

# Electrical transport mechanism in $\text{Cd}_5\text{Se}_{95-x}\text{Zn}_x$ chalcogenide thin films

Mohsin Ganaie<sup>1</sup> · Shabir Ahmad<sup>1</sup> · M. Zulfequar<sup>1</sup>

Received: 2 June 2015 / Accepted: 30 August 2015 / Published online: 4 September 2015  
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**Abstract** The thin films of  $\text{Cd}_5\text{Se}_{95-x}\text{Zn}_x$  ( $x = 0, 2, 4, 6$ ) chalcogenide semiconductors were deposited by using thermal coating unit on ultra clean glass substrate under a high vacuum of  $10^{-6}$  Torr. The amorphous structure of the deposited films has been confirmed by X-ray diffraction technique. Current–voltage (I–V) measurements at high electric fields have been carried out at different fixed temperature for the present samples. The analysis of the data could be fitted to the theory of space charge limited conduction mechanism, from where the density of localized states has been calculated. Temperature dependent DC conductivity has been reported in the temperature range of 290–390 K, which shows that the conduction is due to thermally activated tunneling of charge carriers in the band tails of localized states near Fermi level. The addition of Zn in Cd–Se system results an increase in density of localized states and hence increase in electrical conductivity.

## 1 Introduction

Amorphous chalcogenide (II–VI group elements) semiconductors has been extensively studied due to their wide applications in optoelectronics devices, such as photodiodes, photo resistors, optical wave guides, Solar cells, Laser diodes etc. [1–4]. More recently, the thin film form of these materials have gained much interest due to their structural, morphological and transport properties for their potential use in various technological purposes. Cadmium

zinc selenium ( $\text{CdSeZn}$ ), one of the II–VI group semiconductor materials, plays a prominent part in the modern material science and technology [5]. Thin film of Zn a-semiconductor play a crucial role for fabrication of large area arrays, sensors, interface items, photo conductors, anti reflector coating, IR detectors, optical fibers etc. [6]. By choosing the composition parameter ( $x$ ) these materials can be engineered better for application purposes. Therefore we have a plan to deposit and study the properties of  $\text{CdSeZn}$  thin film. There are number of techniques by which the thin films may be deposited such as thermal evaporation techniques [7], chemical bath deposition [8], chemical vapor deposition [9], etc. Among the different techniques  $\text{CdSeZn}$  films have been prepared by thermal evaporation technique, which is well established technique [10, 12]. The properties mostly depend on the preparation and deposition technique. The addition of Zn in Cd–Se system is expected to create the compositional and structure disorder as compare to binary alloy. Because of low thermal and electrical conductivity amorphous semiconductors are more appropriate for high field conduction. Various researches [10–13] have done on the structural and transport properties of a-semiconductor with different composition. High field conduction study in Vacuum evaporated thin film having different electrode separation has been measured; using this analysis an idea of density of states close to Fermi level is evaluated. In the measurement of SCLC, the superlinear I–V curves due to injection of charges carriers from electrode contacts are measured, when the charge carrier increase large, the current become super-linearly.

In the present work, authors have reported the high field conduction at different temperature having different electrode gap, SCLC seemed to dominant mechanism from where density of states has been calculated.

✉ M. Zulfequar  
mzulfe@rediffmail.com

<sup>1</sup> Department of Physics, Jamia Millia Islamia,  
New Delhi 110025, India