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Modified physical properties by ion-beam mixing of Fe/Si multilayers films

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We investigated the physical properties of ion-beam mixed (IBM) Fe/Si multilayered films (MLF). Experimental and theoretical studies of the optical and magneto-optical (MO) properties of as-deposited MLF allowed us to conclude that a B2-phase nonmagnetic metallic FeSi compound is spontaneously formed between Fe sublayers during deposition. Two nearly same Fe/Si MLF have been prepared by rf-sputtering onto glass substrates at room temperature. The ion beam mixing of the Fe/Si MLF has been performed at room temperature by using Ar+ ions with an energy of 80 keV, a dose of 1×10^{16} ions/cm^2 and a flux of 1.5×10^{6} A/cm^2. A lot of experimental techniques were employed in studying the processes near the interface caused by the IBM. The first set of tools include low-angle and high-angle x-ray diffraction, magnetometry, and ferromagnetic resonance spectroscopy, while the so-called "surface-sensitive" tools, that is, MO and optical spectroscopies were also employed. Such an ion-beam treatment has led to noticeable changes in the structural and physical properties of the Fe/Si MLF. the formation of a new phase which is characterized by a perfect crystalline silicide structure, a low coercivity and a Curie temperature of about 550 K. The obtained results can be explained if a reaction of Fe + FeSi → Fe5Si3 is supposed, which resulted in a formation of the perfectly ordered Fe5Si3 compound.