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Physical Properties of Magnetic Shape-memory Ni_2MnGa Alloy

이성준,[1] 박상윤,[1] 이영백,[1] Y. V. Kudryavtsev,[2] 이주열[3]
[1]한양대학교 물리학과
[2]Institute of Metal Physics, Kiev, Ukraine
[3]호서대학교 물리학과

The physical properties, including the optical, magneto-optical, magnetic and transport ones, of Ni_2MnGa alloy in the martensitic and austenitic states were investigated. The stoichiometric Ni2MnGa alloy was prepared by melting high purity Ni, Mn and Ga pieces in an arc furnace with a water-cooled Cu hearth. Subsequent homogenization of the ingot was achieved by an annealing at 1273 K for 5 hours in a vacuum chamber, then cooled in the furnace. The magnetic and transport properties of Ni2MnGa alloy were investigated at various temperatures. The magnetic susceptibility shows an abrupt increase at 220 K and keeps almost constant until temperature reaches at 380 K. The susceptibility steeply decreases to zero when temperature is higher than 380 K. The dependence of the temperature coefficient of resistivity on temperature shows kinks at the structural and ferro-para magnetic transitions. Electron-magnon and electron-phonon scatterings are dominant for the electronic transport in the martensitic and austenitic states, respectively. The peak positions in the experimental and calculated optical-conductivity (OC) spectrum coincide. The experimental real parts of the off-diagonal components of the dielectric function present two sharp peaks, one at 1.9 eV and the other at 3.2 eV , and a broad shoulder at 3.5 eV ; all are identified by the band-structure calculations. A Lorentz model that consists of two oscillators was employed to fit the interband contribution to OC. It was found that the structural transition plays a more important role for the changes in OC spectrum than the thermal-expansion effect. The results of the transport properties were analyzed in connection with magnetic properties as well as electronic structures of the alloy.