AC MAGNETIC PROPERTIES OF NANOGRANULAR FeCoAlN FILMS.

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Nowadays, electronic devices such as microinductors, transformers and magnetic recording heads are demanded to operate in the GHz frequency range that has stimulated intensive research of new magnetic materials with high frequency permeability. Soft magnetic nanogranular films consisting of magnetic grains embedded in an insulating matrix are appropriate candidates for these applications due to the follows reasons: (a) the intrinsic maze structure of nanogranular films leads to high resistivity which reduces eddy current losses (b) the ferromagnetic resonance (FMR), which is the second main loss mechanism, can be shifted to higher frequencies in materials with high saturation magnetization M_s and anisotropy field H_a. FeCo-based oxide or nitride films, which satify these requirements have recently attracted much attention [1,2].

In the present paper we report on AC magnetic properties of ferromagnetic nanogranular FeCo-based nitride films. The samples were prepared by UHV plasma jet technique [3]. External magnetic field was applied during the deposition. The FeCoAlN films consist of FeCo grains with the size of about 10 nm (evaluated from X-ray diffraction measurements) embedded in an insulating AlN matrix. Magnetic properties of the as-deposited samples were investigated using an AC hysteresis loop tracer. The evaluation of the relative effective permeability frequency dependence was based on a short-circuited strip line method. [4]. The network analyzer (AGILENT E8364B) was used for this kind of measurements.

Figs. 1a and b show the hysteresis loops of a film measured along the easy and hard axis of magnetization, respectively. The coercive field along the easy axis, measured at the frequency of 200 Hz, is about 4 kA/m. The broadening and the roughness of the loop measured along the hard axis indicate the easy axis distribution in the film plane, as was proved by the magneto-optical Kerr effect measurements [5]. Fig. 2 shows the frequency dependence of real μ_{eff}' and imaginary μ_{eff}'' parts of the relative effective permeability. The characteristic frequency at which the natural ferromagnetic resonance occurs is about 1.7 GHz.

References:

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Figures:

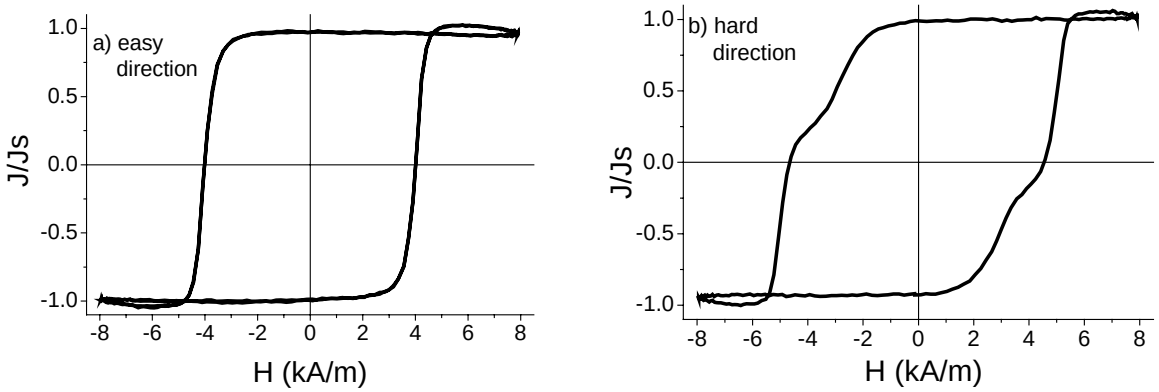

Figure 1: Hysteresis loops of $Fe_{50}Co_{50}$-AlN film measured along a) easy and b) hard axis directions.

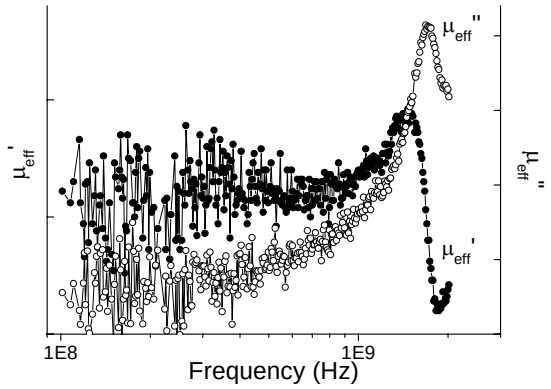

Figure 2: The frequency dependence of relative permeability.