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STRUCTURAL DEPENDENCE OF MAGNETIC, MAGNETO-OPTICAL AND OPTICAL PROPERTIES OF Co-Al ALLOY FILMS

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INTRODUCTION

The electronic structures, physical properties and thermal stability of CoAl intermetallic compound in connection with peculiarities of its atomic structures have been a focus of many investigations during recent years. Perfectly ordered equiatomic alloy is not ferromagnetically ordered even at very low temperatures because of lack of Co - Co nearest neighbors. In contrast to the ordered state of Co-Al alloys, in the disordered one Co and Al atoms randomly occupy the sites of *bcc* lattice and various atomic configurations of the Co and Al atoms on the sites of the *bcc* lattice are occurred. This change in the symmetry and the basis unit cell itself should lead to changes in the electron energy structures (EES) of alloy and its physical properties. In this paper we study the influence of the structural order-disorder transition in Co-rich β-phase Co-Al alloy films on their physical (magnetic, magneto-optical, optical) properties experimentally and analyze obtained data by using the results of the first-principal calculations of the EES and optical properties of CoAl compound.

EXPERIMENTAL PROCEDURE.

$Co_{0.62}Al_{0.38}$ alloy films with a total thickness of 150 nm were prepared by means of flash evaporation technique onto glass substrates in a high vacuum of 5×10^{-5} Pa. An equilibrium ordered β-phase in these films was reached by the film deposition onto heated to 720 K substrates. In order to obtain the disordered state in

Co-Al alloys vapour quenching deposition was employed. The substrate temperature during the deposition was about 150 K.

Magneto-optical properties (equatorial Kerr effect: EKE) of the ordered and disordered $Co_{0.62}Al_{0.38}$ alloy films were investigated by the dynamical method using *p*-plane polarized light at two angles of incidence (66 and 75 degrees) in 250 - 1100 (5 - 1.05 eV) nm spectral range at RT in a AC saturation magnetic field.

The optical properties of the samples were measured at RT in the spectral range of 250 - 2500 nm (5.0 - 0.5 eV) at fixed incidence angle of 73 degrees by the polarimetric Beattie technique.

RESULTS AND DISCUSSION

The transition of the $Co_{0.62}Al_{0.38}$ alloy films from an ordered state into disordered one causes the increase in the magnetic moment measured by VSM on about 20 % and the increase in coercivity from 110 up to 260 Oe. These data agree with results of FMR study.

The loss of the translational invariance caused by the order - disorder transformation leads to the remarkable changes in the optical and magneto-optical properties of the $Co_{0.62}Al_{0.38}$ alloy films: a significant (at least two times at 3 eV) growth of the EKE value and apparent change in the shape of the spectrum are observed; the shift of the main absorption peak in the optical conductivity spectra is accompanied with the appearance of an additional optical absorption in the low energy side of the spectra.

The obtained results are discussed both in the terms of the changes in symmetry of the lattice as well as the defect approach. Taking into account the EES of defects, and the positions of the defect levels in comparison with the Fermi level of the host, a noticeable growth in the infrared region of optical conductivity spectra is attributed to the additional absorption due to the defect levels.