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Influence of the size, shape and concentration of magnetic particles on the optical properties of nano nickel films

ABSTRACT. In general, the optical properties of nanodispersed structures are very different from those of the corresponding bulk materials and depend on the structural parameters: the occupancy q of the volume of the matrix with the dispersed nanoparticles, the size f and shape of the particles, the degree of order in the arrangement of the particles, the properties of the medium, and the presence of vicinal nanoparticles manifested in the dielectric constant ε_m. In the present paper, using discontinuous Ni films as examples, we consider theoretically and experimentally the influence of these structural parameters on the optical properties. The optical spectra strongly depend on composition and dielectric constants of particles and matrix; in their turn the dielectric constants are functions of the structural and electronic parameters and can differ from those of the corresponding bulk materials. Thus, optical spectra investigations can give very useful information about the structural parameters of ultrafine structures. In this work the optical properties of such structures are derived from the theoretical Maxwell Garnett model. The optical spectra of thin Ni films was explained within the framework of the effective medium approximation in two cases: $q < 0.5$ and $0.5 < q < 1$. In this approach an effective refractive index $(n + ik)$ of the nanostructures can be calculated as a function of ε_m, q and particle shape. The results were in good agreement with experimental data.

Keywords: effective medium approximation, nanoparticles, optical spectra

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