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Supplementary Information

for

Nanoporous Au/SnO/Ag Heterogeneous Films for Ultrahigh and Uniform Surface-enhanced Raman Scattering

Hong-Ying Fu, Xing-You Lang,* Chao Hou, Zi Wen, Yong-Fu Zhu, Ming Zhao,

Jian-Chen Li, Wei-Tao Zheng, Yong-Bing Liu, Qing Jiang*

Key Laboratory of Automobile Materials (Jilin University), Ministry of Education, and School of Materials Science and Engineering, Jilin University, Changchun 130022, China

* Correspondence and requests for materials should be addressed to X.Y.L. (email: xylang@jlu.edu.cn) or Q.J. (email: jiangq@jlu.edu.cn).



Figure S1. (a) Typical high-resolution SEM image and (b) EDS of NP Au films dealloyed in concentrated HNO_3 solution for 10 hours. The Cu peaks are from the copper sample holders.



Figure S2. (a) Top-view SEM image and (b) EDS of NP Au films implanted with SnO nanoparticles by electroless plating in 0.2 mM SnCl₂ solution for 120 minutes.



Figure S3. Representative top-view SEM image of NP Au/Ag films without SnO incorporation in 0 mM SnCl₂.



Figure S4. UV-Visible extinction spectra for NP Au, NP Au/SnO, NP Au/SnO/Ag and NP AuAg films. Here NP Au has a characteristic length of ~45 nm. NP Au/SnO is fabricated by plating SnO nanoparticles on the NP Au films in 1 mM SnCl₂ aqueous solution for 2 hours. NP Au/SnO/Ag is prepared by electroless plating Ag shell onto NP Au/SnO film for 30 minutes. NP AuAg is synthesized by electroless plating Ag shell onto NP Au film for 30 minutes.



Figure S5. Surface-enhanced Raman scattering spectra of R6G molecules (10⁻⁷ M) on SERS-active NP Au and NP Au/SnO films. The laser wavelength is 532 nm.



Figure S6. Ag-plating-time dependence of normalized SERS enhancements of NP Au/SnO/Ag films decorated with SnO nanoparticles in 0, 0.2 and 1 mM SnCl₂ solutions relative to bare NP Au or NP Au/SnO (t = 0) [$I(t)/I_0$] at the Raman bands of (a) 1363 cm⁻¹ and (b) 1182 cm⁻¹ of R6G molecule.



Figure S7. SERS spectra of R6G adsorbed on NP Au/Ag films without SnO incorporation that were fabricated by electroless plating Ag shell onto NP Au films with the characteristic length of ~45 nm for 0, 2, 8, 20, 30 min.



Figure S8. SERS spectra of 10⁻⁶ M R6G molecule adsorbed on SnO/Ag films. The SERS intensity of each spectrum collected at different spots is dramatically different from each other, illustrating that the SnO/Ag film exhibits low and nonuniform SERS enhancement.



Figure S9. SERS spectra of 10^{-7} M R6G molecule adsorbed on NP Au/Fe₃O₄/Ag films. The SERS enhancement of NP Au/Fe₃O₄/Ag films increases with the increasing concentrations of FeCl₃ and FeCl₂ from 1 and 0.5 mM to 5 and 2.5 mM, respectively.