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Study of resistivity, Hall coefficient and Carrier concentration of CdSxSe1-x thin films of as deposited by spray pyrolysis

Physics

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ABSTRACT

II-IV group of semiconductor are of great important role due to their application in solar cell fabrication. Spray pyrolysis is a very Cheap and inexpensive method for the preparation of films on large area. Resistivity, Hall mobility, carrier concentration were measured at room temperature by Vender Hall Pauw method. From these results we conclude that resistivity and Hall mobility decreases as percentage of 'S' increases while Hall coefficient increase. This may be due to the donor's cadmium interstitials or sulphur vacancies.

Introduction

CdS_xSe_{1-x} belongs to II-IV compound of semiconducting is an important due to their various application in semiconductor device technology. Thin films of $CdS_xSe_{1-x}$are used in the fabrication of transistor, solar cells, and photoconductors Hall mobilities of charge carriers in the binary compound are known to be limited by Piezoelectric, optical mode, impurities scatterings in different degrees at low temperature (1). Uthanna and Reddy (2) have reported the dependence of electrical resistivity and Hall mobility on the percentage of selenium or sulphur presents the compound. Their results showed that that resistivity decreased expontially with the composition parameter x and Hall mobility increased with x. Also films deposited at high substrate temperature showed a reduction in resistivity. Belyaev et al have concluded studies on resistivity and hall mobility dependence on temperature of the films deposited at 430^0C on mica by the heat screen method. They have taken the measurements in the 100 K -300 K range.

In the present work the resistivity, Hall coefficient and carrier concentration of CdS_xSe_{1-x}thin films by spray pyrolysis were studied in the entire range of composition parameters x (0, 0.25, 0.50, 0.75) and 1 at room temperature. Hall mobility, carrier concentration and resistivity are calculated and their variation with composition is discussed. There are several methods to prepared thin films of CdS_xSe_{1-x}such, as r. f. sputtering, flash evaporation, vacuum evaporation, chemical vapour deposition and spray pyrolysis (5, 6).
We have chosen spray pyrolysis method to prepared cdS_xse_{1-x} thin films, due to easy, inexpensive method. The resistivity and Hall coefficient of thin films was measured.

by Van der Hall Pauw method (7). The thickness of thin films was measured by Michelson interferometer. Ohmic contacts to the films were established by indium solder (no flux). All the reading were taken at room temperature. The temperature of the substrate was measured by pre- calibrated copper constantan thermocouple.

Experimental Details:-

Thin films of CdS_xSe_{1-x} can be prepared by aqueous solution of cadmium chloride, thiourea and selenium dioxide of 0.02 M of each. These three solutions are taken in sprayer and then spray on the substrate which was maintained at 350^0c. The sprayer was move to and fro to avoid the formation of the droplets on the substrate and to ensure the instant evaporation. Thin films of CdS_xSe_{1-x} prepared for different composition parameter x=0, 025, 0.50, 0.75 and 1.0. To desire thin films obtain. The solutions were taken in the ratio of proportion 1:2.2 by volume. The films show the selenium or sulfphur deficiency if solution were taken in the ratio 1:1 by volume.

Measurement of Resistivity, Hall mobility and carrier concentration:-

The resistivity, Hall mobility and carrier concentration were measured at room temperature for CdS_xSe_{1-x} thin films of different composition were shown in table.1. The calculated Hall coefficient, Hall mobility and carrier concentration of thin films were plotted against composition parameter shown in fig a,b,c.

Table.1 showns the hall mobility carrier concentration, Hall coefficient Resistivity and conductivity of CdS_xSe_{1-x} thin films of all composition parameter x at room temperature.

Composition Parameter (x)	Hall mobility μ_h(cm^2/v)	Hall Coefficient $R_h = 1/ne$	Carrier concentration (cm^{-3})	Resistivity ρ	Conductivity σ
0.00	6.06	0.15	$2x10^{16}$	312.5	46.875
0.25	1.02	0.98	$9.5x10^{16}$	65.78	64.464
0.50	0.90	1.11	$4.0x10^{17}$	15.625	17.343
0.75	0.55	1.81	$5.5x10^{17}$	11.363	20.567
1.00	0.11	9.09	$6.00x10^{17}$	10.416	94.681

From the plot we conclude that Hall mobility and resistivity decreases as the composition parameter x is increases i.e. Percentage S increases (Se decreases).

While carrier concentration increases as percentage of S increases (Se decreases). Our calculated value of CdS and CdSe thin films are well agreed with the Reddy et al (8). They stated that rate of decreases of carrier concentration and the rate of increase of mobility as the temperature is lowered. Our calculated value of all the composition may be due to donor might be cadmium interstitials or sulphur vacancies.

Conclusion: - Spray pyrolysis is a simple and inexpensive method for the preparation of solid solution thin films. As the percentage of sulphur increases then Hall mobility and carrier concentration increases. This is due to the donors might be cadmium interstitials or sulphur vacancies.

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