iJRASET
International Journal For Research in
Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 3 **Issue:** I **Month of publication:** January 2015

**DOI:**

ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

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

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***Abstract: Conducting polymers have emerged as a very important class of materials because of their unique electrical, optical and chemical properties leading to the wide range of technological applications. In this paper we shall study the SEM of multilayer ZnS thin film.***
***Key Words: Scanning Electron Microscopy (SEM),ZnS 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 heterojunction solar cells. ZnS is the II–VI family semiconductor, has wide band gap (3.65 eV) at room temperature and large excitation binding energy 60 meV, ZnS is an attractive semiconductor material especially in electronic and optoelectronic application. The dielectric constant of ZnS (wurtzite structure) is 8.75 at lower frequencies and 3.8 at higher frequencies. The molecular mass is 81.389 and the melting temperature is 1450 K []. ZnS was used by Ernest Rutherford and others in the early years of nuclear physics as a scintillation detector, because it emits light on excitation by x-rays or electron beam, making it useful for x-ray screens and cathode ray tubes.It also exhibits phosphorescence due to impurities on illumination with blue or ultraviolet light. Zinc sulfide, with addition of few ppm of suitable activator, is used as phosphor in many applications, from cathode ray tubes through x-ray screens to glow in the dark products.When silver is used as activator, the resulting color is bright blue, with maximum at 450 nm. Manganese yields an orange-red color at around 590 nm. Copper provides long glow time and the familiar glow-in-the-dark greenish color. Copper doped zinc sulfide (ZnS+Cu) is also used in electroluminescent panels. Zinc sulfide is also used as an infrared optical material, transmitting from visible wavelengths to over 12 micrometers. It can be used planar as an optical window or shaped into a lens. It is made as microcrystalline sheets by the synthesis from $H_2S$ gas and zinc vapor and sold as FLIR (Forward Looking IR) grade ZnS in a pale milky yellow visibly opaque form.This material when hot is statically pressed (HIPed) can be converted to a water-clear form known as Cleartran (trademark). Early commercial forms were marketed as Irtran-2 but this designation is now obsolete.

## II. SAMPLE PREPARATION OF ZN

Thin films of ZnS have been prepared by vacuum deposition technique. For sample preparation Zinc 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 Zinc 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, $(NH4)_2\ S_2O_2$ 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

ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

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 ZnS 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.

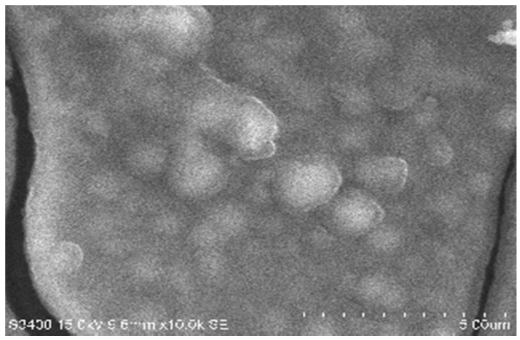

Fig.1. SEM image of ZnS thin film on to glass substrate.

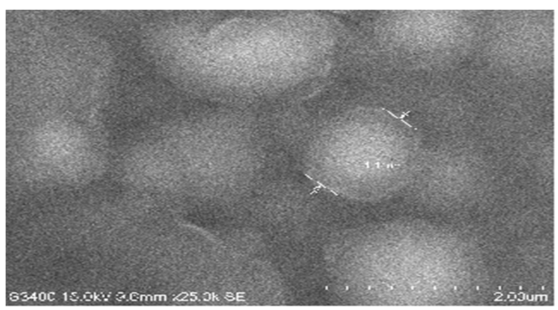

Fig.2. SEM image of Pani/ZnS thin film on to glass substrate.

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

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