Supporting Information

High-resolution and Universal Visualization of Latent Fingerprints Based on Aptamer-functionalized Core–Shell Nanoparticles with Embedded SERS Reporters

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Experimental section

Calculation of the amount of LBA immobilized onto Au/pNTP/SiO$_2$ SERS nanoprobes
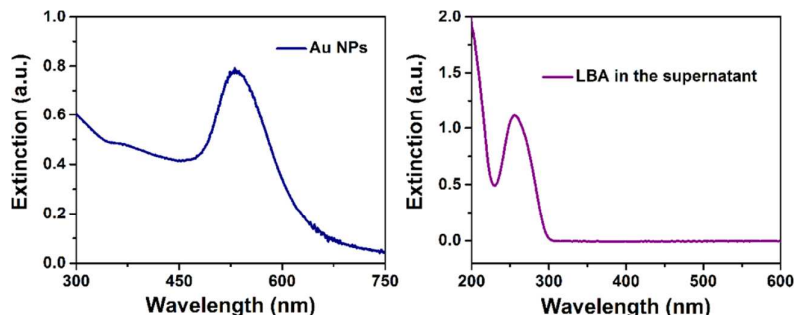

Figure S1 Extinction spectra of pure Au NPs (left) and lysozyme-binding aptamers in the supernatant (right).

The diameter and the plasmon peak of the obtained Au NPs respectively are 55.6 ± 3.0 and 525 nm, as determined by TEM and UV-vis spectroscopy. Thus, extinction coefficient (ε_{NP}) of Au NPs was estimated as:

$$\varepsilon_{NP} = 1.5 \times 10^{10} \ M^{-1}cm^{-1}$$

So, the concentration (C_{NP}) of Au NPs was calculated based on Lambert-Beer's Law and the absorbance in Fig. S0:

$$C_{NP} = \text{Absorbance}/(\varepsilon_{NP} \times \text{cuvette path length})$$

$$= 0.7808/(1.5 \times 10^{10} M^{-1}cm^{-1} \times 1cm) \ = 0.52 \times 10^{-10} M$$

Ulteriorly, the number of Au NPs (N_{NP}) in the solution was given by:

$$N_{NP} = C_{NP} \times \text{Solution Volume} \times \text{Avogadro's Constant}$$

$$= 0.52 \times 10^{-10} M \times 50 mL \times 6.02 \times 10^{23} mol^{-1} = 1.56 \times 10^{12}$$

If there was been no loss during the washing process, the number of Au/pNTP/SiO$_2$ SERS nanoprobes was also 1.56×10^{12}.

The number of LBA immobilized on Au/pNTP/SiO$_2$ SERS nanoprobes can be estimated by comparing the absorbance at 260 nm of the LBA solution before immobilization with that of the supernatant after immobilization. Extinction coefficient (ε_{LBA}) of LBA at 260 nm was calculated to be $5.5 \times 10^5\ M^{-1}cm^{-1}$ based on Lambert-Beer's Law. The number of LBA in the supernatant (N_{S-LBA}) after immobilization was calculated:

$$C_{S-LBA} = \text{Absorbance}/(\varepsilon_{LBA} \times \text{cuvette path length})$$

$$= 1.0898/(5.5 \times 10^5\ M^{-1}cm^{-1} \times 1cm) = 1.99 \times 10^{-6}M$$

$$N_{s-LBA} = C_{s-LBA} \times \text{Solution Volume} \times \text{Avogadro's Constant}$$

$$= 1.99 \times 10^{-6}M \times 2.4mL \times 6.02 \times 10^{23}mol^{-1} = 2.9 \times 10^{15}$$

While the total number of LBA in solution (N_{T-LBA}) before immobilization was calculated:

$$N_{T-LBA} = n_{T-LBA} \times \text{Avogadro's Constant}$$

$$= 5.6nmoL \times 6.02 \times 10^{23}mol^{-1} = 3.4 \times 10^{15}$$

Therefore, the number of LBA immobilized onto the Au/pNTP/SiO$_2$ SERS nanoprobes (N_{LBA}) was given by:

$$N_{LBA} = N_{T-LBA} - N_{s-LBA} = 3.4 \times 10^{15} - 2.9 \times 10^{15} = 5.0 \times 10^{14}$$

Finally, the number of LBA immobilized on per Au/pNTP/SiO$_2$ SERS nanoprobes (N) was estimated as:

$$N = N_{LBA}/N_{Np} = 5.0 \times 10^{14}/1.56 \times 10^{12} = 320$$

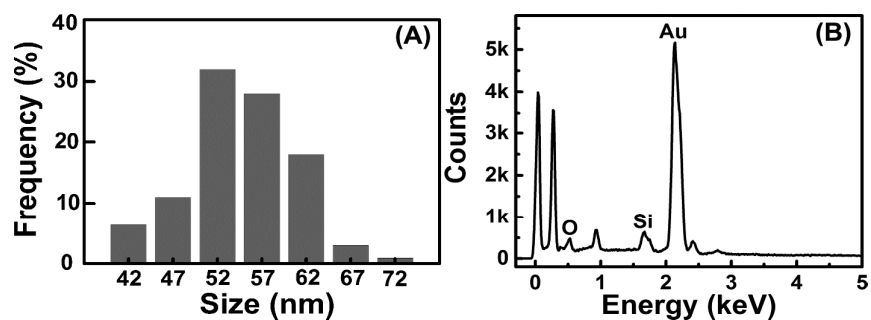(Confidence interval: 320 ± 43, n=3, p=0.87)

Figure S2. (A) Size-histogram of as-prepared Au NPs based on TEM measurement. 100 randomly chosen particles were analyzed. The diameter of each particle was estimated by determining the longest distance between two points at the edge. The resulting average size is about 55.6 nm, the standard deviation is 3.0 nm (B) EDS spectrum of the Au/pNTP/SiO$_2$ nanoparticles.
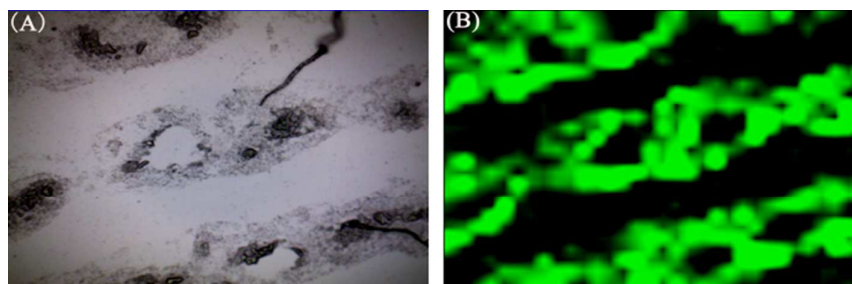

Figure S3. (A) The pattern of the fingerprint with the optical microscope. (B) The SERS imaging of the pattern of the fingerprint.
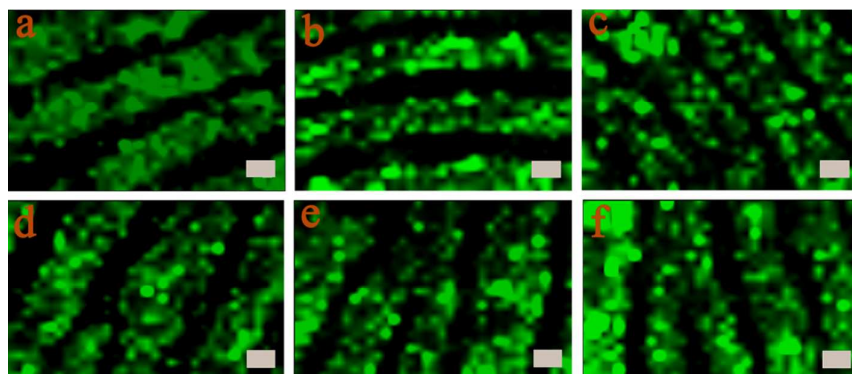
Figure S4. The SERS imaging of the pattern of the latent fingerprint (a-f) on the stainless steel surface using Au/pNTP/SiO$_2$-LBA nanoprobes. (Bar=150 μm).
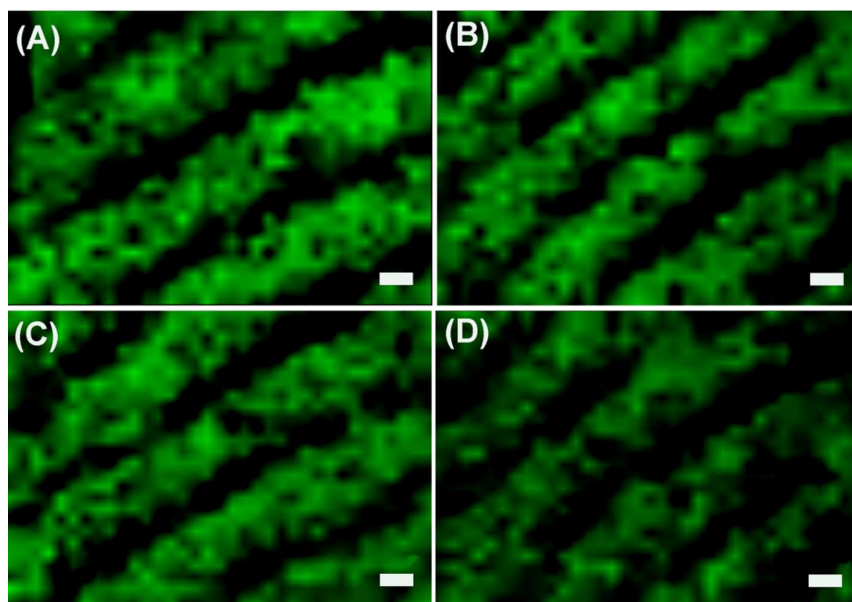

Figure S5. The SERS imaging of the pattern of the latent fingerprint (A-D) on the PVDF membrane surface using Au/pNTP/SiO$_2$-LBA nanoprobes. (Bar=150 μm).