TUNING OPTICAL PROPERTIES OF ITO THIN FILMS WITH TILTED NANOCOLUMNAR STRUCTURES GROWN BY RF-SPUTTERING IN OBLIQUE ANGLE DEPOSITION

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The optical properties of tilted nanocolumnar indium tin oxide (ITO) thin films on glass substrates through the sputtering technique without and with annealing temperature to 250°C in the air are reported. The influence of the flux incident angle on the optical properties is investigated. The samples were prepared under different flux incident angles (θ) of 0°, 40°, 60° and 80° respectively. Scanning electron microscopy images showed nanocolumnar inclination shaped structures and presence of porosity. The inclination respect to a vertical line increased with increase the flux incident angle. The deposited films with annealing temperature showed a cubic structure with preferential (222) plane orientation and crystallites sizes between ~46 nm and ~67 nm. The transmittance values for all samples (without and with annealing) are in the range of 70-90% in the 450-1050 nm wavelength region. The band gap energy had values of ~3.48 to ~3.62 eV and values of ~3.74 to ~3.92 eV to films without and with a temperature of annealing respectively. When the flux incident angle is increased, the refractive index of the films is decreased between ~1.4 to ~1.8 and ~2 to ~2.2 for without and with annealing temperature effect respectively. Thus, the band gap energy and the refractive index properties of the film can be modified over a wide range by adjusting the flux incident angle and the temperature of annealing. It is suggested that the oblique angle deposition technique provides ITO films with more application possibilities by allowing their optical properties to be tailored.

Keywords: ITO thin films, nanocolumns, oblique angle deposition

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