Nanostructured surfaces

Optical and structural features NiO films modified by ion implantation

V.P. Melnik[1], I. P. Lisovskyy[1], B.M. Romanyuk[1], V.G. Popov[1], O.S. Oberemok[1], M.V. Voitovych[1], T.M. Sabov[1], I.M. Khacevych[1], V.A. Nikirin[1]

[1] Lashkarev Institute of Semiconductor Physics NAS of Ukraine,. Prospect Nauky, 41, Kiev-03028, Ukraine.
E-mail: romb@isp.kiev.ua

Nickel oxide is a promising material for the creation of p-type transparent conducting electrodes, electrochromic display devices, chemical and spin-valve giant magnetoresistance sensors, thermoelectric devices at al. It is known that the hole conductivity of NiO films are provided by presence of the nickel vacancies and interstitial oxygen. Changing the concentration of these point defects we can change the optical and electrical characteristics of NiO films. Such Nandy et al. [1] have reported that doping Al atoms into a NiO film enhances the p-type film conductivity. Avendano et al. [2] reported improved transparency in the visible wavelength range in NiO films containing Mg, Al, Si, V, Zr, Nb, Ag, or Ta in aqueous alkaline electrolytes. Ion implantation with the next temperature treatments is a power method for modification of film structure. The purpose of present work was to investigate the specific of structural and optical transformations under ion implantation.

NiO films with thicknesses near 300 nm were deposited on the Si and glass substrates by reactive DC magnetron sputtering of Ni target (99.95%) in the $Ar+O_2$ plasma. The substrate temperatures ranged from room temperature to $350^{O}C$. SNMS depth profiles show that the films contain the concentration of impurities less than 0.1 percent. The film modification was carried out by H^+, Al^+ and Ar^+ ion implantation. The prepared films were annealed at temperature range from 450 to 600 ºC by rapid thermal and furnace annealing. The modified films were studied using X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, Secondary Neutral Mass Spectrometry (SNMS) and Transmission electron microscopy (TEM). It was established that the ion implantation causes a change in the size of nanocrystals, porosity and optical characteristics of NiO films.

1. *Nandy S., Maiti U., Ghosh C., Chattopadhyay K,* // J. Phys. Condens. Matter -2009 -**21**, -P. 115804.
2. *Avendano E., Azens A., Niklasson G., Granqvist* // Sol. Energy Mater. Sol. Cells. -2004, -**84** (1−4), -P. 337−350.