Characterized by the PN multilayer thin film for solar cell application

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Abstract: The multi layer CdS/ZnS/InS thin films are prepared by using chemical bath deposition technique on glass substrate .Deposition of thin film is relatively concentrated of various reactants in the solution of pH and bath temperature are depending on the growth of multi layer thin film. Characterization studies are carried out by optical, electrical and thermal property and these results are reported.

Keywords: CdS thin film, ZnS thin film, CBD, XRD, UV absorption, SEM, EDAX and thermal conductivity.

1. Introduction:

The preparation of II and VI group semiconducting elements has been focus on the recent trend in solar cell applications. A solar cell consists of two layers of semiconductor, one P-type and the other N-type, sandwiched together to form a PN junction. This PN interface induces an electric field across the junction. When particles of light (photons) are absorbed by the semiconductor, they transfer their energy to some of the semiconductor's electrons, which are then able to move about through the material. If the photon's energy is equal to the band gap, the energy transfers, in terms of its photovoltaic cell in thermodynamically. Many techniques have been reported in deposition of CdS/ZnS/InS thin films.

The chemical bath deposition (CBD) method appears to be a relatively simple, in expansion method to prepare a hetro junction films with controlled composition .In particular CBD is widely used for an achieving good-quality thin films.

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2. Experimental:

Thin films are the form of double layer is deposited by CBD technique. For first layer CdS deposition 50 ml of 0.015M CdS, 25 ml of 1.5M thiourea were dissolved with 366 ml of DI water. The solution mixture is poured in to a beaker which were heated and stirred until the temperature reaches 60°C and the pH of the bath is maintained from 8-9 by adding 213ml of 7.5M ammonia solution. The deposition were run over 1 ½ hr and thus the CdS were deposited on a glass substrate.

For second layer CBD – ZnS deposition 50ml of 29.88g ZnS, 25ml of 22.84g thiourea were dissolved with 287ml of DI water. The solution mixture is poured in to a beaker which were heated and stirred and the pH of the bath is maintained from 9-10 by adding 213ml of 7.5M ammonia solution. The deposition were run over 1 ½ hr and thus the ZnS were deposited on a glass substrate. Once the deposition takes place the samples were cleaned with acetone solution.

For third layer CBD- InS deposition, 0.553g of InCl3 and 5.635g of thioacetamide were dissolved around 500ml of DI water where stirred and heated for ½ hr. The pH of this bath began approximately at 5 and decreased to 4 as the deposition progressed. The same glass substrate is dipped inside the bath for third layer of deposition. In this Indium (III) Chloride is the Indium source & thioacetamide is the Sulphide source and thus the InS were deposited on a glass

substrate. Multiple dips were used to increase sample thickness.

3. Result and discussion:

3.1 Structural studies:

Cadmium sulfide is the inorganic compound is a yellow orange colored powder. It occurs in naturally with two different crystal structures has a wide band gap is 2.42 eV. Zinc sulfide is a white to yellow-colored powder or crystal. It is typically encountered in the more stable cubic form, known also as zinc blende or sphalerite. The cubic form has a band gap of 3.54 eV at 300 K whereas the hexagonal form has a band gap of 3.91 eV.

In order to analyze the grain size of multilayer glass/CdS/ZnS /InS thin films, the X-ray intensity data were collected by using k_α radiation from the prepared thin film samples. The X-ray data were collected in the 2θ range from 10° to 100° for all the samples are taken by using X-ray diffract meter with a monochromatic incident beam of wavelength 1.54056Å, offering Cu- k_α stripping procedures. The graphical pattern is taken the various PH level of multi layer CdS/ZnS/InS thin films is shown in the following figure.

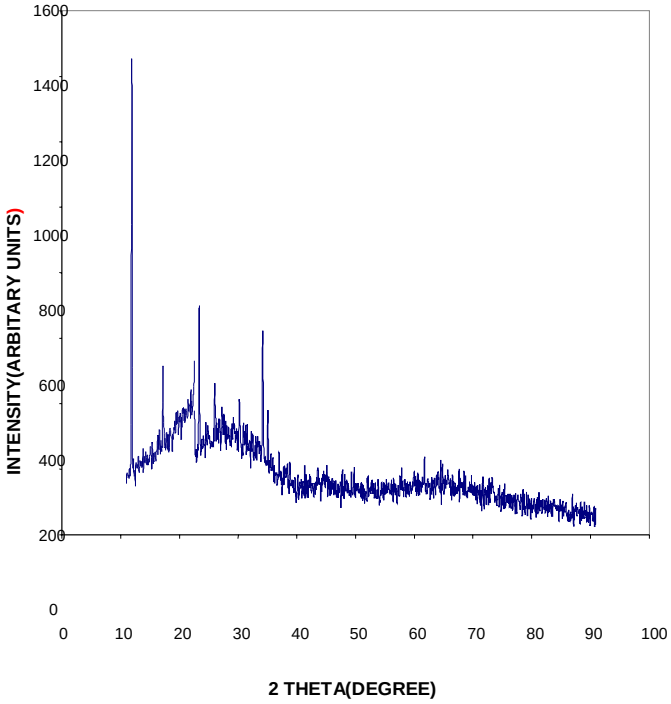


Fig.3.1. XRD –pH level-1.

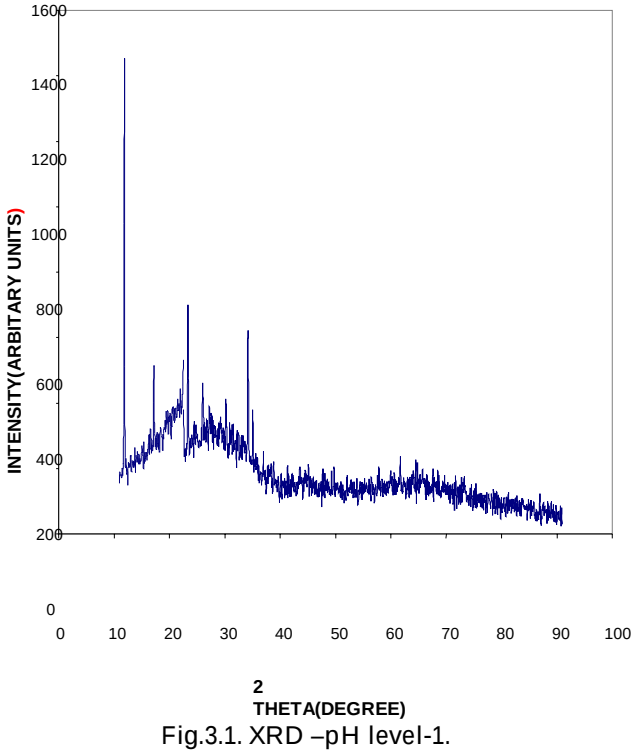


Fig.3.1. XRD –pH level-1.

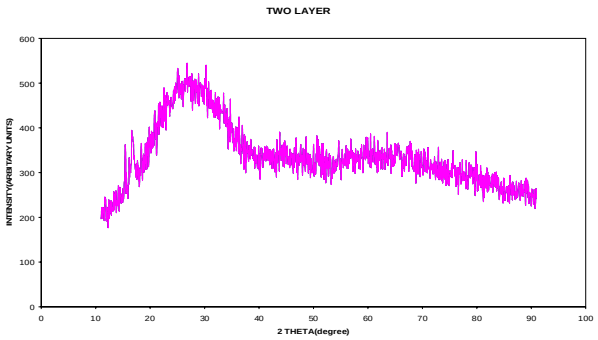
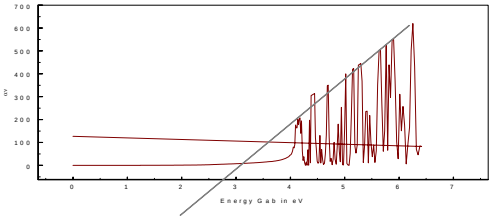


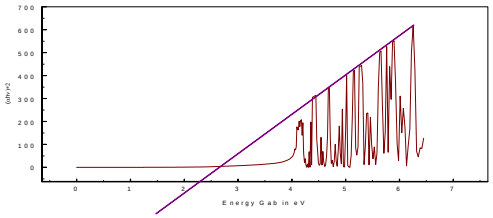
Fig.3.2 XRD-p H level-2

3.2 UV analysis:

In hetro junction is to form a junction with the absorber layer while admitting a maximum amount of light to the junction region and absorber layer. An absorption layer has varied for the energy gab from 2.4 ev to 2.7 ev then the high optical transmission throughout the region with minimal resistive loss for the different band gap of the junction.



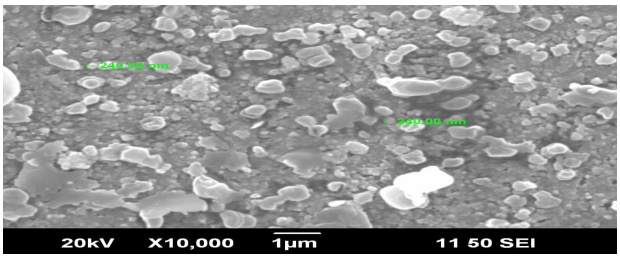
3.2.1 UV graph - pH level -1



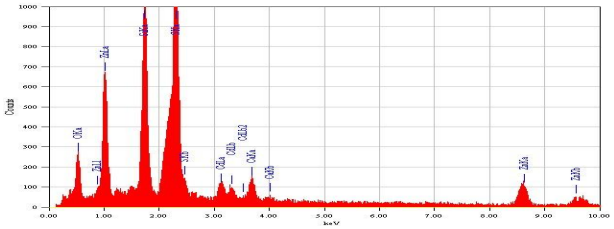
3.2.2 UV graph- pH level -2

3.3 SEM and EDAX:

The surface analysis of the layers has been investigated and visually by scanning electron microscopy. An image of the thin film is polycrystalline and bulk grown on to the glass substrate for the pH level.



3.3. SEM micrograph of the surface



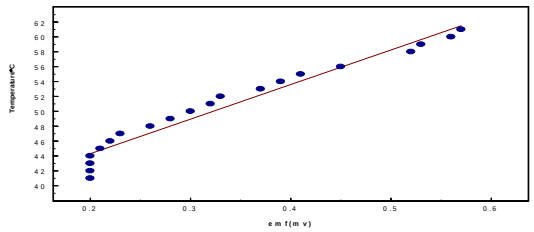
3.3.2. EDAX spectra showing the atomic percents for Cd and Zn respectively.

3.4 Thermal Conductivity of multi layer thin films:

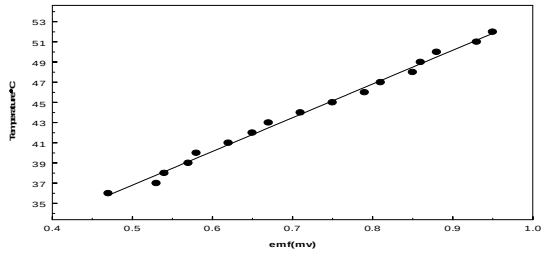
The conductivity of the samples is calculated by using thermal conductivity setup. The graphs are drawn several of four thermo emf corresponding to the temperature. The calibrated temperature versus distance of the thermo couples from one end is shown in figures.

Table 3.4
Conductivity of the multi level thin film for different pH analysis

Buffer layer of Thin Film (Fabrication of CIS solar cell (pv))	*Thermal Conductivity (Kc)*
Glass/cds/zns/In	0.9320
Glass/cds/zns/In	.8195



3.4.1. Thermo (emf) Vs Temperature for pH-1



3.4.2. Thermo (emf) Vs Temperature for pH-2

4. Conclusion:

The absorber layer of Mutli junction is varied and the electrons and holes are recombined after a short time and their forbidden energy gab is occurred is conformed the UV data. The structural properties are varied for the CBD parameter values then crystal lattice constant creates defect in the lattice where recombination centers can occur. The temperature gradient of the sample $(dT/dx)_c$ is determined and the thermal conductivity is calculated. The variation of emf with temperature is responsible for the variation of conductivity of the buffer layer and hence the light absorption coefficient is also varied. The dominant conducting layer is CdS because it matches with the theoretical value of Cd which is 0.97W/K-m. Based on the film properties studied, the data suggest that CdS is better semi conducting material for the preparation of thin films for solar cell applications and the efficiency of the cell is increased by using multi layer coating.

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