[S-24] Magnetic and transport properties of ordered and disordered $Ni_{0.50}Al_{0.50}$ alloy films

K. W. Kim,[1] J. B. Kim,[1] Y. V. Kudryavtsev,[2] J. Y. Rhee,[3] J. S. Park[4] and Y. P. Lee[4]
[1]Department of Physics, Sunmoon University, Asan, Korea
[2]Institute of Metal Physics, NAS of Ukraine, Kiev, Ukraine
[3]Department of Physics, Hoseo University, Asan, Korea
[4]Department of Physics, Hanyang University, Seoul, Korea

The electronic structures, physical properties and thermal stability of 3d transition metal (TM) compounds in connection with peculiarities of their crystalline structures have been a focus of many investigations during recent years. β-phase Ni-Al alloys have a CsCl-type (B2) crystal structure in a Ni concentration range of 45 - 60 at.% (at 293 K) and are stable, at least, to the melting point (1911 K). Because of the specific local environment and significant charge transfer NiAl compound is not ferromagnetically ordered as was shown experimentally and theoretically. In contrast to the ordered state of NiAl alloy, the Ni and Al atoms can randomly occupy the sites of bcc lattice in the disordered state. Arbitrary occupation of the sites of bcc lattice by the Ni and Al atoms can change the local environment in Ni-Al alloy and create the so-called antistructure Ni atoms (Ni-ASA, Ni atom at Al site) or even their clusters. Therefore, it might be expected that this change in symmetry and basis of the unit cell itself leads to noticeable changes in the electronic energy structures (EES) and hence in the physical properties of this alloy. In this study, the influence of structural disorder on the EES and physical properties of NiAl alloy films were investigated.

The ordered state in the $Ni_{0.50}Al_{0.50}$ alloy films was obtained by the film deposition onto glass and Si substrates at 780 K, 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 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. The disordered $Ni_{0.50}Al_{0.50}$ alloy films (in contrast to the ordered state) are ferromagnetically ordered below 50

K. 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 observed temperature and structural dependences of 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.