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Research Article

Synthesis and Effect of Thickness on the Structure and Optical Properties of ZnO Thin Films Prepared By Sol-Gel Spin Coating Method

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Abstract: In this work , (ZnO) films are prepared by (sol – gel) method . Zinc Oxide (ZnO) thin films was growth on to hot glass substrate at 60 oC temperature by spin coating. Then samples were annealed at temperature (450) ºC with three thicknesses (58 ,69 and 77)nm for 1 hr. The experimental diffraction angle Θ and d-spacing values are in agreement with the standard ASTM data for all thin film thicknesses .The structure parameters like lattice parameter (a); grain size (D) ; dislocation density (σ); micro strain (ε)are calculated . The absorbance (A) , transmittance (T) and reflectance (R) are recorded in the range (300 – 1000) nm , and used to calculate the refractive index (n) , extinction coefficient (k) , band gap (Eg) , optical conductivity (σ_{opt}) , complex dielectric constant (ε_1 ,ε_2 ,ε_∞), relaxation time () , average interband oscillator wave length (λo) , average oscillator strength (So) , (N/m*), dissipation factor (tanδ) and the optical dispersion parameters (Eo , Ed) were determined.

Keywords*:* Zinc Oxide ; Sol-Gel ; thin films ; X-ray diffraction , structure parameters ,Optical properties.

1-Interoduction

Zinc Oxide (ZnO) belongs to the family of II-VI compound wide – gap semiconductor with a room temperature direct band gap of (3.37) eV and a large exciton binding energy of about (60) mV, which makes it a very attractive material for the application to the advanced optoelectronic devices [1], and good efficiency of exciton recombination that with result in a high gain at room temperature. Also, it displays good piozoeletric, good catalysis and novel optical proportions, such as UV-light –emitting or lasing proportion. Specially, ZnO has a high break down voltage that is almost four times that of GaAs [2-4]. This is the reason that ZnO has recently received more and more attention from many researchers.

The structure of ZnO is a mixture of cubic and hexagonal structure depending on the manufacturing conditions. The electronic transport mechanism in polycrystalline thin films strongly depends on their structure (i.e . grain size , grain boundaries and structure defects). The X-ray diffraction technique was used to determine the crystalline structure and grain size Of ZnO thin films [5].Most prominent crystalline structure of ZnO is wurtzite type, although it also exists in the cubic Zinc blende and rock salt structure. In wartzite type each Zn ion is surrounded by a tetragonal coordination. This give rise to polar symmetry along the hexagonal axises which is responsible for a number of properties of ZnO [6].
Zinc Oxide is one of transparent conducting oxide (TCO) materials whose thin films attract much interest. (TCO's thin film is a wide direct band gap compound semiconductor such as In2O3 , SnO2 , ZnO , CdO , Cd2SnO4 ,…….)[7].

It is important material due to its typical proportion such as high chemical and mechanical stability and high optical transparency in visible and near – infrared region (more than 80% depends on the deposition technique and thickness), It can be used as antireflection coating layer solar cells [8] and gas sensor [9] . Moreover, ZnO is promising material for short wave optoelectronic devices, especially for UV light – emitting diode and laser diode, due to its large exciton binding energy is much larger than the room temperature thermal energy [10].

Many techniques have been employed to prepare ZnO films such as pulsed laser deposition (PLD), magnetron sputtering (MOCVD), spray pyrolysis [11-14]. Thermal Vacuum Evaporation (TVE) and molecular beam epitaxy [15]. Sol-gel technique is widely adopted due to its comparatively simple procedure as there is no need of costly vacuum system and it has a wide-range advantage of large area deposition and uniformity of the films thickness. The sol-gel process also offers other advantages for thin film deposition including outstanding control of the stoichiometry and easy doping in film composition. The structure and physical properties of ZnO thin films prepared by sol –gel technique using various inorganic and organic precursors at different deposition conditions have been reported in literature [16, 17].

F.Leandro et al [18] found that the film thickness has a strong influence on the optical absorption of nanostructured α- Fe2O3 nano thin film. They report that, stress induced due to increased thickness, generator detects in the crystal lattice of the hermatite film, which intern increase the electron-hole recombination process [6, 19]. In the present work , thin films of ZnO have been fabrication by spin coating on to glass substrats .optical constant and oscillating parameter have been determined as an include the absorbance , transmittance , reflectance spectra , refractive index , extinction coefficient , optical conductivity , complex dielectric constant and thickness.