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Structural dependence of the optical and the magneto-optical properties of Mn1-xFex alloy films

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$Mn_{1-x}Fe_x$ alloy films have been prepared by face-to-face dc sputtering of the Mn and Fe targets onto large glass substrates kept at 293 K. The x-ray diffraction study shows a bcc structure for the $Mn_{1-x}Fe_x$ alloy films with $x > 0.9$, a mixture of the *fcc* (γ-Mn-Fe phase) and the bcc (α-Fe phase) structures for $0.65 < x < 0.80$, and a *fcc*-like structure (γ-Mn-Fe phase and α-Mn phase) for $x < 0.65$. The structural dependence of the magneto-optical (MO) [equatorial Kerr effect (EKE)] and the optical [optical conductivity (OC)] properties of $Mn_{1-x}Fe_x$ alloy films have been investigated.

It was shown that the EKE signal at 293 K for the $Mn_{1-x}Fe_x$ alloy films can be observed only for $x > 0.50$. All the EKE spectra have nearly the same spectral shape (Fe-like) and differ from each other only in the intensity. The observed experimental EKE spectra for the Fe-rich $Mn_{1-x}Fe_x$ alloy films can be nicely described by the simulated ones made in the framework of the effective medium approximation.

The optical properties of all the investigated $Mn_{1-x}Fe_x$ alloy films can be separated into three groups which are related to the different crystalline structures: the OC spectra for the $Mn_{1-x}Fe_x$ alloy films which contains α-Fe phase ($x > 0.65 \sim 0.70$) exhibit a noticeable interband absorption peak at about 2.4 eV; such a peak is completely absent in the γ-Mn-Fe phase alloys, and the α-Mn alloys reveal a significant interband absorption peak near 1.4-1.5 eV. The first-principles calculations of the MO properties and the OC of Mn-Fe alloy films are in progress to elucidate the obtained experimental results.