Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

Supporting Information

Multi hot spots configuration on urchin-like Ag nanoparticle/ZnO hollow nanosphere arrays for high sensitive SERS

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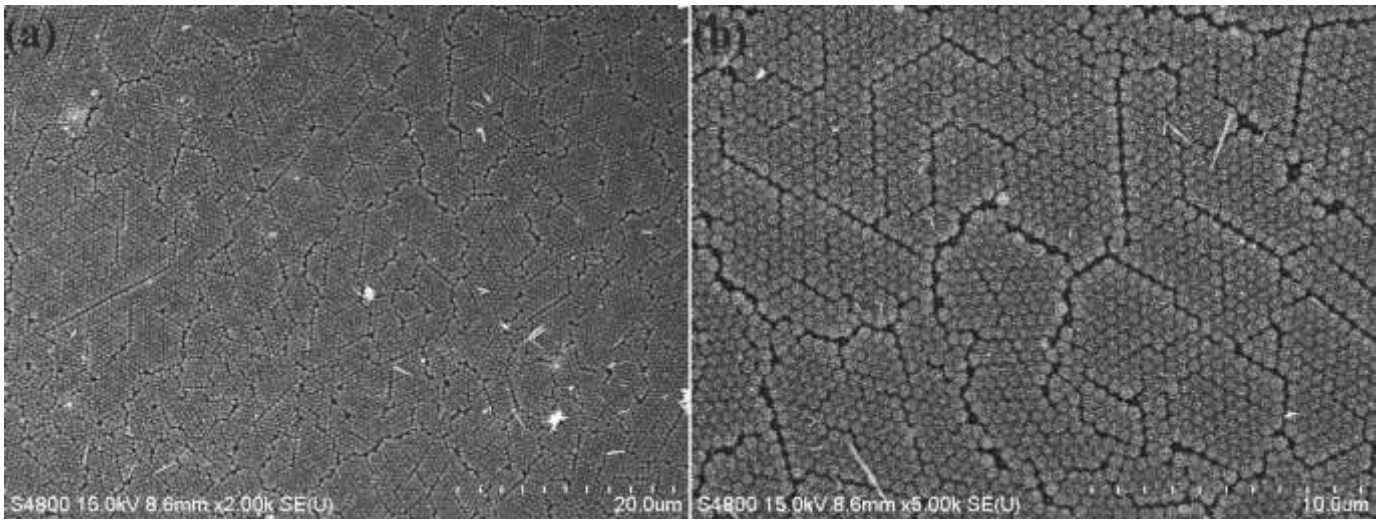

Figure S1. The low magnification SEM images of the urchin-like Ag NP/ZnO HNS arrays.

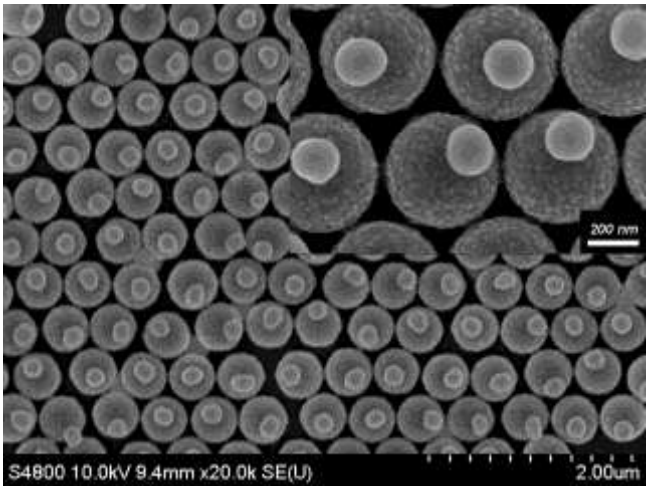

Figure S2. SEM image of the Ag NP/ZnO HNS arrays and the corresponding nanostructures in high magnification as shown in inset.

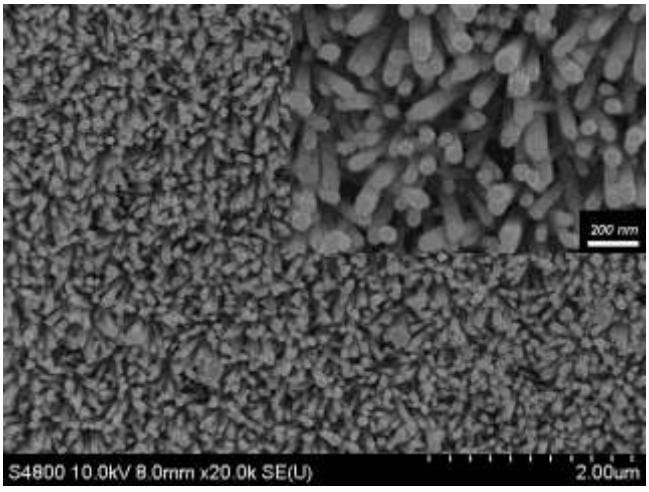

Figure S3. SEM image of the ZnO NR with the corresponding nanostructures in high magnification as shown in inset.

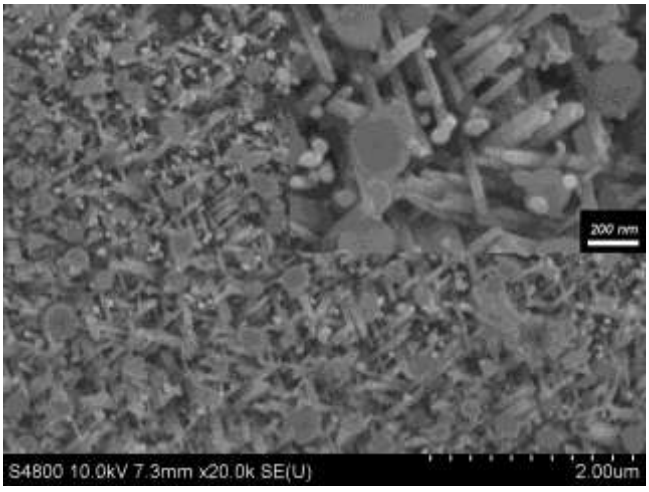

Figure S4. SEM image of the Ag NP/ZnO NR with the corresponding nanostructures in high magnification as shown in inset.

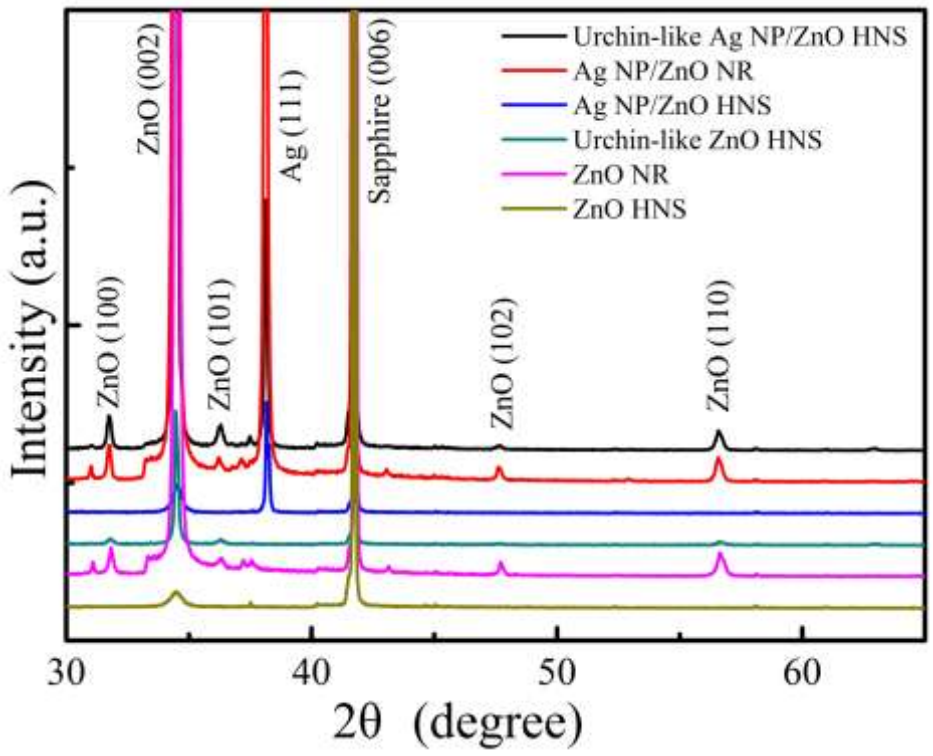

Figure S5. XRD patterns of ZnO HNS, ZnO NR and urchin-like ZnO HNS arrays decorated with or without Ag.

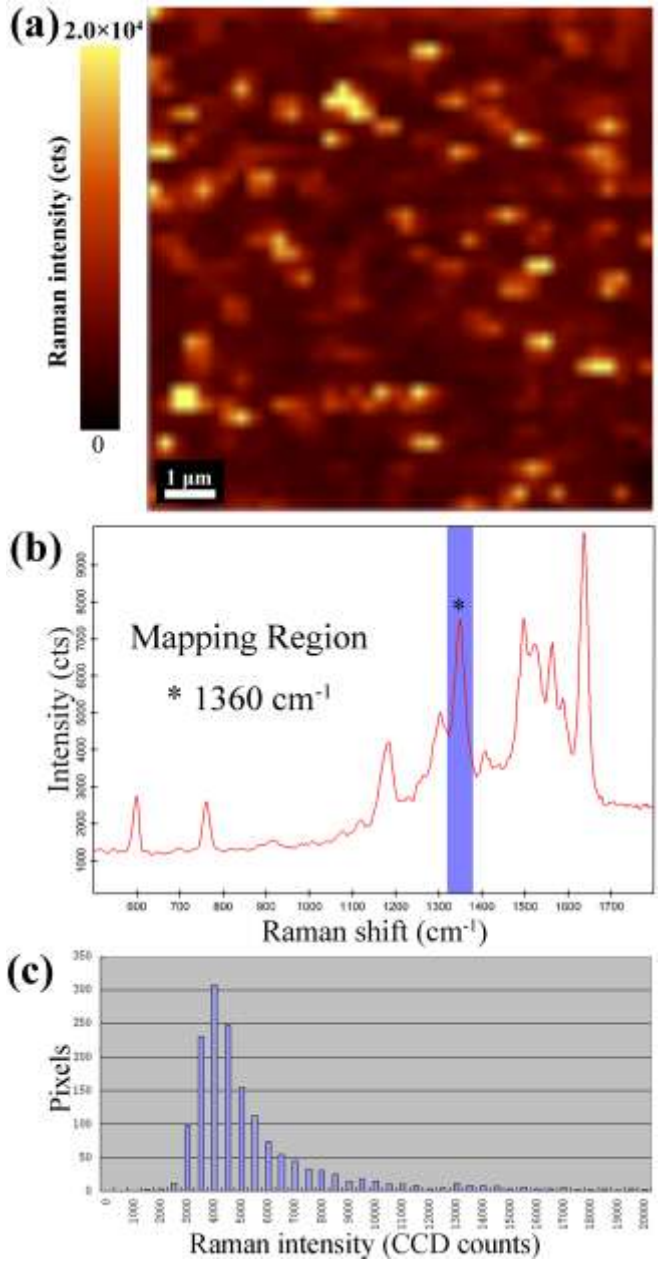

Figure S6. (a) Raman mapping image on the urchin-like Ag NP/ZnO HNS arrays (10 μm ×10 μm) at the Raman shift of 1360 cm^{-1}, (b) the corresponding Raman spectrum and (c) histogram of the Raman intensity distribution in the Raman mapping (a).

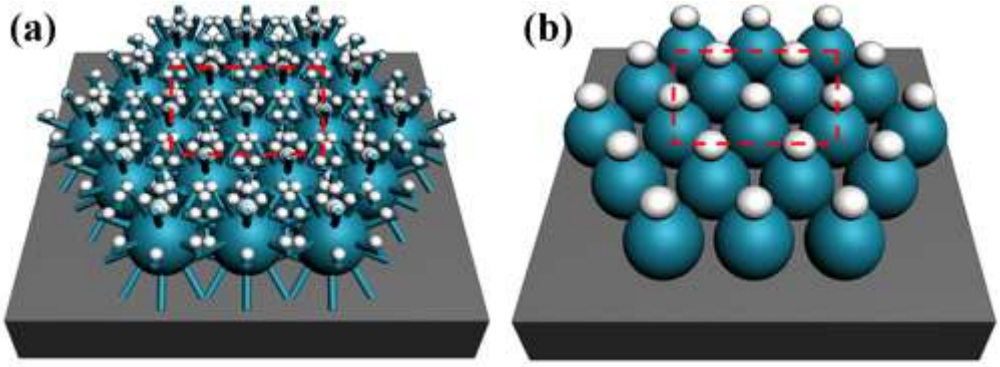

Figure S7. The calculation models of (a) urchin-like Ag NP/ZnO HNS and (b) Ag NP/ZnO HNS arrays employed in the simulation by the finite-difference time-domain (FDTD) solutions method. To get the precise optical characteristics, both the urchin-like Ag NP/ZnO HNS and Ag NP/ZnO HNS structures were set as an array system with as much similarity to experimentally fabricated structures as possible. ZnO HNSs in both structures are separated by a 500 nm distance with the diameter of 450 nm and shell thickness of 20 nm, which are the same with the measured parameters in SEM results. As shown in (a), in the urchin-like Ag NP/ZnO HNS composite structure, ZnO NRs in a hexagonal shape with the longitudinal length of 200 nm and side length of 25 nm are stemmed on a ZnO HNS with the intersection angle of 90° between neighbored NRs in the first level and 45° in both the second and third level, where the three levels were separated by 20°, 40° and 60° around the top of the sphere to the bottom. The Ag NPs in the ellipsoid shape similar as that in experimental samples were configurated. An average size of 60 nm in transverse direction and 48 nm in longitudinal direction for the Ag NP on the top of ZnO HNS and smaller sizes of 40 nm in transverse direction and 32 nm in longitudinal direction for Ag NPs on the NRs were employed. As a comparison, the Ag in the larger sizes of 100 nm in transverse direction and 80 nm in longitudinal directions were applied as shown in (b). In the calculation, the optical constants of Ag and Al_2O_3 were taken from Palik.[S1]

Reference

(S1) E. Palik, Handbook of optical constants of solids, Academic, New York, 1985.