Optical characterization of citrate stabilized gold nanoparticles by two color surface plasmon resonance spectroscopy


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The optical determination of the dimensions and dielectric constant of small noble metal nanoparticles (NPs) deposited over solid substrates is still challenging, due to the strong dependence of the surface plasmon resonance (SPR) on size, the distance between the NPs and their volume fraction [1-2]. In this work, we use an all-optical approach based on two wavelengths angular scanning SPR spectroscopy [3] to determine both the dimensions and surface density of spherical gold nanoparticle (AuNPs) immobilized onto Au/SiO2 plasmonic substrates or Dielectric Loaded Waveguides (DLWGs) by (3-Aminopropyl)triethoxysilane (APTS) ligand. For the interpretation of the experimental SPR curves, the dielectric function of the small AuNPs was theoretically calculated considering the size-dependent boundary scattering effect [4], while the optical properties of the AuNPs/external medium nanocomposite layer were modeled using the Maxwells Garnett theory [5]. We demonstrate that when the colloidal solution of NPs is monodisperse and their surface density is low, the dielectric function of the metal/dielectric composite layer can be expressed at the first order in the volume fraction, allowing the precise determination of the average diameter of the AuNPs by two wavelength SPR spectroscopy.

References