STRUCTURAL AND MAGNETIC PROPERTIES OF NANOPHASE ELECTRODEPOSITED Fe-S FILMS

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This work address the structure and magnetic properties of nanostructured Fe-S films. Samples of Fe-S (300-600 nm in thickness and maximum 12 wt % S) were prepared by electrodeposition. Structural features of the films were investigated by XRD, SEM, TEM and AFM. Magnetization and coercivity measurements were carried out on the films by torque (TQM) and vibrating sample (VSM) magnetometry. The electron diffraction patterns of the films with 9 wt % S are the diffusion halo specific for amorphous materials, however the first reflection is very bright, this fact is not usual for amorphous materials and testifies to a great extent of the short-range atomic order. On the basis of data obtained, one can assume that $Fe_{81}S_9$ films consist of nanometer size crystalline clusters (< 5 nm) of iron surrounded by sulfur atoms. The central part of clusters are formed by iron atoms (Fe α-phase) while the iron atoms removed from the centre, which are connected with sulfur atoms surrounding the iron clusters (Fe-S phase). This unusual structure of Fe-S films leads to the peculiarities of their magnetic properties. Nonmagnetic sulfur element has a significant effect on the magnetic moment of the nearest Fe host atom causing a reduction from its value in the bulk state. Moreover, the magnetization is linear both in $H_{//}$ and $H_{\perp}$ to the film plane, and exhibiting low remanance (< 0.5), coercivity (0.6 kA/m) and anisotropy energy (< 50 J/m^3). The obtained data about the magnetic moment can be interpreted in the context of self-consistent cluster calculations.

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