Investigation of physical properties of conductive, transparent RF sputtered ITO thin films as a function of thickness and post annealing Temperature

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Abstract: Thin films Indium tin oxide (ITO) with various thicknesses, from 130-620nm, have been deposited on the thin glass substrates by RF sputtering using ITO ceramic (90% wt. In$_2$O$_3$ and 10% wt. SnO$_2$) target, and subsequently annealed in vacuum at various temperatures. Electrical and optical characteristics of ITO samples, before and after annealing at different temperatures, were investigated by four point probe and UV/VIS/IR spectrophotometer. Structural properties of layers deposited at optimum temperature of 400°C were analyzed by XRD. SEM analysis was used to investigate the morphology of the optimal surface layer. Results show that by increasing the thickness, crystalline structure varies, so that sheet resistance, resistivity and transparency of films vary. Layer deposited with 130nm (lower thickness) has 83.71% transmittance and $2.34 \times 10^{-4}$ cm resistivity. In contrast, 620nm thickness film with 79.07% transparency has the lowest electrical resistivity about $1 \times 10^{-4}$ cm at 400°C. This layer can be used as an optimal film with $1.6 \Omega/\square$ sheet resistance for many applications.

Keywords: thin films, tin doped indium oxide, crystalline structure, annealing in vacuum, thickness variation, sputtering