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Tuning the optical properties of porous gold nanoparticles

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Porous gold nanoparticles (PG-NP) are very popular because of their high surface/volume ratio; moreover they have stronger plasmonic properties than their solid counterparts. The electron oscillations induced electric field around the PG-NPs opens the possibility to manipulate visible and near infrared light at the nanoscale. This property makes PG-NPs popular in a wide range of fields including biomedical, energy, environment protection, sensing and even in analytical applications such as surface-enhanced Raman spectroscopy (SERS). We have shown that although the as-produced PG-NPs start to coarsen at the temperature as low as 160°C, their equivalents passivated with a few nanometer of Alumina or Titania layer using. Plasma-enhanced atomic layer deposition (PE-ALD) is thermally stable up to 800°C. We prepared porous gold nanoparticles with solid state dewetting–dealloying methods. In this work we present our study about the change of the morphological and optical properties of porous gold nanoparticles coated with thin (5-7 nm) Al_2O_3 as well as TiO_2 layer using PE-ALD method due to thermal processing. Investigations by scanning electron microscopy showed that the porous gold cores preserved their initial morphology up to 7000°C. The optical resonance of the TiO_2 coated particles found to be different from the Al_2O_3 coated ones. Above 700°C, the TiO_2 coating loses its thermal stability. As a consequence, the morphology and also the optical properties of the hybrid structure start to suffer significant change. The resonance energy of the electron excitations are extremely sensitive to the composition, size, shape and the dielectric function of the surrounding medium of the PG-NPs. In order to investigate the influence the last of the above, alumina-titania-mixed coatings were prepared on the PG-NP and compared it with previous findings of Alumina and Titania coated cases. The samples were annealed in air at different temperature. Changes of the morphology, as well as optical extinction spectra were measured in a wide wavelength range. It was found that the different alumina-titania ratio influences the morphology as well as the optical properties of porous gold nanoparticles.