Structure-Phase Composition and Thermoresistive Properties of Film Systems Based on Fe and Cu

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According to the phase diagram Cu-Fe for bulk samples of the system components do not mix. The structural state of this samples can be interpreted as pseudoalloys. In addition, the study magnetoresistance (MR) of two-component films based on Cu and Fe, obtained simultaneously [1 - 3] or layers [4, 5] condensation, indicating the formation of their granular state and, as a result, implementation of the spin-dependent scattering of electrons (SDSE) and the effect of giant magnetic resistance (GMR). Since the solubility of Fe atoms in the Cu matrix is very limited, it is somewhat unclear is the question of the mechanism of formation of granular state.

The purpose of this work is study the crystal structure, diffusion processes and the possibility of stabilizing the situation in granular multilayers $[Cu/Fe]_n/S$ obtained at relatively low speeds and high thermal and electro-chemical deposition. It was found that the samples in both cases with two-phase structure of fcc-Cu + bcc-Fe (sign of pseudoalloys), although studies using secondary-ion mass spectrometry indicate weak mutual diffusion of atoms with the diffusion coefficient order 10^{-19} m^2/s. Analysis indicates that this is not effective diffusion due mainly ion-stimulated diffusion limits on crystalline Cu or Fe with little contribution condensation-induced diffusion. Measurement of defense indicate that the samples obtained from the low deposition rate (10^{-2} nm/s), implemented with effect amplitude GMR from 0,2% ($[Cu\ (2nm)/Fe\ (2nm)]_4/S$) to 0,4% ($[Cu\ (2)/Fe\ (2)]_{10}/S$). When the deposition of relatively high rate (1 - 2 nm/s) MR has all the features of AMR with amplitude 0,15 – 0,30%. The results are discussed in terms of a possible mechanism SDSE.

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