# Electrical Properties of II-VI Solid-Solution of ZnSe Thin Films by Spray Pyrolysis

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**Abstract:** ***Solid-solution of II-VI group of semiconducting thin films have important due to opto-electronic devices. The conducting type was tested by hot probe method was of n-type semiconductor. From the Arrhenius plot, the conductivity increases as the temperature increases. Grain size of the the films increases as temperature increases which indicate the optical band gap increases. Hence grain boundary effect decreases. The shallow trapping states preferably due to interstial zinc or selenide vacancies are expected to dominates extrinsic conductivity, whereas higher temperature deep traps state influence are appears.***

**Keywords:** ZnSe thin films, electrical properties

## 1. Introduction

Thin films of zinc selenide are of considerable interest using to their use in the fabrication of heterojunction solar cells and other upto-electronic devices. Photoelctronic properties of ZnSe thin films are greatly influenced by both native and foreign imperfections. Foreign atom are generally contaminated in the lattice during the film preparation which can cause a considerable change in the electrical and optical properties of semiconductor films, without causing a major change in the crystal structures. However heat treatment or annealing effect reduced these type of defects.

Although, these exist various films deposition techniques, such as chemical bath deposition, vapour deposition, flash evaporation, r.f. sputtering and spray pyrolysis. We have chosen spray pyrolysis method because it is easy,simple, inexpensive and easy to handle to preparation of the films on the large substrate area. Although the variety of works on ZnSe thin films and photoconductivity properties is desirable for understanding rate of defects level in the photoconductivity mechanism.
In this paper we have reported the electrical properties of ZnSe thin films prepared at optimized temperature $350^0$C.

## 2. Preparation of the films

Aqueous solution of zinc chloride and selenium dioxide were used for spraying the films on the preheated glass substrate. The solution of each was 0.1 M. Chemical are used as AR-grade. The temperature of the substrate was maintained at $350^0$C , which was the most optimized temperature for the production of ZnSe thin film. The temperature of the substrate was measured by pre-calibrated copper constantan thermocouple. The sprayer was mechanically move to and fro to avoid the formation of the droplets on the substrate and insure the instant evaporation. To prepare desired ZnSe thin films, the proportion of the solution was taken in the ratio 1:2.2 by volume. The selenium deficiency [1-3] was observed if the ratio of the proportion taken as 1:1 by volume. The spray rate was maintained at 3.5 ml/min and spraying pressure 12 kg/cm$^{2.}$ The thickness of the films so obtained was of the order of 0.163 μm. Thickness of the films was measured by Michelson interferometer. Resistivity of the films was determined by using four probe method [4]. The conductivity of the films was tested by hot probe method.

## 3. Electrical Properties

Conductivity of the was tested by hot-Probe method was of n-type semiconductor. Fig.1. Shows the Arrhenius plot of conductivity versus inverse temperature.

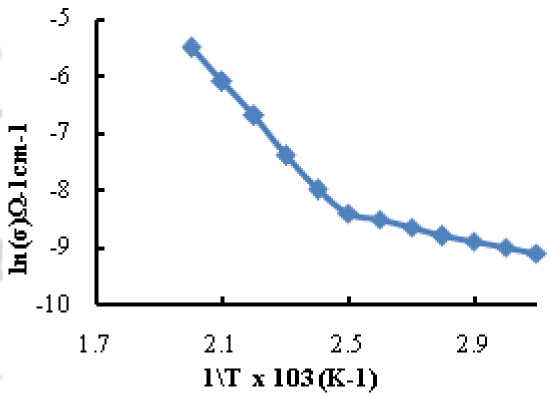


**Figure 1:** Arrhenius plot of conductivity versus inverse temperature

Electrical resistivity of the films was calculated by using four probe method (4)

$$\varrho = 2\pi s\ V/I\ /G_7\ (t/s) \quad (1)$$

and $G_7$ (t/s) = 2s/t ln (2)

Where s-the distance between the probes, t-be the thickness of the films I be the current generated from constant current source between the inner probes, V-the voltage between outer probes.

The temperature dependence of dark conductivity was studied from the temperature range 300 k to 573 k. The rise of conductivity (σ) is usually expressed as,

$$\sigma = \sigma_0 \exp\ (-Ea/kT) \quad (2)$$

Where $\sigma_0$-is the prexpontial term, k-Boltzmann constant, T-be the absolute temperature, Ea-be the activation energy. The conductivity plot clearly shows two conduction region. The slope is less in the low temperature region but increases further increases of temperature. From the slopes of the plot, the activation energies are calculated, polycrystalline thin films of ZnSe have grain boundary effect reduced on the heat treatment.

It is seen from the conductivity energies that the films do not possess the intrinsic conductivity strictly in this entire range of temperature. The shallow trapping states preferably due to interstial zinc or selenide vacancies are expected to dominate the extrinsic conductivity near the room temperature whereas at higher temperature deep traps states influence are probable appears. The increases the conductivity at high temperature may be attributed to the increase in the band gap of ZnSe thin films [5] and hence increase the activation energy. The increase the activation energy increase the grain size of the films hence on heat treatment of the films grain boundary effect decreases just like CdSe thin films [6].

## 4. Conclusion

Spray pyrolysis is a simple and inexpensive method to prepare thin films of ZnSe. From the conductivity plot the activation energy increases as temperature increases, indicates the decrease of grain boundary effect.

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