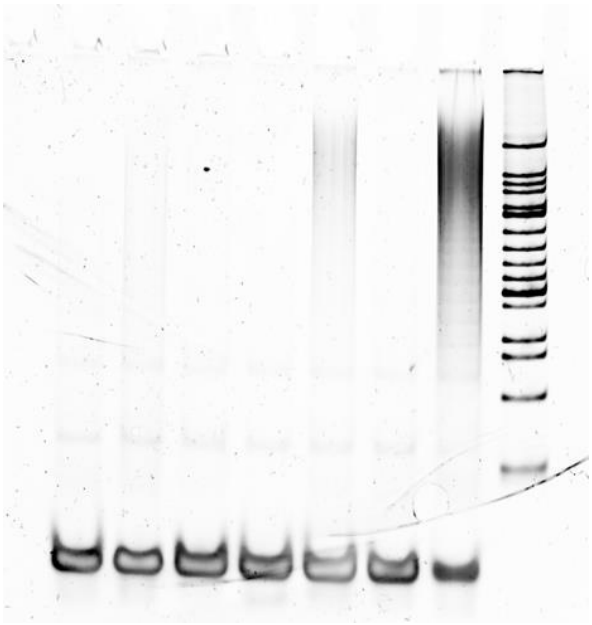

Figure S6. The gel electrophoresis results to illustrate the selectivity of the detection system. From left to right were added with mismatch (3), mismatch(2), mismatch(1), random, insert, delete, target and marker.

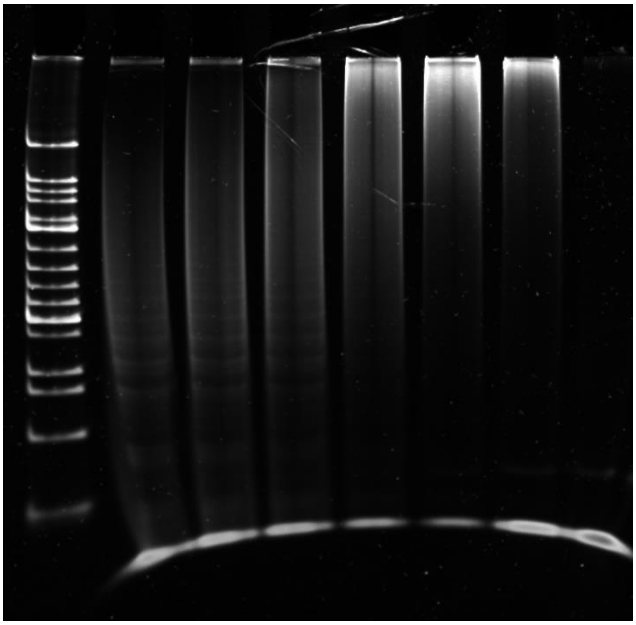

Figure S7. Gel electrophoresis analysis of MicroRNA triggered HCR. The lane from left to right represent target concentration at 2, 1, 0.5, 0.25, 0.125, 0.0625 and 0 nM, respectively.

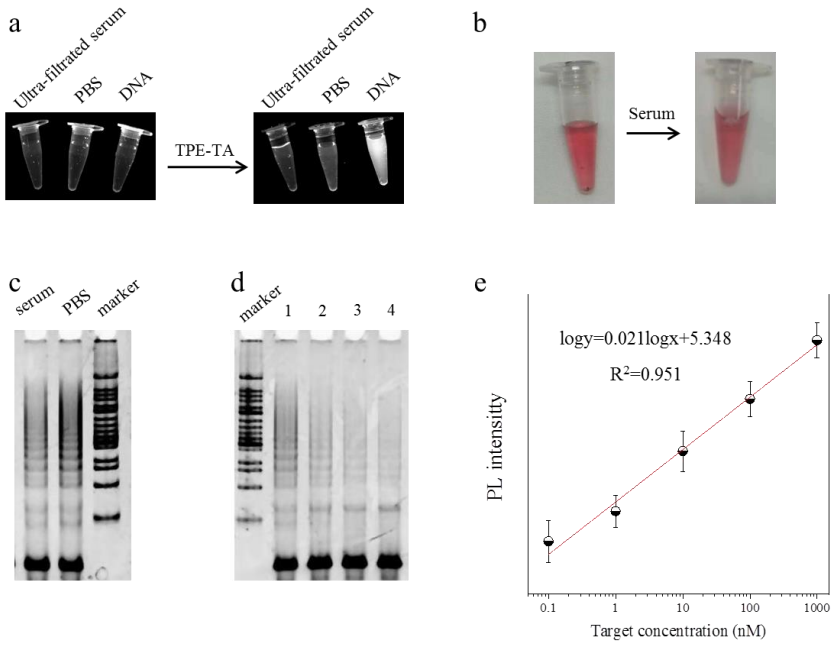

Figure S8. Detection of target DNA in serum. a) The investigation of the fluorescence signal of different solutions before and after adding TPE-TA. b) Stability test of DNA protected Au NPs in serum. c) Gel electrophoresis result of HCR products conducted in filtered serum and PBS. d) Gel electrophoresis results of HCR products initiated with different amounts of target DNA. lane 1, 1μM; lane 2, 500 nM; lane 3; 250 nM; lane 4, 125 nM. e) Plots of fluorescence intensities against target DNA concentration in filtered serum.

Reference:

(1) Y. Hong, H. Xiong, J. W. Y. Lam, M. Häußler, J. Liu, Y. Yu, Y. Zhong, H. H. Y. Sung, I. D. Williams, K. S. Wong, B. Z. Tang. Fluorescent Bioprobes: Structural Matching in the Docking Processes of Aggregation-Induced Emission Fluorogens on DNA Surfaces *Chem.-Eur. J.* **2010**, *16*, 1232-1245.

(2) Grabar, K. C.; Freeman, R. G.; Freeman, G.; Hommer, M. B.Preparation and Characterization of Au Colloid Monolayers. *Anal. Chem*. **1995**, *67*, 735-743.