Surface plasmon resonance dependence on size in metallic nanospheres.

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Metalic nanostructures are of high interest due to their ability to capture, concentrate and manipulate light in sub-wavelength scale. Such remarkable properties are attributed to the excitation of surface plasmons and has variety possible applications to photovoltaic, photonic, sensing and surface-enhanced Raman scattering. According to experimental observations plasmon resonance is high sensitive to nanoparticle size and shape, particularly we see redshift of resonance wavelength with growing dimension.

Plasmon oscillations could be described by dipole type excitations , where dissipation is caused by scattering and Lorentz friction due to electromagnetic field irradiation. Dependence on nanosphere radius for both those processes is investigated in aim to optimize nanoparticle size for largest attenuation rate.

In research we used semiclassical random phase approximation, which take into consideration electron density oscillations in metal, and classical electrodynamics approach by Finite element method (FEM). In FEM calculation we used commercial package (COMSOL Multiphysics), in order to accurately simulate extinction spectra with modified gold and silver nanoparticle optical properties and for different surrounding dielectric media.

In paper we discus calculation results for plasmon resonance wavelength and effective attenuation rate of surface plasmons dependence on nanosphere radius. The attenuation rate was optimized according to nanosphere radius and redshift of resonance wavelength was observed.

The theoretical and numerical predictions have been verified by a measurement of extinction of light due to plasmon excitations in nanosphere colloidal water solutions, for Au and Ag metallic components with radius from 10 to 75 nm. We obtained good agreement of plasmon resonances with experimental results

[1] W.Jacak, J. Krasnyj, J. Jacak, R. Gonczarek, A. Chepok, L. Jacak, D. Z. Hu, and D. Schaadt, *J. Appl. Phys.* **107**, 124317 (2010).