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Scanning Electron Microscopy (SEM) of Multilayer CDS Thin Films

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Abstract: *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.*

Key Words:- Scanning Electron Microscopy(SEM), CdS thin films

I. INTRODUCTION

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 hetero junction solar cells.

Sharma, R.P. et al, showed that CdS /polyaniline composite thin films can form tunable band gap hetero structure 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/Cm², a possibility of polyaniline as ohmic contact.

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 hetero structure.

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 code positing Sulphur together with CdS.

II. 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.

III. 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 S₂O₈ as on oxidant. Distilled aniline (0.02 M) is dissolved in 300 ml of pre-cooled HCl (1.0M) 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 HCl (1.0M) upto the green colour disappears. This ppt is further extracted with terta-hydrofuran and NMP (N-Methyl Pyrolidinone) solution by soxhelt 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

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polymer in the powder form. This powder is vacuum evaporated on to highly cleaned glass substrate as well as metallic substrate.

IV. 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 inhomogenities and thus reveals these inhomogenities 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 crystallinity.

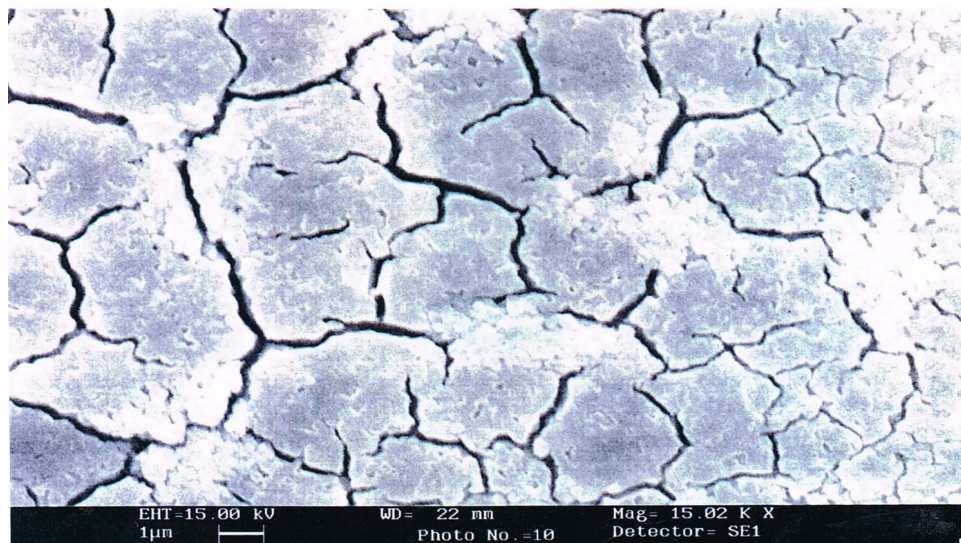


Fig.1. SEM image of CdS thin film on to glass substrate.

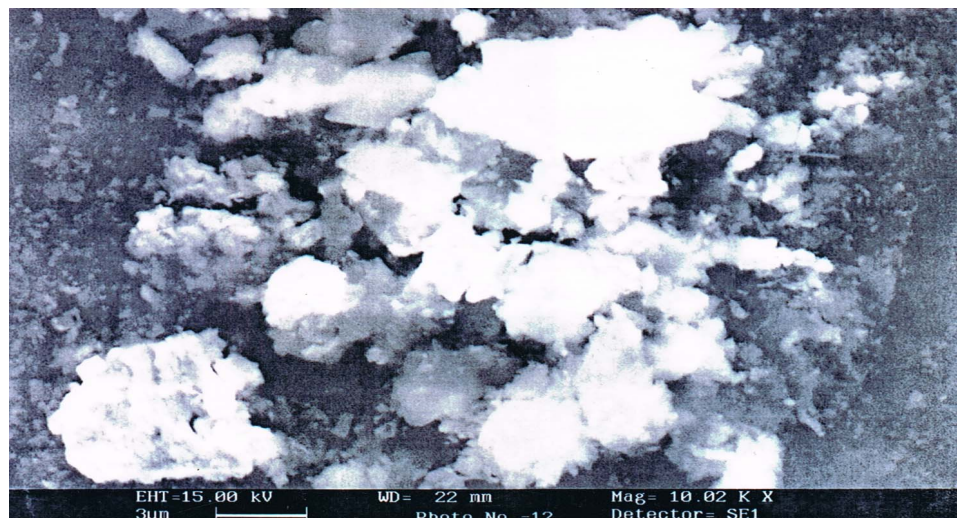


Fig.2. SEM image of Pani/CdS thin film on to glass substrate.

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V. 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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