

Transparent Conductive Indium Zinc Tin Oxide Thin Films for Solar Cell Applications

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Abstract : Indium zinc tin oxide (IZTO) thin films were studied as a possible alternative to indium tin oxide (ITO) films for providing low-cost transparent conducting oxide (TCO) for thin film photovoltaic devices. IZTO films were deposited onto glass substrates at room temperature. A dc/rf magnetron co-sputtering system equipped with a ceramic target of the same composition was used to deposit TCO films. Earlier studies showed that the resistivity value of $\text{In}_{0.6}\text{Zn}_{0.2}\text{Sn}_{0.2}\text{O}_{1.5}$ (IZTO20) films could be lowered to approximately $6 \times 10^{-4} \text{ohm-cm}$ without sacrificing optical transparency and still maintaining amorphous structure through the optimization of process variables. The growth rate was kept at about 8 nm/min while the oxygen-to-argon pressure ratio varied from 0% to 7.5%. As-deposited films were always amorphous and showed strong oxygen pressure dependence of electrical resistivity and electron concentration values. Influence of forming gas anneal (FGA) at medium temperatures was also studied and proven effective in improving electrical properties. In this study, the chemical composition of the targets and the films varied around the $\text{In}_{0.6}\text{Zn}_{0.2}\text{Sn}_{0.2}\text{O}_{1.5}$ (IZTO20). It was the main objective of this paper to investigate how off-stoichiometry affected TCO characteristics including electrical resistivity and optical transmission. In addition to the composition effect, we have also studied how film properties changed with processing variables. IZTO thin films have shown their potential as a possible alternative to ITO thin films, in such way that they could be adopted in some applications where currently ITO and IZO thin films are being used. Our experimental results are compared to those obtained for commercial ITO thin films from solar cell application view point.

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