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# Scanning Electron Microscopy (SEM) of Multilayer CdS Thin Films

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**Abstract**
The sulphide semiconductors are one of the most extensively investigated semiconductor in thin film form and a large variety of deposition techniques have been utilized to obtain solar cells. The Cadmium sulphide films grown by vacuum evaporation technique has been used as gas sensors for detection of oxygen and with a direct band gap it serve as a window material for heterojunction solar cells. The first thin solid films were obtained by electrolysis in 1864, B White Bunsen and Grover obtained metallic film in the year 1852, by thermal evaporation on explosion of a current carrying metal wire. The usefulness of optical properties of metal films and scientific curiosity about the behavior of two dimensional solid have been responsible for the immense interest in the study of the science and technology of thin films.In this paper we shall study the SEM of multilayer CdS thin film.

## 1.Introduction

Polymers are generally known for their insulating property because of covalent bond present in saturated carbon compounds. Since desirable properties can be conveniently attained by tailoring the polymer structure and also by incorporating additives, scientists have been enthusiastic to explore the possibility of transforming insulating polymers into conducting or semiconducting materials envisaging such special characteristics like low density, ease of fabrication, flexibility of design, low energy and labour requirements for fabrication and processing.

Thin films have been extensively studied for over a century because of their potential, technical value and scientific curiosity. Thin material may also be formed from a liquid or a paste in which it is called a 'thick film'. It is not the thickness that is important in defining a film, but rather the way it is created with the consequential effects on its microstructure and properties.

For analysis of thin film studies, physical phenomena peculiar to thin film and the basis for their study are generally the consequence of their plane geometry, size and unique structure, epitaxial growth. The occurrence of meta stable structures size limited electron and phonon transport progress in metals, semiconductors and insulators, quantum mechanical tunneling through normal and super conducting metal insulator junctions, micromagnetics and plasma resonance, absorption are some of the noteworthy contribution of thin films phenomena to solid state Physics research. The technical interests which stimulates these studies have also been rewarded in the form of useful inversion such as a variety of active and passive microminiaturized components and for devices.

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Sharma, R.P. et al, showed that CdS /polyaniline composite thin films can form tunable band gap heterostructure with vacuum evaporation CdS thin film on to glass substrate.

Jayachandran, M. et al, prepared Polyaniline layers onto porous structure by in-situ electrode position and showed photoluminescence at room temperature with a maximum current density 20 mA/Cm$^2$, a possibility of polyaniline as ohmic contact.

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Schlamp, M.C. et al, demonstrated improved efficiency in LED's made with CdS and CdSe core / shell type nanocrystal incorporated in semiconducting polymers.

Ad vincula, R.C et al,reported improvement in performance of LED's which incorporated polyaniline coated on to ITO glass polyelectrolyte layer for heterostructure.

N.F. Foster et al, prepared the polycrystalline CdS films and found that the structural, electrical and optical properties of vacuum coated thin films of Cadmium Sulphide are very sensitive to the deposition conditions e.g. the degree of vacuum, the rate of deposition, the substrate temperature and the subsequent heat treatment. He also found that the CdS films have excess of Cadmium owing to the dissociation of CdS during evaporation, and concluded that the stoichiometry can be restored by codepositingSulphur together with CdS.

## 2.Sample Preparation of CDS

Thin films of CdS have been prepared by vacuum deposition technique. For sample preparation Cadmium Sulphide powder of 99.99%. purity was evaporated at about 115°C from a deep narrow mouthed molybdenum boat. Deposition was made on to highly cleaned glass substrate held at 200°C in a vacuum of $10^{-5}$torr. The substrate was cleaned in aquaregia washed in distilled water and isopropyl alcohol (IPA). We have used glass substrate for the preparation of Cadmium Sulphide.

## 3.Sample Preparation of Poly aniline

Thin film of polyaniline have been prepared by vacuum evaporation technique, polyaniline is usually prepared by redox polymerization of aniline using ammonium perdisulphate, $(NH4)_2$ $S_2O_2$ as on oxidant. Distilled aniline (0.02 M) is dissolved in 300 ml of pre-cooled HC1 (l.0M) solution, maintained at 0-50°C. A calculated amount of ammonium perdisulphate, (0.05M) dissolved in 200 ml of HCl (1M), pre-coated to 0-50° C, is added to the above solution. The dark green precipitate (ppt) resulting from this reaction is washed with HC1 (l.OM) uptil the green colour disappears. This ppt is further extracted with terta-hydofuran and NMP (N-Methyl Pyrolidinone) solution by soxhelf extraction and dried to yield the emeraldine salt. Emeraldine base can be obtained by heating the emeraldine salt with ammonia solution. Simultaneously, separate salt solution is prepared by dissolving the MX (M=Metal and X=Halide) in distilled water. The solution is then slowly added to the precooled polymer solution with constant stirring. The composite is then dried in an oven, at high temperature, to get the conducting polymer in the powder form. This powder is vacuum evaporated on to highly cleaned glass substrate as well as metallic substrate.

**4. Scanning-Electron Microscopy (SEM)** :-

Scanning Electron Microscopy provides a direct structural evidence of the growth and perfection of the film. This is one of the most useful methods for the investigation of the surface topography, microstructural feature etc. It is based upon the fact that the electron are absorbed or diffracted at inhomogeneity's and thus reveals these inhomogeneity's as contrast effect. The secondary electrons are generated by the interaction of loosely bound electrons of the surface atoms. The emission of secondary electrons is sensitive to the incident beam direction and the topography of the surface layer. The contrast hence depends on the rate of secondary electron yields and the incident angle of primary beam to the surface being examined.

The surface morphology of the samples has been investigated by scanning electron microscopy. To access the size and morphology the electron beam of 15 KV have been used the SEM image of CdS on glass substrate is shown in fig. (1). This indicate that the surface is smooth and grain boundaries are widens which are seen as thick black lines between the grains which are connecting together.

On the other hand when the thin film of Pani is coated on to the same sample as described above and different type of surface morphology can be seen in the fig. (2) Which shows a large surface area and comparative higher degree of crystalinity.

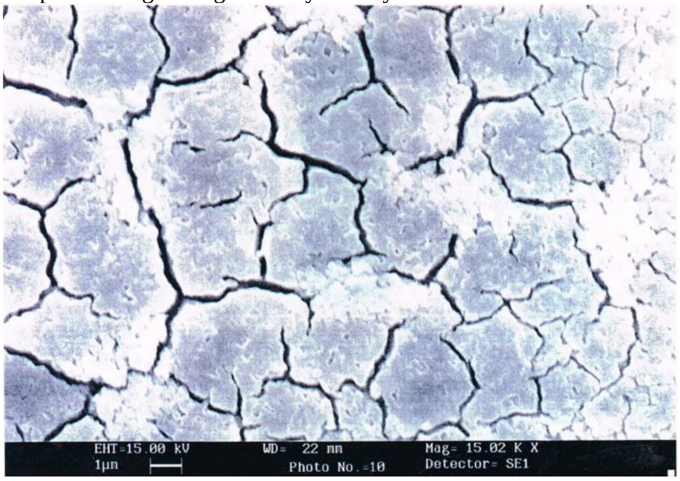


**Fig.1.** SEM image of CdS thin film on to glass substrate.


**Fig.2** SEM image of Pani/CdS thin film on to glass substrate

## 5. Results and Discussions

The prepared films were subjected to scanning electron microscopy analysis to study surface morphology. The SEM study of Cds/Glass the surface is smooth and grain boundaries are widen which are seen as thick black lines between the grains while for pani/CdS a large surface area and comparatively higher degree of crystalline is observed.

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