Effect of 25 keV cobalt ion implantation on the structural and optical properties of In_2O_3 thin films

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In this paper, the effect of low energy (25keV) Co ion beam on the structural and optical properties of indium oxide thin films have been studied. The use of low energy ion beams as a method of doping is attracting a lot of research interest. This is due to the various advantages that are offered by ion implantation over conventional methods of doping such as better depth and concentration control [1]. We have grown indium oxide films on quartz substrates using a two-step approach involving thermal evaporation followed by thermal oxidation. Cobalt ion implantation of these films was carried out at Inter University Accelerator Center using the negative ion implanter at an energy of 25keV and at different doses ranging from 10^{15} - 10^{16} ions/cm².

Figure 1: XRD pattern of Co-implanted In_2O_3 films at different ion doses

To study the changes in its structural and optical properties various studies were performed such as XRD, SEM-EDAX, RBS and UV-Vis Spectrophotometry. The XRD spectra depicted in Figure 1 shows the effect of Co-implantation on the crystallinity of the films. It can be clearly seen that the crystallinity of the films is enhanced as we increase the ion

dose from 10^{15} to 10^{16} ions/cm². The crystallite size is also found to increase from 11.6nm to 27.3 nm with increase in ion dose. This can be attributed to the fact that ion implantation promotes crystal growth [2]. Rutherford back scattering spectrometry was also performed to provide an evidence for the presence of Cobalt in the implanted samples. SEM- EDAX study was carried out to study the changes in surface morphology and elemental composition percentage of the films upon implantation.

UV-Vis Spectra is shown in Figure 2 representing transmittance vs. wavelength variation for different ion doses which depicts a decrease in the optical transmittance with increasing ion dose.

The crystallinity of the films is enhanced due to ion implantation which opens doors to applications such as gas sensors.

Figure 2: transmittance vs. wavelength graph for Co-implanted In_2O_3 films at different ion doses

References

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