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GROWTH AND MORPHOLOGIC, ELECTRIC AND MAGNETIC CHARACTERIZATION OF NANOMETRIC IRON NITRIDE FILMS

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Abstract – Nanometric iron nitride films were synthesized by magnetron sputtering in a mixed Ar+N_2 atmosphere with different reactive gas proportions. The experimental parameters fixed for the synthesis of the films were current (60 mA), the total pressure (6 psi) and the deposition time (10 min). The morphological, electrical and magnetic characterizations of the samples were made by atomic force microscope (AFM), four-point probe, magneto-optical Kerr effect (MOKE) and ferromagnetic resonance (FMR).

Since the early days following the discovery of the binary Fe- N_2 compound, a great deal of attention has been devoted to the investigation of their structural, electrical and magnetic properties [1-3]. In the present work, Fe-N_2 compound was prepared by trading system for films growth with source DC magnetron sputtering, which consists of a stainless steel chamber of 30x30x30 cm^3, a target of high purity iron (99.99%) whose distance to substrate is 10 cm. The experimental parameters fixed for the synthesis of the films were current (60 mA), the total pressure (6 psi) and the deposition time (10 min).

The substrate used for all samples was the glass (known as amorphous substrate). Six polycrystalline films samples were prepared with a ratio of Ar/N_2, 5, 2, 1, 0.5, 0.2 and 0, where the first five films are ferromagnetic. The morphological, electrical and magnetic characterizations these samples was made by AFM, four-point probe, MOKE and FMR. All measurements were performed at room temperature.

With the AFM were taken micrographs of 2x2μm^2 and stored in matrices of *512x512 pixel*, using a silicon tip with radius of 10nm, where the scan was done in dynamic mode with a frequency of 223,186 kHz. For the electric property analysis, a current of 0.1mA was applied in the film plan. The films static magnetization properties were determined by MOKE, where measurements were made using a parallel field of 600 Oe. The dynamic properties of the magnetization were obtained using a magnetic field up to 9 kGauss and a microwave frequency of 8.6 GHz.

The growth rate was analyzed with the AFM technique, which has a direct influence of the concentration of nitrogen in the thickness film. The electrical resistivity of polycrystalline films (~10^{-4}Ωcm) is much larger than the Iron (~10μΩcm). But, in the non ferromagnetic film, the electrical resistivity presents a magnitude order in the semiconductor range (~10^{-2}Ωcm). Finally, the results of FMR and MOKE demonstrated the absence of uniaxial and cubic magneto-crystalline anisotropy and a typical hysteresis loop of soft ferromagnetic materials.

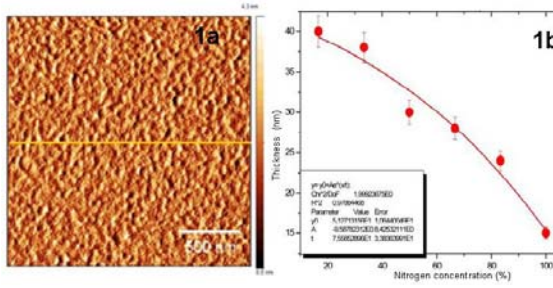

Figure 1: **a)** Micrography of the A_6 sample. **b)** Deposition rate versus nitrogen concentration.

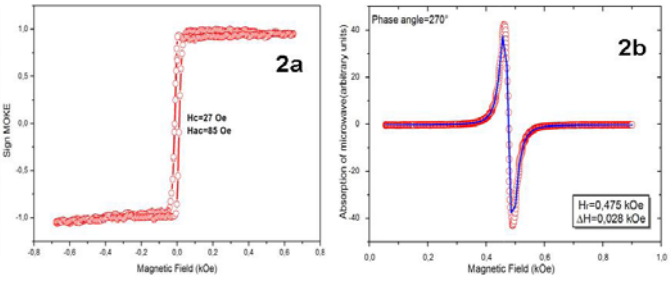

Figure 2: A_3 sample . **a)** Hysteresis loop and **b)** FMR spectra.

References

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