Optical Properties of Metal Nanoclusters on a Substrate

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The past few years demonstated extended use of metallic nanoclusters as sensing elements in various biosensor systems. Most of these systems exploit the unique optical properties of gold nanoparticles determined by the localized surface plasmon resonance. The operation of such devices is based on the dependence of the plasmon resonance on either the local dielectric environment of an individual nanoparticle or the mean distance between the approaching particles. Reports are now available on the biospecific interactions taking place on gold particles in systems where nanoparticles are represented as ordered structures, either as selfassembled monolayers or as part of polymer assemblies. Urgency of study of properties of plane arrays of nanoparticles is related also with creation of covers with tunable optical properties. Varying the mutual arrangement of nanoparticles, one can change the reflective properties of surface and its resonant properties in wide spectral range.

We present a detailed discussion of optical properties of aggregated conjugate-based structures such as bispheres, linear chains, plane arrays. The interaction of electromagnetic wave with a cluster of nanoparticles situated on a substrate is considered. Our attention is focused on dependence of extinction and scattering spectra on the optical coupling of conjugates, effects of interparticle spacing and cluster structure. The reflection of light from nanoclusters is analyzed with structure factor taken into account for different mutual arrangement of nanoparticles. Both Coulomb (near-field) and retarded parts of optical fields acting between nanoparticles and from substrate side were considered in details.