Supplemental Information

Sandwich SERS detection system based on optical convergence and synergistic enhancement effects

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1. Characterization of the gap between adjacent nanoparticles

Table S1 Characterization results of the gap between adjacent nanoparticles

Distr./nm	Mean/nm	Amount	Freq.
1-1.5	1.25	0	0.00%
1.5-2	1.75	9	15.00%
2-2.5	2.25	10	16.67%
2.5-3	2.75	10	16.67%
3-3.5	3.25	11	18.33%
3.5-4	3.75	11	18.33%
4-4.5	4.25	3	5.00%
4.5-5	4.75	3	5.00%
5-5.5	5.25	3	5.00%
5.5-6	5.75	0	0.00%

We used the Nano Measurer software to count the size of 60 nanogaps, and the results are shown in the table above. Calculations show that the gap size between adjacent nanoparticles is about 3.1 nm.

2. The preparation of AgNPs.

In detail, 100 mL $AgNO_3$ aqueous solution (1 mM) was heated to boiling at reflux, and then 2 mL of trisodium citrate solution with a mass fraction of 1% was quickly added to it. After continuous boiling and stirring for about 30 minutes, the resultant yellow-green colloid indicates successful preparation of the silver nanosol. The prepared silver nanosol was cooled to room temperature, then placed in a brown bottle and stored in a refrigerator at 4°C until use.

3. The comparison test results of the PDMS microlens SERS substrate and the PDMS planar film SERS substrate.

Fig. S1 is the comparison test results of the PDMS microlens SERS substrate and the PDMS planar film SERS substrate. From which, calculating with the Raman intensity for R6G (1×10^{-7} M) at a 612 cm^{-1} peak, it is shown that the microlens increases the SERS intensity by around 1.85 times.

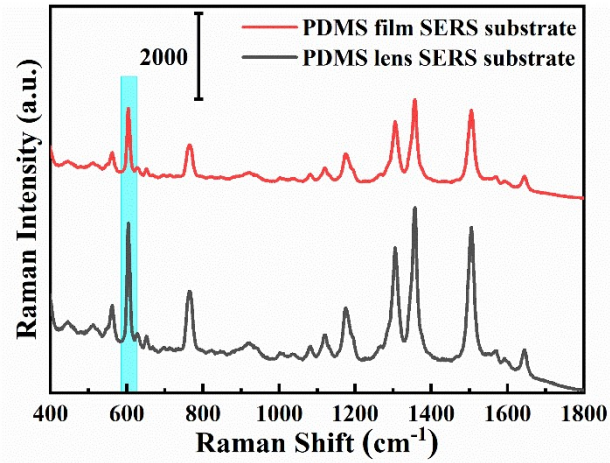

Fig. S1 Raman spectra of the R6G collected on the PDMS microlens and PDMS planar film SERS substrate.

4. Simulation results when using objective lenses with different numerical apertures.

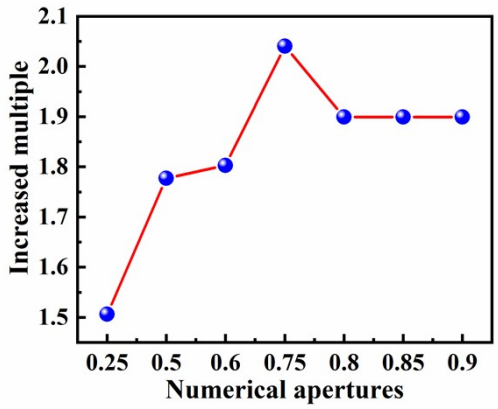

Fig. S2 Simulation results of the effect of the microlens when using objective lens with different numerical apertures.

5. The detection of R6G of different concentrations by using the microlens SERS substrate @ Au film system

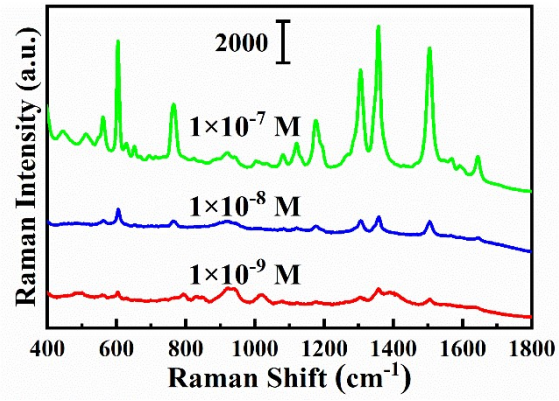

Fig. S2 SERS spectra of the R6G solution with different concentrations