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Influence of the structural disorder on the magnetic, optical and transport properties of β -phase $Ni_{0.50}Al_{0.50}$ alloy films

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The influence of the structural disorder on the magnetic, optical and transport properties of the $Ni_{0.50}Al_{0.50}$ alloy films has been investigated. The ordered state in the $Ni_{0.50}Al_{0.50}$ alloy films was obtained by the film deposition onto the glass and Si substrates at 780K, while the formation of the long range order in the $Ni_{0.50}Al_{0.50}$ alloy films was suppressed by using the vapor-quenching deposition onto the substrates cooled by liquid nitrogen. The origin of the main interband absorption peaks of the ordered NiAl compound was interpreted by using the results of ab initio calculations.

The loss of the translational invariance in the disordered state leads to significant changes in the magnetic properties of the $Ni_{0.50}Al_{0.50}$ alloy films: it was shown that the disordered $Ni_{0.50}Al_{0.50}$ alloy films (in contrast to the ordered state) are ferromagnetically ordered below 50K. The structural disordering also induces noticeable changes in the optical properties of the alloy, i.e., a decrease in the plasma frequency and an increase in the relaxation frequency of free electrons as well as to a decrease in the intensity of the interband absorption peaks. Temperature dependences of the resistivity for both ordered and disordered states of the $Ni_{0.50}Al_{0.50}$ alloy films exhibit the resistivity minima in the low-temperature region nearly at the same temperature, which do not depend on the magnetic field. On the other hand, the temperature coefficients of resistivity for the ordered and disordered states are significantly different. The changes in the transport properties of

the alloy films caused by the order-disorder structural transformation are explained by using various models for transport in the disordered systems. The observed temperature and structural dependences of the resistivity of the investigated $Ni_{0.50}Al_{0.50}$ alloy films as well as their optical properties are understood by the partial localization of the electronic states near the Fermi level.