Morphological Characterization of $Cd_xZn_{1-x}S$ Thin Films

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***Abstract*—The $Cd_xZn_{1-x}S$ thin films deposited by CBD technique onto bare glass substrates. The synthesized thin films are studied the morphologically. Zn doping has significant effect on the surface morphology of thin films. The observed difference in initial and final atomic percentage from EDAX data of the composition indicate that all the film are Cd rich. The increase of Zn enhanced the improvement in the microstructure of the surface morphology.**

Keywords- thin films; $Cd_xZn_{1-x}S$; SEM; EDAX

I. INTRODUCTION

Thin film technology is simultaneously one of the oldest arts and ever growing field in Science and technology. The studies on thin films formation are being pursued with increasing interest on account of their proven applications in magnetic, optical, electronic, optoelectronic, solar selective, decorative coating, solar cells, etc[1-9]

Recently II-IV compounds in thin film form have received great attention by many researchers because of their semiconducting and other interesting physical properties. The wider band gap of II-IV compound semiconductor (CdS) have got vital role as a window absorber layer in thin film solar photovoltaic devices. The reports of literature survey show that the efficiency of solar cell devices is enhanced by increasing the band gap of buffer layer. [10-15]

The CdZnS having larger band gap than CdS material can be used as window absorber layer. In the present work efforts have been made to synthesize the $Cd_xZn_{1-x}S$ thin films and to study morphologically the effect of increasing Zn content.[16-20]

II. EXPERIMENTAL

A. Process

The $Cd_xZn_{1-x}S$ thin films are synthesized by employing the chemicals cadmium chloride ($CdCl_2$), zinc chloride ($ZnCl_2$) and thiourea (NH_2CSNH_2) were used as Cd^{+2}, Zn^{+2} and S^{-2} ions respectively. The molarities of $CdCl_2$, $ZnCl_2$, and NH_2-CS-NH_2 were 0.3M, 0.25M and 0.25M prepared for the deposition. The experimental precursors with different proportion were taken in reaction beaker for deposition of $Cd_xZn_{1-x}S$.

III. DEPOSITION OF $CD_XZN_{1-X}S$ THIN FILMS

The deposition process by CBD technique was carried out for different parameters. The pH of the solution was adjusted to 11 by adding the aqueous NH_3. The reaction beaker was kept in temperature bath, maintained at constant 80° C. Glass substrates were cleaned by 24 hr immersion in chromic acid, rinsed with acetone and distilled water. The experimental glass substrates were mounted on substrate holder and immersed in the reaction beaker. The substrate holder was rotated at slow speed (50 rpm) by means of DC geared motor for 38 to 40 minutes. The pH of the precursor, reaction temperature, rotation speed and dipping time of the substrate were kept constant throughout the experiment at optimized values. The thin, uniform $Cd_xZn_{1-x}S$ films were obtained at the end of the reaction process.

The sets of $Cd_xZn_{1-x}S$ thin films were prepared $Cd_xZn_{1-x}S$. Thin films were rinsed with deionized water to remove the loosely bound particles and annealed at 100 °C for one hour. The synthesized $Cd_xZn_{1-x}S$ films are subjected to morphological characterizations to study the effect of Zn content on morphological, compositional characteristics. The CdS films were prepared on optimizing the bath parameters.

TABLE I. SYNTHESIZED $CD_XZN_{1-X}S$ THIN FILM SAMPLES TYPE STYLES

Composition x	**Deposition Precursors**		
	$CdCl_2$ (ml)	**$ZnCl_2$ (ml)**	**NH_2CSNH_2 (ml)**
0.0	8	0	5
0.2	8	2	5
0.4	6	4	5
0.6	4	6	5
0.8	2	8	5
1.0	0	10	5
0.0	8	0	5

IV. CHARACTREIZATIONS OF $CD_XZN_{1-X}S$ THIN FULMS

The morphological characterization is the most important factors for a reliable and outstanding performance of semiconductor devices. In the upcoming literature those properties of the deposited material onto bare clean glass substrate samples are outlined with their important findings.

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A. *Morphological Characterization: SEM*

In order to investigate the effect of Zn content on the surface morphology of the prepared $Cd_xZn_{1-x}S$ thin film the selected film are scanned by using Scanning electron microscopy (SEM Model: Quanta 200 ESEM). The scanning electron microscopy is convenient and versatile tool to investigate the microstructure of $Cd_xZn_{1-x}S$ thin films. The SEM micrograph of $Cd_xZn_{1-x}S$ thin film with composition $Cd_{0.0}Zn_{1.0}S$ is presented in Figure I. All the films were scanned at 15 KX magnifications. The micrograph shows that the films deposited cover the whole substrate with uniform surface morphology. SEM image show that Zn doping has significant effect on the surface morphology of the CdZnS thin film. There are some spheroid shapes growth appears as the creation of nucleation centre on the film surface.

SEM image conforms the porous fibrous network consisting of regularly arranged matrix over which regular shaped fine particles systematically distributed. The larger size spherical granules were observed on the scan image due to aggregation of spheroid structure of S^{-2} ions.

The effect of increase of Zn content in $Cd_xZn_{1-x}S$ thin films clearly understood from the improvement in the microstructure of the surface morphology from Figures I. The micrograph of $Cd_{0.0}Zn_{1.0}S$ shows spherical granules of ZnS particles irregularly distributed over the substrate. All compositions except $Cd_{0.0}Zn_{1.0}S$ shows fibrous network. The SEM study confirms that even low Zn content was effectively changes the microstructure $Cd_xZn_{1-x}S$ thin films.

The $Cd_xZn_{1-x}S$ (x=1.0, 0. 8, 0.6, 0.8, 0.2, and 0.0) films synthesized by using present CBD technique. SEM image of $Cd_xZn_{1-x}S$ is as shown in following Figure I.

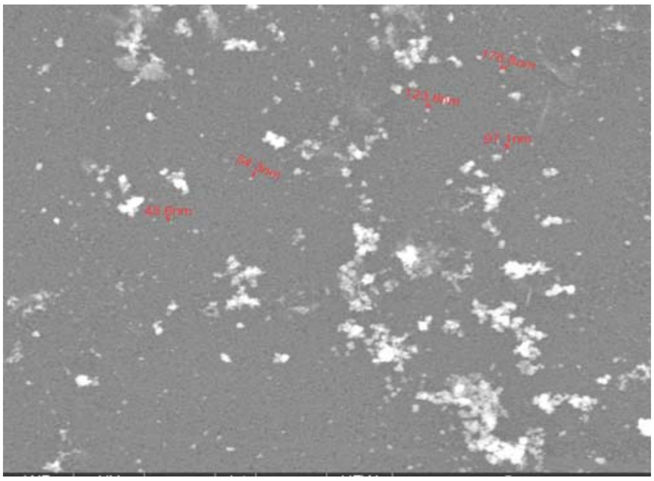

FIGURE I. SEM IMAGE OF $CD_XZN_{1-X}S$

B. *EDAX Analysis*

An EDAX spectrum presented in following Figure II, represents the composition of CdS films. The Peak at 1.75 KeV is assigned to glass. The observed atomic percentage of S^{2-} and Cd^{2+} from EDAX spectra was 46.52 and 56.14 % respectively. The composition shows Cd rich CdS films. It is shown in following Figure II.

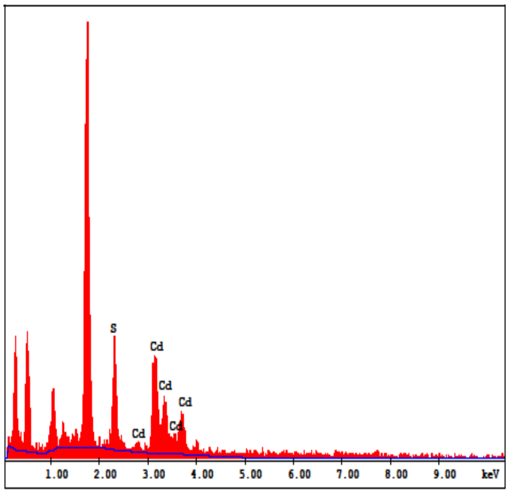

FIGURE II. EDAX SPECTRUM

V. RESULTS AND DISCUSSIONS

The micrograph shows that the films deposited cover the whole substrate with uniform surface morphology. SEM images show that Zn doping has significant effect on the surface morphology of the CdZnS thin film. There are some spheroid shapes growth appears as the creation of nucleation centre on the film surface.

SEM image shows the porous fibrous network consisting of regularly arranged matrix over which regular shaped fine particles systematically distributed. The larger size spherical granules were observed on the scan image due to aggregation of spheroid structure of S^{-2} ions.

The observed difference in initial and final atomic percentage from EDAX data of the composition indicate that all the film are Cd rich. 3”, and “Heading 4” are prescribed.

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