Plasmonic Spectra and Cubic Optical Nonlinearity of Nanostructured Gold Films

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The aim of the report is to summarize spectral and nonlinear optical properties of the nanostructured Au films with random and regular positioning of the nanoparticles. Properties of the plasmon spectra and characteristics of the third-order nonlinearity are considered.

Plasmonic spectra of the structures under study were measured depending on their topography features. The third order optical susceptibility $\chi^{(3)}$ of the samples is measured in resonant and nonresonant conditions respectively to the plasmonic band. Maximum value of the $\chi^{(3)}$ was measured to be $8 \cdot 10^{-5}$ esu.

The nonlinear optical response dynamics was measured under femtosecond laser excitation at λ=400nm and 800 nm. It was shown that the nonlinear optical response is induced during less than 200 fs and is due to free electron generation and the following electron-electron scattering resulting in electron gas heating. The relaxation of the nonlinearity goes with two different times “fast” $\tau_1 \sim 2 \div 5$ ps and “slow” $\tau_2 \sim 200$ ps. It was shown that the “fast” relaxation corresponds to the time of hot electros thermalisation, meanwhile the “slow” one corresponds to Au nanoparticle lattice cooling down.