Magnetic properties dependence on the iron oxide nanoparticles concentration in polymer nanocomposite

A.A.Novakova*[1], T.S.Gendler[2], V.Yu.Lanchinskaya[1] and T.Yu.Kiseleva[1]

[1]Moscow M.V.Lomonosov State University, 117234 Moscow, Russia
[2] United Institute of Physics of the Earth RAS, Moscow, Russia

*Corresponding author: e-mail: novakova@nm.ru, Phone: +7(095) 939 12 26, Fax: +7(095) 932 88 20

The polymer nanocomposites containing Fe_3O_4 nanoparticles (10-20 nm) in a polyvinyl alcohol matrix films (200 m depth) were synthesized using an original method of *in situ* preparation, which allows to obtain different concentrations of oxide particles in the PVA matrix. The range of concentrations obtained (from 0.6 up to 43 vol.%) enabled a study of the nanocomposites magnetic and structural properties in dependence on the average interparticle distance [1]. Those properties were investigated by means of X-ray diffraction, transmission and depth selective conversion Mossbauer spectroscopy (for layer-by-layer phase and magnetic analysis [2]) and magnetization (remanent Jrs and spontaneous Jn) measurements . The obtained results showed that the base concentration strongly influenced not only the composition of the nanoparticles formed (magnetite nanoparticles with different sizes and oxidation degree) but also non-homogeneous distribution of the particles within the matrix volume. The appearance of hyperfine magnetic fields characteristic for agglomerates of magnetite nanoparticles in the Mossbauer spectra of the films middle layers was observed for the samples with large oxide nanoparticles concentration. At the same time the doublet superparamagnetic components were characteristic for the films subsurface layers Mossbauer spectra. The spontaneous magnetization measurements performed in three mutual orthogonal directions revealed the "in plane" direction of J_n vector and its volume increase with nanoparticles concentration growth in the samples. The magnetic anisotropy observed in the samples with heterogeneous distribution of magnetite nanoparticles agglomerates along the films depth due to the peculiarities of the polymer nanocomposites method "in situ" preparation.

References

[1] A.A.Novakova, V.Yu.Lanchinskaya, et al., JMMM **258-259**, 354 (2003).
[2] A.Kuprin and A.Novakova, Nuclear Instruments and Methods in Phys. Research **B62** , 493 (1992).