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Physical properties of rare earth metal (Gd^{3+}) doped SnO_2 thin films prepared by simplified spray pyrolysis technique using nebulizer(Article)

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Abstract

Pristine and rare earth (i.e) gadolinium doped SnO_2 thin films have been coated on micro-glass substrates with different Gd doping concentration at constant temperature 450 °C by simplified spray pyrolysis technique using nebulizer unit. The variation of doping concentration from 0 to 6 wt.% in the steps of 2 wt.%. Structural, optical, electrical, morphological and photoluminescence properties had been examined as a function of gadolinium doping level. The X-ray diffraction study exposed that all the prepared pristine and Gd doped SnO_2 thin films are (110) preferred orientation with tetragonal crystal structure. The observed transmittance of Gd:SnO_2 thin film varies between 91–80% in the visible regions. The estimated optical band gap value was initially decreased from 3.79 to 3.74 eV and then it was slightly increased as 3.77 eV with respect to the increase of Gd doping concentrations. Homogeneous surface morphology with polyhedrons like grains without cracks for all the prepared samples was illustrated by SEM studies. EDS spectra confirms that the existence of Sn, O and Gd elements in the 4% Gd doped SnO_2 thin film surface. PL results indicates that three emission bands such as ultra violet, blue and green emission peaks at the wavelength of 360, 493 and 519 nm respectively, for all the prepared Gd:SnO_2 films. Minimum resistivity (ρ) 7.14×10^{-4} Ω-cm with activation energy (E_a) 0.05 eV, maximum carrier concentration (n) 2.36×10^{20} cm^{-3} and figure of merit (ϕ) 52.96×10^{-3} $(\Omega/sq)^{-1}$ were obtained for 4% Gd doped SnO_2 thin film using Hall effect measurements.

Author keywords

Electrical properties | Nebulized spray pyrolysis | Optical | Photoluminescence | SnO_2

Indexed keywords

Engineering controlled terms: Activation energy | Carrier concentration | Crystal orientation | Electric properties | Energy gap | Film preparation | Gadolinium | Morphology | Photoluminescence | Rare earths | Semiconductor doping | Spray pyrolysis | Substrates | Surface morphology

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