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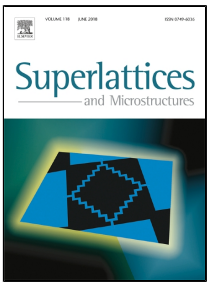

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Synthesis and Characterization of Zinc-Tin-mixed oxides thin films

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Abstract

The mixed oxides thin films were prepared by spray pyrolysis method on glass substrates using different molar ratios of zinc and tin in the starting solution Zn/(Zn+Sn)= 25 at.%, 50 at.%, and 60 at.%. The structural, morphological and optical properties were characterized by X-ray diffraction (XRD), atomic force microscopy (AFM), Scanning Electron Microscopy (SEM) and spectrophotometry. XRD analysis indicate the coexistence of both the hexagonal phase of ZnO and the tetragonal phase of SnO_2 for all mixed thin films. Microstructural parameters such as micro-strain and crystallite size suggest the good crystallinity of mixed thin film at 60 at.%. Optical analysis by means of transmittance T (λ) and reflectance R (λ) measurements allowed us to determine the optical constants for single and mixed oxides. The refractive index dispersion was adequately described by the Wemple-Di-Domenico model. The values of oscillator energy E_0, dispersion energy E_d, high-frequency dielectric constant ε_∞ as well as the ratio of the carrier concentration to the effective mass N/m^* were estimated according to both Wemple-Di-Domenico and Spitzer–Fan models.

Keywords: Zinc oxide; Tin oxide; Mixed thin films; Spray pyrolysis; Optical properties.

1. Introduction

Recently mixed oxides thin films received considerable attention from the research community. Especially, among various oxide semiconductors, wide direct band gap of SnO_2 (3.6 eV) [1] and ZnO (3.37 eV) [1] as well as mixed oxides (ZnO, SnO_2) thin films are the preferable materials for most applications, such as displays, solar cells [2], gas sensors [3], piezoelectric devises [4], anti-reflection coating [5], TCO alternative to the widely employed in smart windows and PVs [6, 7] and for solar thermal applications in flat-plate collectors etc. Such films are usually synthesized by a variety of techniques including RF magnetron sputtering [8], spray pyrolysis [9, 10], sol gel [11] and pulsed laser deposition [12]. However, among all these techniques the spray pyrolysis is a cost effective, stable and reliable technique to fabricate highly transparent films with thickness uniformity. Among these literatures, few studies