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Influence of ZnSe on Electrical Resistivity in ternary thin films of $Cd_{1-x}Zn_xSe$ prepared by vacuum Evaporation

Sarita and *Gulbir Singh
Department of Physics, Govt. (P.G.) College, Hisar
*Department of Physics, S.G. (P.G.) College, Saroorpur Khurd, Meerut (UP)

ABSTRACT
Ternary alloys of cadmium and zinc selenide ($Cd1_{-x}Zn_xSe$) is attracting a great deal of attention due to their fundamental experimental and applied interest in thin film devices. Thin films of CdZnSe alloy were prepared by vacuum evaporation technique. The I-V characterization and the electrical resistivity of selenium rich system at room temperature have been studied using Keithley I-V measurement system by two probe method at room temperature. The electrical resistivity of the samples has been found to vary between $0.05 \times 10^6\ \Omega$ cm and $0.416 \times 10^6\ \Omega$ cm.
Key words: *ternary alloys, vacuum evaporation, electrical resistivity.*

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INTRODUCTION

The technological interest in ternary alloys of II-VI group based devices is mainly caused by their very low production costs. CdSe is a n-type material and they are of interest for their applications as photoconductors [1], solar cells [2], thin film transistors [3], gas sensors [4]. ZnSe has a direct band gap of 2.7 eV and is transparent over a wide range of the visible spectrum. Cadmium zinc-selenide [(CdZn) Se] is used in electroluminescent, photo luminescent, photoconductive and photovoltaic device applications because of its interesting size-dependent properties as well as a high stability and wide optical band gap which covers the maximum electromagnetic spectrum [5,6].

EXPERIMENTAL

The as-deposited thin films of $Cd_{1-x}Zn_xSe$ alloy at different composition (x= 0, 0.2, 0.4, 0.6, 0.8, 1) have been deposited onto highly cleaned glass substrate by using vacuum evaporation technique (Vacuum Coating Unit Model 12A4). The silver paste was used to make electrodes on the vacuum evaporated $Cd_{1-x}Zn_xSe$ thin films for I-V measurements. The distance between these two electrodes was kept 3 mm. The I-V characterization of the samples was done using Keithley I-V measurement system (Model No. SCS - 4200). The measurements were done in the range of -10 V to +10 V at a step of 0.05 V at room temperature using two probe methods.

RESULT AND DISCUSSION

The figure 1 shows the I-V characteristics of vacuum evaporated $Cd_{1-x}Zn_x$Sethin films at room temperature. For all samples the variation of current (I) with applied bias voltage (V) in the range of -10 to +10 Volt are linear i.e. the conduction is ohmic (I directly proportional to V). From the I-V characteristics of the samples, the electrical resistivity has been determined. The value of electrical resistivity of vacuum evaporated $Cd_{1-x}Zn_xSe$ (x=0, 0.2, 0.4, 0.6, 0.8, 1) thin films with composition 'x' are given in table 1.

Table 1: Variation of Resistivity with Composition 'x'.

mposition (x)	Resistivity (* 10^6 Ω cm)
CdSe	0.05
$Cd_{0.8}Zn_{0.2}Se$	0.41
$Cd_{0.6}Zn_{0.4}Se$	0.416
$Cd_{0.4}Zn_{0.6}Se$	0.191
$Cd_{0.2}Zn_{0.4}Se$	0.127
ZnSe	0.119

The figure 2 shows that the resistivity is maximum for x = 0.4 (i.e.$Cd_{0.6}Zn_{0.4}Se$) and is lowest for x = 0 (i.e. CdSe) in the ternary system of $Cd_{1-x}Zn_xSe$ thin films at room temperature.

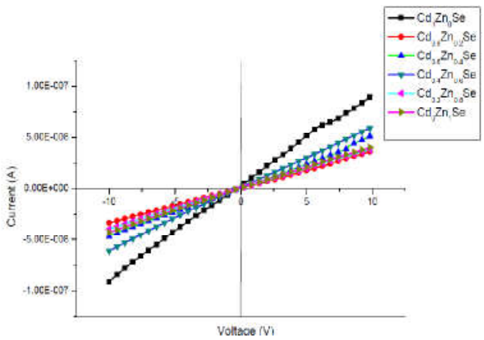

Figure1: Comparative Study of C-V Characteristics of Vacuum Evaporated $Cd_{1-x}Zn_xSe$ Thin Films.

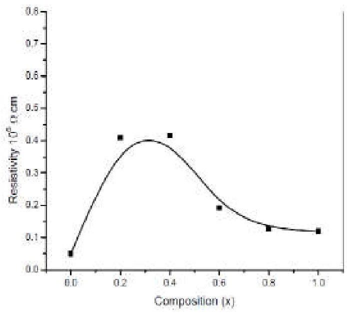

Figure 2: Comparative Study of Resistivity of Vacuum Evaporated $Cd_{1-x}Zn_xSe$ Thin Films.

CONCLUSION

The reason being that as we introduce Zn content in CdSe the resistivity increases and reaches at maximum for x = 0.4. This may be due to that some Zn content settles down at the interstitial sites of CdSe lattice as the volume of Cd atom (atomic radius 0.171 nm) is greater than that of Zn atom (atomic radius 0.138). Due to this factor there is an increment in the number of scattering center available in the material and therefore, it causes increase in the resistivity.

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