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| Title: | Fabrication of silver nanodome embedded zinc oxide nanorods for enhanced Raman spectroscopy |
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| Abstract: | Herein, we demonstrate a facile and versatile method to decorate various sizes of silver nanodomes (ZnONR@AgND) along the length of zinc oxide nanorods (AgND) grown over fluorine-doped tin oxide (FTO) substrate. The silver nanodomes (AgND) embedded along the edges of hexagonal zinc oxide nanorods/FTO (ZnONR) substrate were fabricated by using a combination of size selective ZnONR growth and thermal reconstruction. The prepared heterostructure's structural, morphological, and optical behaviors were analyzed by Transmission electron microscopy (TEM), X-Ray diffraction, Raman spectroscopy, field emission scanning electron microscopy (FE-SEM), and UV-Vis spectroscopy. The results confirm the formation of ZnONR@AgND heterostructure with close-packing and construction of the crystalline AgND, adhering to the different faces of the 1D semiconducting ZnONR rods. The AgND size and separation was controlled by the initial sputter thickness and the thermal budget employed during annealing. Insight into the enhanced mechanism for surface-enhanced raman scattering (SERS) activity of ZnONR@AgND was ascertained by probing the hot-spot localization and the enhancement in the electric field by COMSOL simulations and experimentally verified by using rhodamine 6 G (R6G) probe molecules at various concentration 10−3 − 10−12 M. The prepared ZnONR@AgND demonstrated a superior SERS signal (~10 times) due to localization of the hot spots at the AgNDs compared to pure Ag nanoparticles substrate (for 10−6 M). The improved SERS performance of the ZnONR@AgND is attributed to an effective charge transport within the plasmonic AgND, semiconducting ZnO, and the R6G molecule facilitated by the ability of the heterostructure to accommodate multiple hot-spots in a limited volume. This work demonstrates that the SERS activity of semiconductor-based hybrid Raman substrate can be significantly improved by effectively tuning the metal nanoparticle size and density along the length of such hybrid nanowires. |
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