Available online at: www.basra-science-journal.org

ISSN –1817 –2695

Optical constants of Zinc sulphide ZnS thin films for different annealing temperature

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Received 22-4-2013 , Accepted 2-3-2014

Abstract

Zinc sulphide ZnS thin films were prepared by the spray pyrolysis (SP) technique on glass substrates at different temperatures (450, 500,550 and 600°C). Transmittance and absorbance measurements in the wavelength range (200–1000 nm) were used to calculate the refractive index n and the extinction coefficient k. The optical band gap $E_g(= E_{opt.}^{WD})$, optical conductivity σ_{opt}, complex dielectric constant ε_1, ε_2, ε_∞, relaxation time τ, average interband oscillator wave length λ_o average oscillator strength S_o, N/m*(N the free charge carrier concentration , m* the effective mass of the free charge carrier) and dissipation factor tanδ were determined. The analysis of the optical absorption data indicates that the optical band gap was indirect transitions. According to Wemple and Didomenico method, the optical dispersion parameters E_o and E_d were determined.

Keywords: Zinc sulphide; Optical properties; Optical dispersion parameters; Dielectric constant; Relaxation time.

1. Introduction

Zinc sulphide thin films have in recent years been rediscovered as a subject of considerable research interest due to their very unique physical properties (piezoelectricity, conductivity, magnetic and optical) and a wide range of possible device application. Special care is directed to optical and magnetic memory devices, laser system, blue light diodes, medicine, environment protection, solar cells (transparent conducting electrodes), displays, ultrasonic transducers and sensor [1-3].

(ZnS) is important semiconductor material with a wide direct band gap E_g = 3.5 eV, high refractive index (2.35 at 632 nm), high effective dielectric constant (9 at 1 MHz). It's optical properties make it useful as a filter reflector and planer wave guide [4]. ZnS has been studied due to its wide applications as phosphors and catalysts [5]. ZnS is also applicable for a variety