Nanocomposites and nanomaterials

Features of superferromagnetic state ordering in the nanogranular films with perpendicular anisotropy

M M Kulyk[1(*)], V M Kalita[1], S M Ryabchenko[1]

[1] Institute of Physics, National Academy of Sciences of Ukraine. Prospect Nauki, 46, Kiev-03039, Ukraine.
*E-mail:*nikolaj.kulik.ifnasu@gmail.com*

Films with perpendicular growth anisotropy may find applied applications and can be used as model system, in which magnetic interactions of different space scale between particles are realized.

As a rule, in nanogranular (NG) films there are two types of interactions: a dipole-dipole intergranular interaction and exchange intergranular interaction. The superferromagnetic state in NG film can be organized through the ferro-type exchange interparticle interaction.

Magnetisation reversal of NG systems in superferromagnetic (SFM) state, types and structure of boundaries between superdomains are not enough investigated. The magnetisation reversal of the ensemble in the SFM state can be essentially different from magnetisation reversal of domains in usual ferromagnetics. This may be due to the fact, that the wall between superdomains can be perpetually thin, so the boundary transiting can be between the particles from different superdomains.

To determine the effect of SFM state on the properties of films with perpendicular anisotropy, the features of magnetisation reversal of NG films of composite Co/Al_2O_3 with 57.2 at. % Co were explored theoretically and experimentally.

It was found, that the film is in the SFM state, accompanied by occurrence of superdomains, at the room temperature. It was shown, that the transition from multidomain SFM state to the homogeneous SFM state occured critically. The critical field value depended on anisotropy of interparticle exchange. Magnetisation reversal of multidomain state occured by a motion of domain walls of superdomains. The major factor, affecting on a coercivity, was the anisotropy of particles. The coercive force of the explored film had the abnormal angular and temperature dependence.

Suggested model of anisotropy modification with anisotropic exchange interaction sufficiently explains received experimental results.