

## ABSTRACT

This work explores the effect of copper ion implantation on structural, morphological, electrical and optical properties of ZnO thin film at different ion doses. The ZnO films were prepared on Si (100) substrate by using DC magnetron sputtering system in reactive oxygen atmosphere. The as-prepared films were implanted with 350 keV copper ions at doses of  $5 \times 10^{12}$  ions/cm<sup>2</sup>,  $1 \times 10^{13}$  ions/cm<sup>2</sup>,  $5 \times 10^{13}$  ions/cm<sup>2</sup>,  $1 \times 10^{14}$  ions/cm<sup>2</sup> by Pelletron Accelerator. The grazing incident angle X-ray diffraction (GIXRD) results revealed highly c-axis (002) oriented ZnO film with large intensity and narrow full width at half maximum (FWHM). After copper ion implantation in ZnO film, the intensity of (002) diffraction peak was considerably decreased which was followed by increase in its FWHM value. The peak shifting towards lower diffraction angle was noticed at all the ion doses which depicted an increase in the lattice parameter of copper implanted ZnO film due to substitution of Cu<sup>+</sup> on the Zn sites. The crystallite size was decreased and lattice strain increased due to lattice disorder/changes created by copper ion implantation in ZnO film. The surface morphology results indicated elongated grains of the ion-implanted films having grain size within the range of 44 nm to 48 nm. The higher grain size after copper implantation was attributed to the aggregation of small grains; however, this size was decreased at  $1 \times 10^{14}$  ions/cm<sup>2</sup> due to segregation of the grains. The energy dispersive x-ray spectroscopy results showed the presence of copper inside the ion implanted films. The electrical resistivity was increased after ion implantation at  $5 \times 10^{13}$  ions/cm<sup>2</sup>; however, it was started decreasing with increasing ion dose to  $1 \times 10^{14}$  ions/cm<sup>2</sup>. The changes in resistivity were explained in terms of changes in the crystalline quality of the film at different doses. The band gap of ZnO was decreased after the copper ion implantation which was attributed to reduction in the carrier concentration in the film implanted with acceptor copper ions.