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Structural and Optical Investigations of 120 keV Ag Ion Implanted ZnO Thin Films

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Abstract

Structural as well as optical modifications in zinc oxide (ZnO) thin film with Ag ion implantation were carried out in the present study. The pure ZnO thin films were synthesized by RF-magnetron sputtering technique at room temperature. 120 keV Ag ion beam was used for Ag ion implantation with different implantation dose from 3×10^{14} to 3×10^{16} ions/cm^2 by negative ion implantation facility. The thickness and composition of pure ZnO and Ag implanted film at higher dose 3×10^{16} ions/cm^2 were estimated by Rutherford backscattering spectroscopy. The change in surface stoichiometry was estimated by using X-ray photoelectron spectroscopy with Ag ion implantation. The modifications in structural features with Ag ion implantation in ZnO films were observed by X-ray diffraction technique (XRD). The pure ZnO thin film was preferentially grown in c-axis direction with crystallite size ~ 10.6 nm confirmed by XRD. Surface morphology of the pure and Ag implanted ZnO thin films was estimated by atomic force microscopy and revealed the roughness and grain size were increased with increasing the implantation dose. The transmittance of the films was decreased drastically at higher implantation dose as corroborated by UV-visible spectroscopy. Raman spectroscopy of the films was used to understand the lattice defects and disordering during Ag ion implantation. At the higher dose, the film was entirely oriented in *c*-axis confirmed by X-ray pattern, which can be beneficial for device fabrication.

Keywords: Ion implantation; Rutherford backscattering spectroscopy; Raman spectroscopy; Zinc oxide; Thin films; Sputtering; X-ray diffraction

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