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Influence of inactivated dopants clusters and post annealing on electrical and optical properties of indium tin oxide on plastic substrates

TERRY ALFORD, HAUK HAN, School of Materials and Flexible Display Center at Arizona State University, JAY LEWIS, Center for Materials and Electronic Technologies, RTI International — Indium tin oxide (ITO) films have been introduced as a transparent electrode for large area electronics such like display and photovoltaics due to their high electrical conductivity coupled with high transmission. This study describes the influence of Sn defect clusters on the electrical and optical properties of the ITO films. Absorption coefficient analysis indicates that electrically inactive Sn clusters generate defect states within the band gap and strongly affect the electrical and optical properties of the ITO films. Electrical and optical properties of ITO films are enhanced by reduction of Sn defect clusters with activation of Sn dopants, upon heat treatment. To explain the enhanced carrier transport property, we propose the reaction model based on our Rutherford backscattering spectrometry (RBS), Hall measurement, and x-ray photoelectron spectroscopy (XPS) data. The proposed model describes Sn^{4+} ions forming a neutral defect complex with Sn^{2+} ions which may not contribute to electrical conductivity in the amorphous phase. These Sn defect clusters in the amorphous phase dissociate and could contribute to an increase in Sn^{4+} concentration in ITO films without changing oxygen contents.

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