Nanoplasmonics and surface enhanced spectroscopy

Plasmon dispersion properties in porous gold film: spatial dispersion.

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Porous gold films (por-Au) are nanocomposite porous (porosity up to 50%) films with disordered arrays of gold nanoparticles (Au NPs) with average size of 5-6 nm at wide dispersion. The films are produced by pulsed laser deposition from direct flow of erosion torch particles in argon atmosphere using a YAG: Nd^{3+} laser (λ=1.06 mkm, E_i=0.2 J, t=10 ns, f=25 Hz). Absorption broad bands are presented in measured transmission spectra and characterized by localized surface plasmon resonance (LSPR) with maxima in the wavelength range of 550-740 nm. Spectral and angular dependencies of polarization difference $\rho(\lambda, \theta)$ of internal reflection coefficients of s- and p-polarized radiation and spectral dependencies of isotropic reflection angles $\theta_{\rho=0}(\lambda)$ were measured in Kretschmann geometry by modulation polarization spectroscopy technique. Dispersion relations of LSPR for radiative modes and two types of nonradiative modes were obtained. The first one was on isolated non-interacting NPs and the second – between adjacent NPs due to dipole-dipole interactions. The plasma frequencies of electron oscillations in Au NPs, ranges of frequency and damping parameters of two types of LSPR were determined at various incident angles and wavelengths of light. The negative sign was demonstrated in dispersion relations of the second type of LSPR, which was caused by spatial dispersion of dielectric functions, nonlocal dielectric response on electromagnetic excitations. The correlation between LSPR characteristics, manifestation of spatial dispersion and structure of Au NPs arrays, their spatial distributions, configurations in dependencies on formation conditions of por-Au films have been discussed.