[IV-10] [초청]

Solid-state reaction in Ti/Ni multilayers

이주열, 이영백*, 김태하*, 김기원*, Y. V. Kudryavtsev*, B. Szymanski**
호서대학교 물리학과, *선문대학교 물리학과, **Institute of Molecular Physics Polish Academy of Sciences

Ti/Ni multilayered films (MLF) are ideal for neutron optics particularly in neutron guides and focusing devices. This system also possesses the tendency of amorphization through a solid-state reaction (SSR). This behaviors are closely related to the electronis structures and both magneto-optical (MO) and optical properties of metals depend strongly on their electron energy structures. Mutual inter-diffusion of the Ti and Ni atoms in the MLF caused by a low temperature annealing should decrease the thickness of pure Ni, as well as change the chemical and atomic order in the reactive zone. The application of the MO spectroscopy to the study of SSR in the MLF allows us to obtain an additional information on the changes in the atomic and chemical orders in the interface region. The optical one has no restriction on the magnetic state of the constituent sublayers. Therefore, the changes in magnetic, MO and optical properties of the Ti/Ni MLF due to SSR can be expected. To the best of our knowledge, the MO and optical spectroscopies were not used for this purpose.

SSR has been studied in the series of the Ti/Ni MLFs with bilayer periods of 0.65 - 22.2 nm and constant ratio of the Ti to Ni sublayers thickness by using MO and optical spectroscopies as well as an x-ray diffraction. The experimental MO and optical spectra are compared with the computer-simulated spectra, assuming various interface models. The relative changes in the x-ray diffraction spectra and MO properties of the Ti/Ni MLF caused by annealing are bigger for the multilayers with ''thick'' sublayers, or the SSR with the formation of amorphous alloy takes place mainly in the Ti/Ni multilayers with ''thick'' sublayers, while in the Ti/Ni MLF with the ''thin'' one it is already happened during the deposition. The existence of the nominal threshold thickness of the Ni-sublayer for the observation of the equatorial Kerr effect in the as-deposited and annealed Ti/Ni MLFs of about 3.0 and 4.5 nm thick is explained by the formation of amorphous alloy during the deposition or the formation of the nonmagnetic alloyed regions between pure components as a result of the SSR. For the case of Ti/Ni MLF the MO approach is more sensitive for the determination of the thickness of the reacted zone, while x-ray diffraction is more useful for structural analyses.