ABSTRACT

This work investigates the carbon ions implantation effects on NiO thin film deposited on Si substrate by Direct Current magnetron sputtering. The NiO films were exposed to singly charged carbon ions (C^+) of energy 300 keV using Pelletron Accelerator. The films were irradiated at different values of exposure time such as 1, 30, 60 and 120 min corresponding to the dose of 0.04×10^{13}, 1.4×10^{13}, 2.8×10^{13} and 5.6×10^{13} ion/cm^2 respectively. The unirradiated and carbon irradiated (C-NiO) films were characterized by different techniques namely, X-ray diffraction (XRD), Atomic Force Microscopy (AFM) and Ultraviolet-visible (UV-vis) spectroscopy. The XRD graphs portrayed NiO (200) peak indicating the cubic crystal structure of the film. The lattice constant of NiO was decreased after C^+ implantation. The C^+ implantation in NiO film improved its crystallinity which was explained using the Thermal Spike Model. The surface roughness of NiO film was increased with increase of the exposure time. The energy band gap of NiO was also increased with increasing the C^+ exposure time. The NiO film with optimum crystallinity was used to fabricate a metal-semiconductor-metal (MSM) photodetector. An interdigitated mask was used to make metal contacts on the film. The Ag contacts were deposited on C-NiO by using thermal evaporator system. The photodetection response of the film was studied using current-voltage (I-V) and current-time (I-t) measurements. The C-NiO film was exposed to UV light of energy slightly greater than the band gap energy of the film. The I-V results displayed a substantial increase in the photocurrent of the Ag/C-NiO/Ag MSM device under UV light. Moreover, a Schottky contact was formed which was ascribed to the greater work function of the semiconductor relative to the Ag. Photodetection parameters like responsivity, sensitivity, detectivity, current gain, quantum efficiency, and rise/fall time were calculated and compared with the literature.