High frequency and magnetostatic properties of composites based on nano-structured Fe-N films

Alexander Getman [b,*], S. Maklakov [a], A. Osipov [a], K. Rozanov [a], I. Ryzhikov [a], M. Sedova [a], N. Perov [b], A. Radkovskaya [b], A. Sivov [b]

[a] *Inst. for Theoretical and Applied Electrodynamics, Russian Academy of Science, 13/19 Izhorskaya, 125412, Russia.*

[b] *Faculty of Physics, M.V. Lomonosov Moscow State University, Vorob'evy Gory 119992, Russia.*

We haveve studied the influence of the structure of Fe-N films and Fe-N powder composites on magnetostatic and high frequency properties. Iron film samples of $0.1 - 1.3$ μm thickness were deposited on mylar substrate by magnetron sputtering. Fe-N powder was produced by decomposition of Fe-N films. The structure was investigated by scanning electron microscopy (SEM) and atomic force microscopy (AFM), magnetostatic properties were measured by vibrating sample magnetometer (VSM), high frequency permeability spectra measurements were done at the range of $0.1 - 10$ GHz using coaxial technique. Iron films are shown to have columnar structure and the average diameter of columns on the surface of the film increases linearly with film's thickness. The diameter of columns on the surface of the film increases anisotropically with film's thickness defining the easy axis of in-plane anisotropy. In-plane anisotropy of the film reduces remanent magnetization, the amplitude and Q-quality of the resonance of high frequency permeability spectra. Magnetostatic and high frequency properties of Fe-N powder composites do not depend on the thickness of the particles. Fe-N powder composites have lower amplitude of the permeability spectra in comparison with Fe-N films due to much higher demagnetization field of randomly oriented Fe particles in the composite.

* Corresponding author.
Email address: getman3d@gmx.net (Alexander Getman).