Supplementary Information

Fabrication Optimization and Application of 3D Hybrid SERS Substrates

Xiaoyuan Geng,[a,b], Chen Wu[a,b], Siying Liu[a,b,d], Yu Han[a,b], Liang Song*[a,b,c] and Yun Zhang*[a,b,c,d]

[a] CAS Key Laboratory of Design and Assembly of Functional Nanostructures, and Fujian Provincial Key Laboratory of Nanomaterials, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, Fuzhou 350002, P. R. China.

[b] Xiamen Institute of Rare Earth Materials, Haixi Institute, Chinese Academy of Sciences, Xiamen Key Laboratory of Rare Earth Photoelectric Functional Materials, Xiamen 361021, P. R. China.

[c] Ganjiang Innovation Academy, Chinese Academy of Sciences, Jiangxi 341000, P. R. China.

[d] University of Chinese Academy of Sciences, Beijing 100049, P. R. China

E-mail: songliang@fjirsm.ac.cn and zhangy@fjirsm.ac.cn

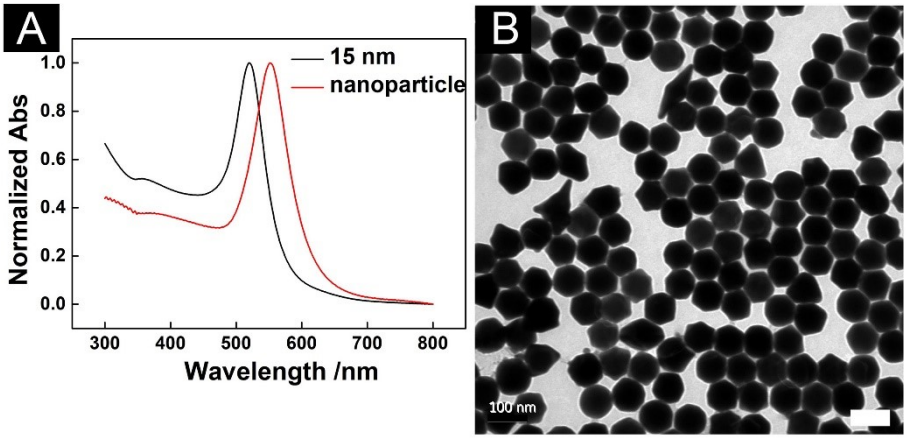

Fig. S1 (A) The UV-vis-IR absorption spectra of Au nanoparticles with sizes of 15.98 ± 0.64 nm (black) and 79.09 ± 3.28 nm (red). (B) TEM images of the Au nanoparticles with a size of 79.09 ± 3.28 nm. The scale bar is 100 nm.

Table S1. The nanogap spacing between nanoparticles of 2D substrates composed of AuNS of different diameters

AuNS size	15.98 ± 0.64 nm	29.82 ± 1.35 nm	45.68 ± 1.99 nm	54.67 ± 2.61 nm	64.76 ± 2.46 nm
Distance of nanogap	6.04 ± 1.28 nm	3.31 ± 1.04 nm	4.44 ± 1.06 nm	3.57 ± 0.82 nm	3.65 ± 0.70 nm

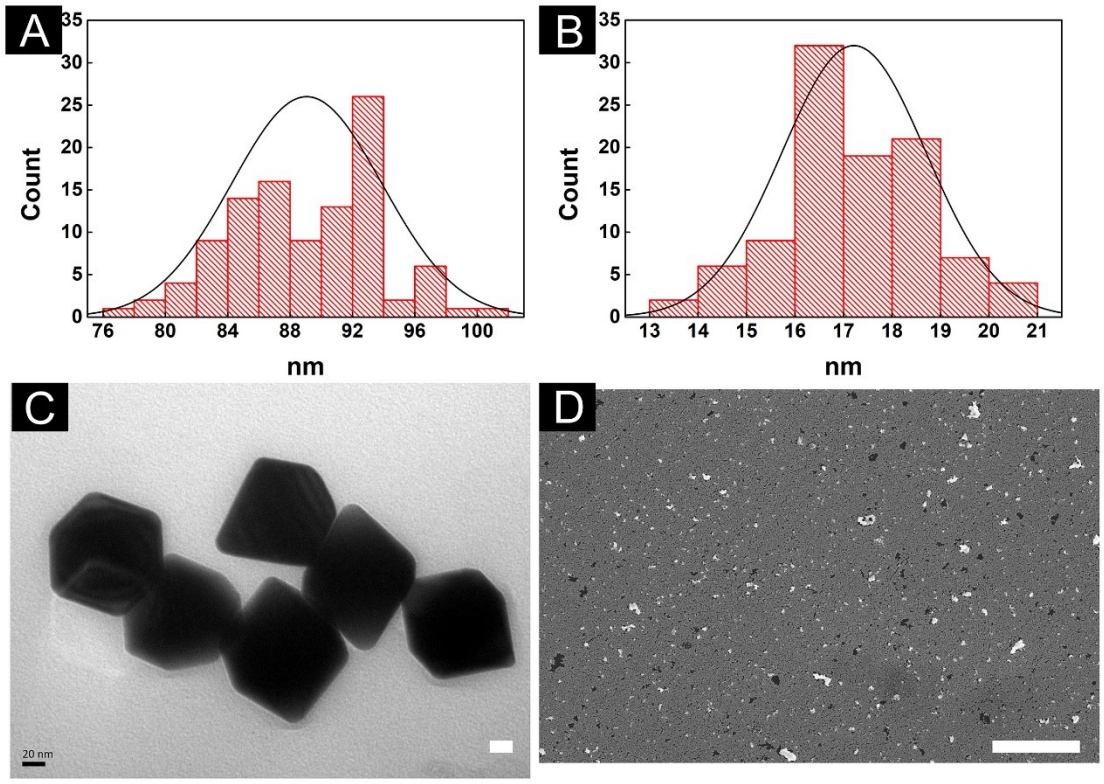

Fig. S2 (A) The distribution of the length of AuNR. (B) The distribution of the diameter of AuNR. (C) TEM of AuNO with the scale bar of 20 nm. (D) SEM of AuNO with the scale bar of 10 μm.

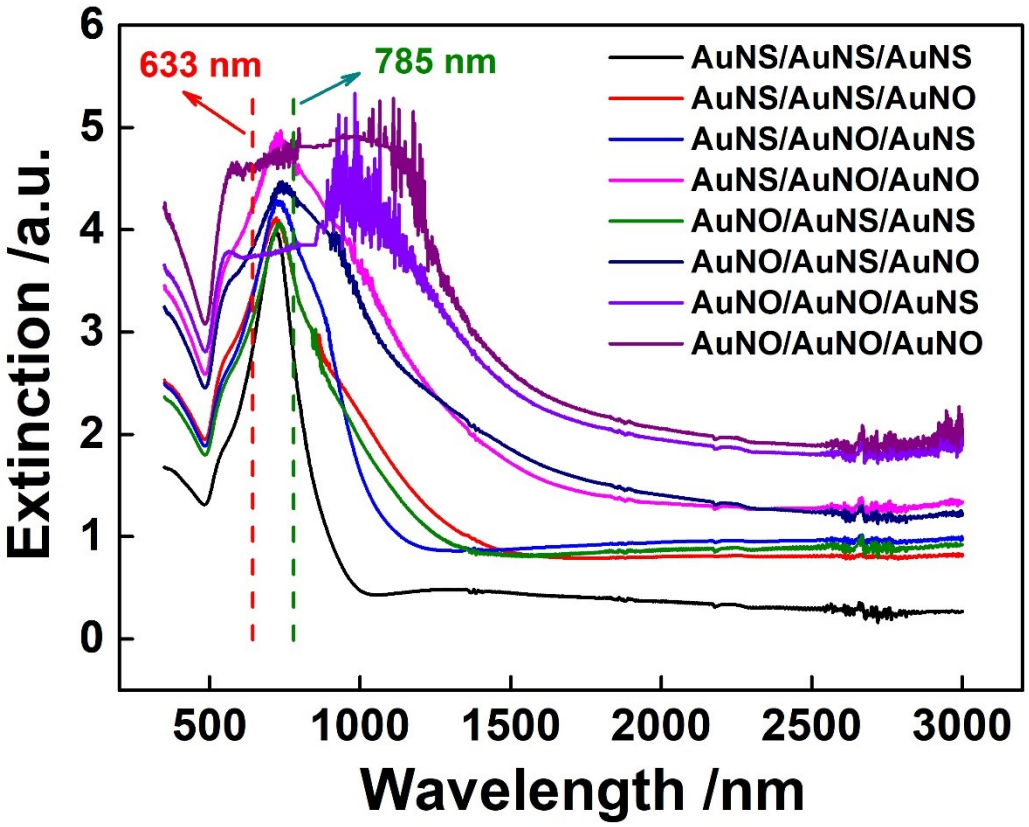

Fig. S3 The UV-Vis-NIR spectra of the substrates with different combination of (1) AuNS/AuNS/AuNS, (2) AuNS/AuNS/AuNO, (3) AuNS/AuNO/AuNS, (4) AuNS/AuNO/AuNO, (5) AuNO/AuNS/AuNS, (6) AuNO/AuNS/AuNO, (7) AuNO/AuNO/AuNS, (8) AuNO/AuNO/AuNO.

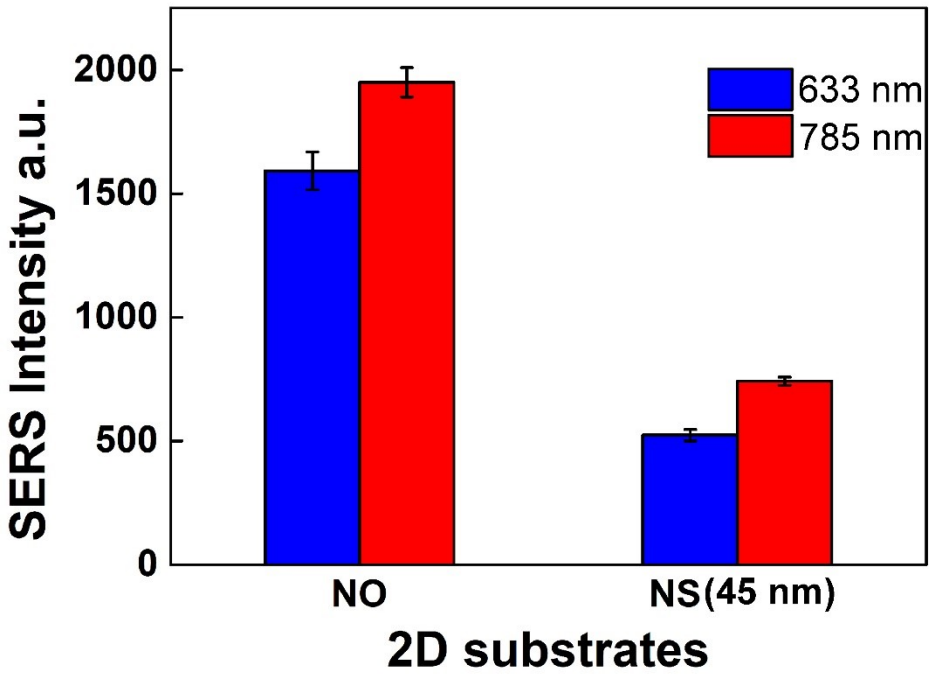

Fig. S4 Histogram of SERS intensity of monolayer AuNO and AuNS planar substrates. The SERS intensity at 1080 cm^{-1} of 4-MBA were used for comparing the performance.

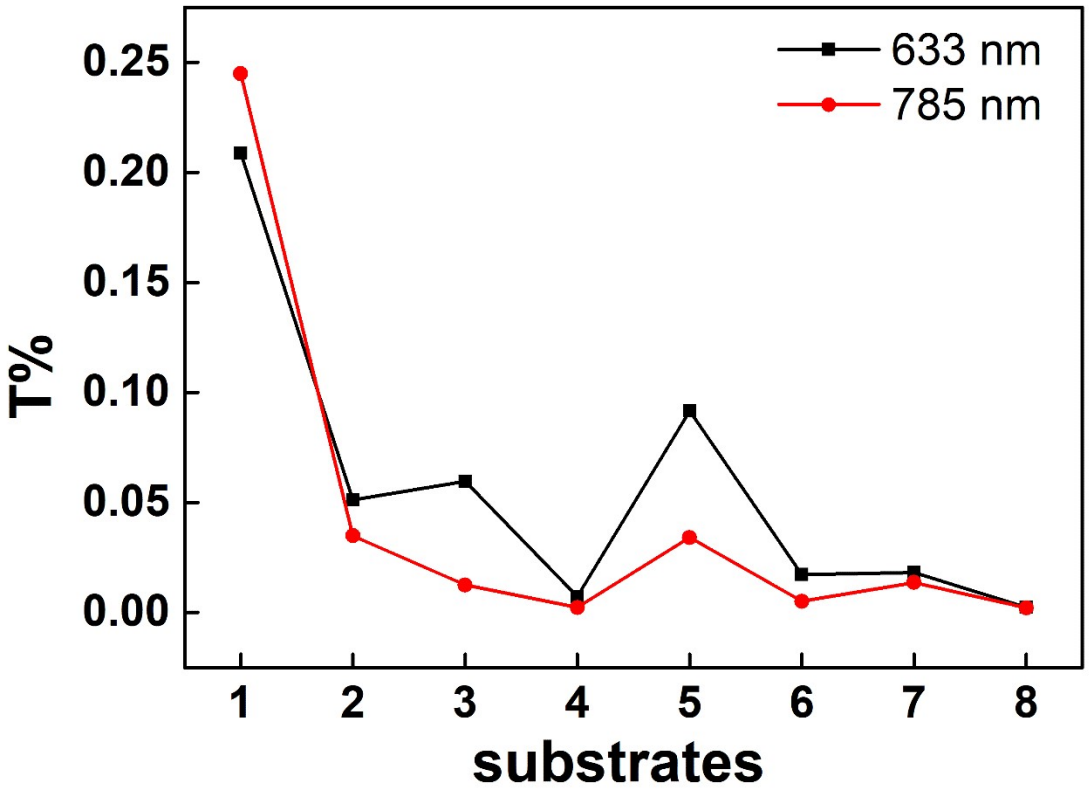

Fig. S5 Light transmittance of the substrates (1) AuNS/AuNS/AuNS, (2) AuNS/AuNS/AuNO, (3) AuNS/AuNO/AuNS, (4) AuNS/AuNO/AuNO, (5) AuNO/AuNS/AuNS, (6) AuNO/AuNS/AuNO, (7) AuNO/AuNO/AuNS, (8) AuNO/AuNO/AuNO at wavelengths of 633 and 785 nm, respectively.