Investigation of Optical and Electrical Properties of Amorphous $Se_{95-x}S_xZn_5$(x=0.2, 2, 5 and 10) Thin Films

Mohd. Nasir[1a)],Shabir Ahmad[1], M. Zulfequar[1b)].

[1]*Department of physics, Jamia Millia Islamia, New Delhi-110025, India*

[a)]Co-author. Email: nasir_sphy@yahoo.com
[b)]Corresponding author. Email: zulfequarphy@rediffmail.com

Abstract. In this study, we reported that the optical and electrical analysis of amorphous $Se_{90-x}S_xZn_5$ (x=0.2, 2, 5, 10) thin films. Bulk samples of the investigated material were prepared by melt quenching technique. Thin films of ~ 300nm thickness were deposited on cleaned glass substrates by thermal evaporation technique. The morphological study of the investigated material in powder form carried out by scanning electron microscopy (SEM) confirms the disorder of the material increases at lower sulfur doping (up to 5%) whereas at higher (S) doping (10%) the defects of the material decreases. The optical parameters were estimated from optical absorption spectra data measured from UV-Vis-spectrophotometer in the wavelength range 200-900 nm. It was found that the value of optical band gap (E_g) of the investigated thin films decreases up to lower S doping and increases at higher (S) doping. The other optical parameters such as absorption coefficient (α) and extinction coefficient (K) increases up to lower S doping and decreases at higher S doping. This remarkable change in the values of optical parameters was interpreted on the basis of model proposed by Davis and Mott. Electrical parameters of the investigated thin films were carried out in the temperature range 309-370 K. Analysis of data shows activation energy decreases with the increase of concentration of (S) increases up to 5% and at 10% it increases again.

INTRODUCTION

From last three decades the nanosize materials as a type of recent quantum solid state materials, have been subjected to extensive research for their unique chemical and physical properties. But in recent years, because of the number of practical applications in the field of optoelectronics and electro-optics, a great deal of interest has been shown in the studies of the optical and electrical conduction behavior of various semiconducting materials [1-6]. Nevertheless, most of the experimental work carried out so far for Se-S-Zn relates to various conduction mechanisms, which only provides information about the nature of transport processes. The alloy materials are belongs to a special group of Non-crystalline semiconductors, which consist of one, two and more chalcogenide elements S, Se, Te of the periodic table from the VI group. Selenium, Zinc and Sulfur $Se_{90-x}S_xZn_5$ is a promising candidate from II-VI semiconducting materials due to their future application in optoelectronic devices such as solar cell, laser diodes (LD) and green-blue light emitting diodes (LED), etc. [7-9]. It can also be used as dielectric mirrors; optically controlled switching devices [10-11].It's a promising material for photo-electronic devices. Therefore, Se-S-Zn is of immense interest as a model material in such form as thin film, quantum wells and bulk crystals [12]. A wide range of applications could be anticipated in the use of nanometer size particles in electronic devices [13].In contrast silicon and other group IV tetra-hedrally bonded semiconductors; the chalcogenide alloys have attracted a lot attention due to their interesting optical, electrical and physical properties which can be controlled by changing their chemical composition [14-15]. This property of chalcogenide alloys makes these materials useful for technological applications including phase change memories. The major drawback of alloys semiconductors over their crystalline counterparts is the presence of inherent defect states in the mobility gap of these materials. Chalcogenide semiconductors have also drawn great awareness from scientists because of their latent applications in various solid-state devices. The transport mechanics of charge carriers in nano-materials has been subject of intensive theoretical and experimental investigation for the last few years. These studies have been stimulated by the attractive possibilities of using the structure disorder in

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