Nanocomposites and nanomaterials

Influence of the surface morphology on the magnetoresistance of ultrathin Fe films

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In order to determine the magnetoresistance anisotropy and identify positive anisotropic magnetoresistance in structurally discontinuous films, the measurement was performed in configuration "current in the film plane" and for two magnetic field geometries with respect to the current (longitudinal and transverse magnetoresistance). From the obtained at room temperature isotropic field dependences of the longitudinal and transverse magnetoresistance it follows that they coincide within the experimental margin of error.

A negative isotropic magnetoresistance is observed for as-deposited samples in the range of effective thicknesses of d_{Fe}= 10–20 nm. This fact indicates that the magnetoresistance anisotropy impact is insignificant, while the observed dominant effect is not anisotropic and is conditioned by spin-dependent electron tunneling between the ferromagnetic islands, since the mutual orientation of current and field is not important for such a mechanism [1, 2]. It should be noted that condensation was performed on a neutral non-oriented substrate (glass, carbon film) at room temperature ($T_s \approx 300$ K $< 2T_m/3$) (where T_m is the melting temperature); therefore the diffusion mobility of atoms on the substrate was complicated.

The electron microscopic findings indicate the formation during deposition of many small crystallization centers and their simultaneous growth. As a result, practically the same structure was observed in as-deposited films regardless of their composition and thickness. Irregularly shaped islands are of 2–5 nm in size, and the gaps between them take the form of channels of approximately 1–2 nm width. Thus, the Volmer-Weber growth mechanism is implemented for the films.

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