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SYNTHESIS AND CHARACTERISATION OF CADMIUM SELENIDE THIN FILM

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Abstract - *Cadmium Selenide was successfully deposited on ITO substrate under optimized condition by electro deposition technique. The film is uniform and had well adherence to the substrate without any pores. As the molar concentration increases the orientation of the crystallites is more randomized than in the as prepared film. The structural, optical and morphological properties of the film were investigated by XRD, UV-Visible PL and SEM. The XRD pattern indicates that this film was crystallized in the structure.*

***Keywords*:** *Cadmium Selenide, electro deposition, SEM, UV, XRD.*

I. INTRODUCTION

Cadmium Selenide have attracted considerable attention due to their interesting properties and potential applications. Cadmium Selenide (Cd Se) are interesting semiconductor compounds that are widely used as holographic recording systems, optical and optoelectronic materials in infrared electronic and memory switching devices and in photoelectrical cells [1]. Cadmium Selenide is a interesting metal chalcogenide semiconductor materials[2]. The purpose of present study is to explore and report in detail the structural properties, optical properties and morphological properties of Antimony Selenide thin film prepared by electro deposition technique.

II. EXPERIMENTAL PROCEDURE

Precursor solution is prepared by taking the ratio of cadmium chloride and selenium dioxide (0.2 gm each (1:1)) is mixed with 20ml of distilled water. A typical electrolyte contains the constant molarity of 0.06M in $CdCl_2$ and 0.1M in SeO_2. The ($CdCl_2$ +SeO_2) thin films were prepared by electro deposition technique. The films were grown on ITO plate under the optimized conditions. This ratio of concentration is denoted by A1, A2, and A3.These grown films are uniform. The color of the film is red. Well adherent with the surface. All chemicals were of AR grade.

III. RESULTS AND DISCUSSION

A. XRD Analysis

Figures 1. Shows the X-ray diffraction pattern of the electro deposited Cadmium Selenide thin film..It belongs to hexagonal structure with a = 4.275 A°, c = 7.053 A° for sample A1**.**

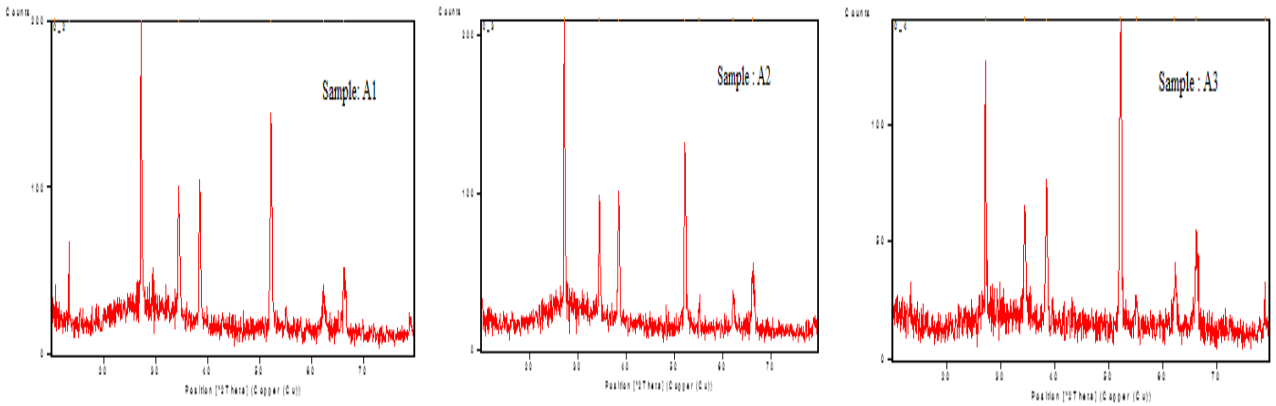

Figure 1. XRD pattern of Cd Se Thin Film

Crystallite size (D) was calculated using Debye-Scherrer's formula [3],

$$D = \frac{0.9*\lambda}{\beta*cos\theta}$$

Where D is the crystallite size, λ is the wavelength of the k_α line, β is the full width at half maxima (FWHM) in radians and θ is the Bragg's angle. The crystalline size were determined and size increases from 37 nm – 48 nm and 42 nm – 54 nm. Size is increased when the concentration is increased. The dislocation density and strain will be decreases as concentration increases.

B. Morphological studies and compositional analysis

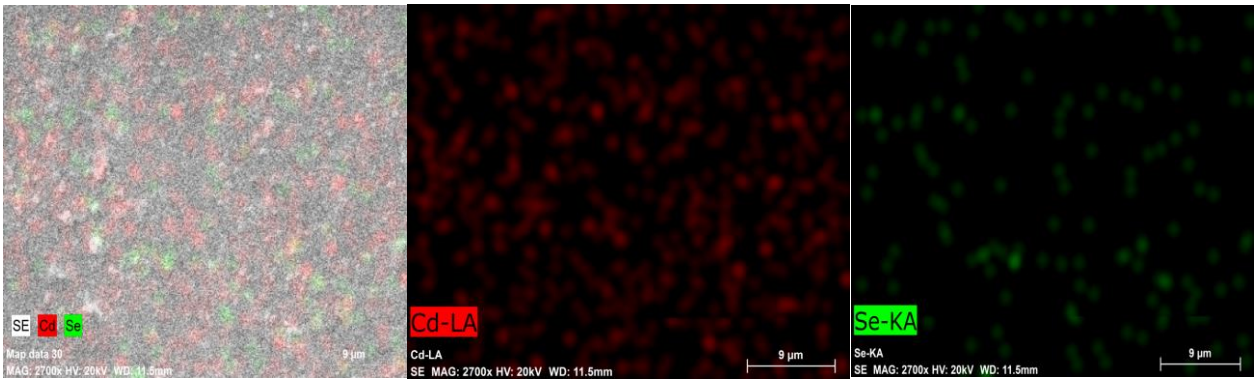

Figure 2. HRSEM image of Cd Se Thin Film

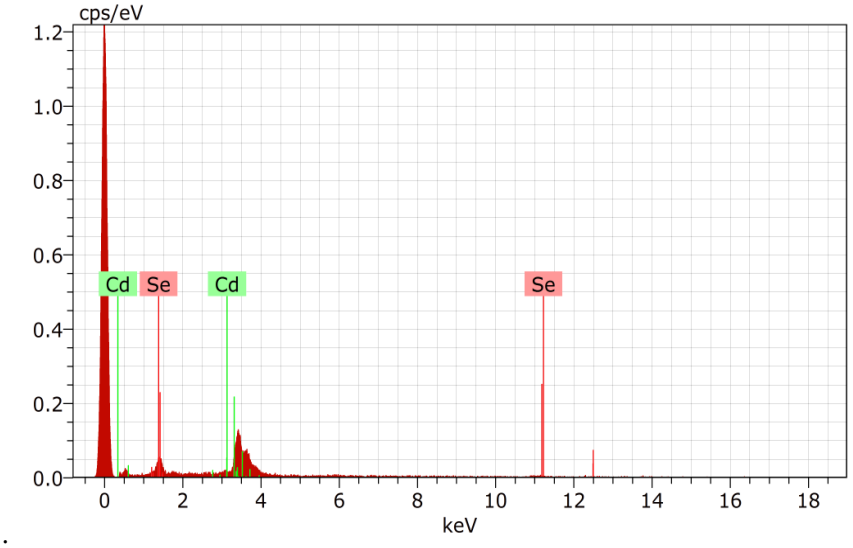

Figure 3. EDAX images of Cd Se Thin Film

Scanning electron microscopy is a convenient tool to study the surface morphology of micro and nano scale material as well as thin film. From the figure2 shows the HRSEM images of Cd Se thin films.. The particle size increases as the concentration increased. The High Resolution Scanning Electron Microscope (HRSEM) is used to Show the separated atom formation in the given sample. The occurrence of the cadmium ions (red in color) and selenium ions (green in color) are shown in the SEM microscope.

The EDAX analysis from figures 3 revealed that the presence of Cadmium, selenium, oxygen and other elements like silicon, tin on the ITO substrate. EDAX spectrum recorded in the binding energy region of 0-10 keV shows the presence of cadmium and selenium in thin films. EDAX analysis of the mass% and atom% of Cadmium Selenide films are tabulated in Table 1. EDAX spectrum confirms the presence of Cadmium and selenium in thin films[4].

Table 1. Mass and Atom percentage of Cd Se

Sample	Element	Series	Unknown Element [wt.%]	Mass [wt.%]	Atom [wt.%]	Error (3 sigma) [wt.%]
A3	Selenium	K-series	2.55	15.05	20.14	1.54
	cadmium	L-series	14.43	84.95	79.86	1.87
Total			16.98	100.00	100.00	

C. OPTICAL PROPERTIES OF CADMIUM SELENIDE

The Optical absorbance of Cd Se thin film were studied in the wavelength range 600-1100 nm using JASCO v-530 model spectrophotometer. All measurements were made in the laboratory at room temperature.

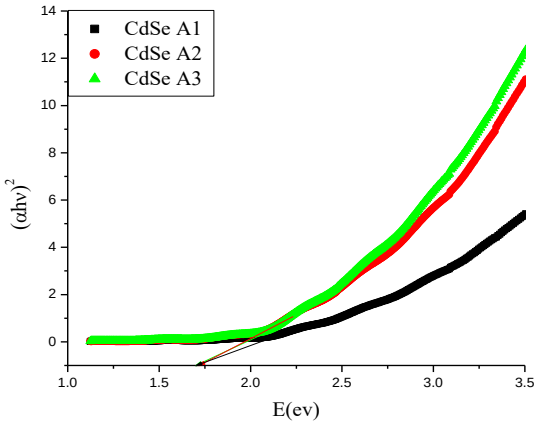

Figure 4. Band gap comparison of CdSe film

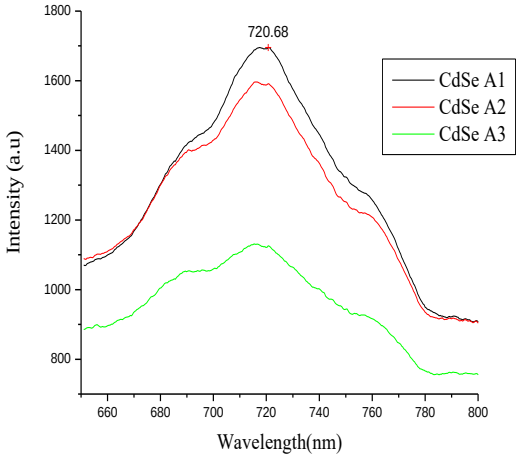

Figure 5. PL emission comparison of CdSe film

Table 2. Comparison of band gap with UV and PL

Deposited film CdSe	Direct band gap(eV)	PL Band gap E= hν (eV)
A1	1.721	1.721
A2	1.728	1.730
A3	1.732	1.732

Photoluminescence spectra shows emission of a net intense peak under 450 nm excitation. PL spectrum of CdSe nanoparticles and thin films under 450 nm excitation consists of one narrow emission peak at 721 nm (1.72 eV), which is attributed to shallow trap emission and other weak peaks which correspond to deep trap emission and impurity related emissions. High PL intensity in films indicating better crystalline structure, presence of less defects or impurity states by eliminating non-radioactive decay at their surface site

IV. CONCLUSION

Cadmium Selenide thin films were successfully deposited on ITO substrates by electro deposition technique. The films were uniform and had good aherence to the substrate. The XRD of Cadmium Selenide films formed a hexagonal structure. The crystalline size of the films were determined by scherrer's formula and it increases from 37-48 nm as the concentration increases. The energy gap values of the films were determined and compared with the reported one. The emitted and excited wavelength were determined from the photoluminescence spectra. The structural properties, surface morphological studies and chemical composition analysis were investigated and reported.

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