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Optical and Dispersion Analysis of Zinc Selenide Thin Film

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Abstract

Thin film of Zinc Selenide (ZnSe) has deposited by thermal evaporation method onto pre cleaned glass substrate under high vacuum condition. The deposited ZnSe film has been characterized for optical and dispersion analysis from absorption spectra within the wavelength range of 300 nm-1100 nm which was recorded by using UV-Visible spectrophotometer. The optical parameters (optical band gap, Urbach energy, steepness parameter, complex dielectric constant, extinction coefficient and refractive index) have been calculated from absorption spectra. The dispersion parameters (oscillation energy, dispersion energy, oscillator strength, oscillator wavelength, static refractive index, high frequency dielectric constant, lattice dielectric constant and plasma resonance frequency) have been analyzed by Wemple-DiDomenico single oscillator model.

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Keywords: Absorption spectra; optical parameters; dispersin parameters; ZnSe thin film

1. Introduction

The ZnSe thin film exhibits many physical phenomena with novel optical, photoluminescent and electroluminescent properties. For technological point of view, ZnSe thin film is potentially applicable for optoelectronic and electronic industries. ZnSe thin film has wide band gap (2.7 eV) and low resistivity which is suitable for red, green and blue light emitting diode and thin film transistors. It is also applicable for buffer/window

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layer in chalcogenide based thin film solar cells [1-4]. The ZnSe thin film has high transparency over a wide range of spectrum and relatively large value of linear and non linear optical coefficient. These properties of ZnSe thin film make it useful for manufacturing lenses for high IR laser [5] and dielectric mirror [6].

In this paper, optical and dispersion parameters of ZnSe thin film has been analyzed by Tauc and Wemple-DiDomenico single oscillator model.

2. Experimental Procedure

ZnSe polycrystalline film was deposited on to pre cleaned glass substrate by thermal evaporation method under high vacuum condition at controllable substrate temperature. The glass substrate was cleaned with chromic acid, acetone and was rinsed in distilled water before deposition process. ZnSe powder (99.999% pure) was used as target material which kept in Molybdenum boat. The rate of deposition was controlled by external current. The film thickness and deposition rate was found to be 7300Å and 2-5 Å/s respectively which were measured by Quartz crystal monitor during deposition process. The deposition process was performed in stainless steel vacuum chamber with pressure of 5 x 10^{-6} mbar. Optical and dispersion parameters of ZnSe thin film studied by absorption spectra at room temperature in the spectral range between 300nm-1100nm by UV-Visible spectrophotometer (CARY-300, Varian, Australia).

3. Results and Discussion

3.1. Optical analysis

The optical transmittance and reflectance spectra of ZnSe thin film were obtained from absorption spectra by using following relation [7];

$$T = \frac{1}{10^{A}} \tag{1}$$

$$A + T + R = 1 \tag{2}$$

Where A, T and R are absorption, transmittance and reflectance values of ZnSe thin film respectively.

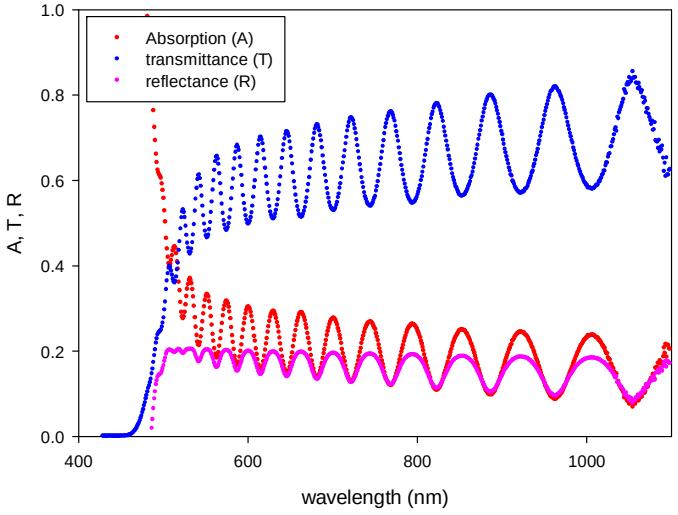

Fig.1: Absorption, transmittance and reflectance spectra of ZnSe thin film.