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STRUCTURAL CHARACTERIZATION OF ZINC SULPHIDE THIN FILMS WITH PANI FOR OPTOELECTRONIC DEVICES

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ABSTRACT

In the present investigation thin film of Zinc Sulphide with Polyaniline deposited onto it has been characterized for their structural properties. Polyaniline is used in different fields viz. microelectronic sensors, anticorrosion coatings, electro chromic devices, electroluminescence devices, low noise field effect transistors and for non linear devices. It exhibits insulating to metallic state or vice-versa. ZnS is the II–VI family semiconductor having wide band gap 3.65 eV at room temperature. It is an attractive semiconductor material especially in electronic and optoelectronic application. The structural characterization has been carried out in terms of their SEM & XRD studies. The SEM studies show a very interesting different type of morphology. The peaks in the XRD patterns confirm that ZnS film has a poly crystalline hexagonal wurtzite crystal structure.

KEYWORDS: *PANI, SEM, XRD, Wurtzite*

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INTRODUCTION

Conducting polymers have emerged as a very important class of materials because of their unique electrical, optical and structural properties leading to the wide range of technological applications [1]. It is used in different fields viz. microelectronic sensors, anticorrosion coatings, electro chromic devices, electroluminescence devices, low noise field effect transistors and for electromagnetic shield and non linear devices etc [2]. PANI exhibits insulating to metallic state or vice-versa, transition on doping with different protonics and inorganics. This transaction property of polymer has enabled it for use in large number of practical applications [3].

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[4]. 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 [5-6].

In this investigation we report structural characterization of ZnS thin film with Polyaniline deposited onto it.

EXPERIMENTAL DETAILS

Sample Preparation

A pure 1µm thickness ZnS thin film was first coated by vacuum evaporation on to highly cleaned glass substrate at room temperature in a vacuum of 2×10^{-5} torr. Polyaniline used for evaporation was chemically synthesized by oxidative polymerization of aniline using ammonium per disulphate $(NH4)_2S_2O_8$ under controlled conditions, this yielded the emeraldine salt. Treating the salt with ammonia solution produces emeraldine base powder.

This was used for evaporation on to ZnS thin layer in a vacuum of 10^{-9} Pa forming a thin film of Polyaniline [7].

Characterization of Sample

The films so obtained were subjected for structural characterization. As a result of which the following observations has been observed and reported.

X-RAY DIFFRACTION

X-ray diffraction is unique and non destructive technique to confirm and find the structure of a crystal. In figureure 1, 2 and 3 the XRD pattern of pure polyaniline, XRD pattern of ZnS and XRD pattern of PANI on ZnS respectively, has been reported. The XRD pattern of pure Polyaniline in figureure 1 shows its amorphous structure because no strong peak has been appeared in XRD pattern. In the XRD pattern of ZnS [figure 2], strong peaks appear at 2θ= 31.5°, 36.1°, 47.4°, 56.4°and 62.9° which corresponds to (101), (100), (102), (110), (103) planes, that confirms the hexagonal structure of ZnS. The peaks in the XRD patterns show that ZnS film has a poly crystalline hexagonal wurtzite Crystal structure. The XRD patterns of ZnS in figure. 2 shows that the highly intense (100) peak shows the most preferred orientation. Other peaks with less intensity shows less preferred orientations. In case of PANI on ZnS same preferred orientation is observed with modified intensity [figure. 3]. In addition there is no second phase peak in XRD patterns for ZnS-composites.

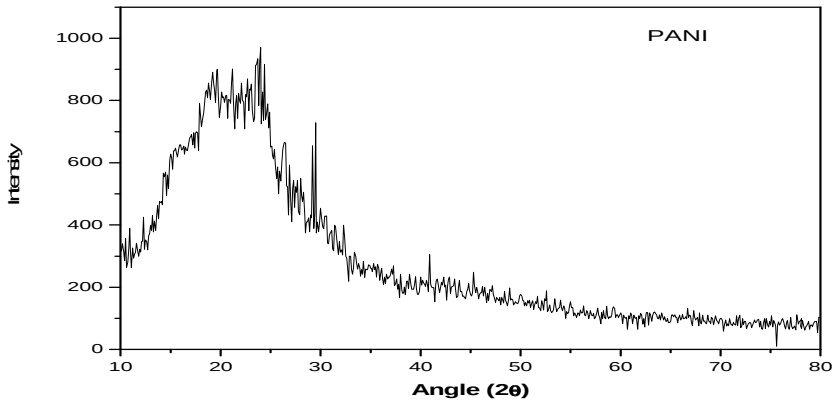

Figure 1: X-Ray Diffraction Pattern of PANI

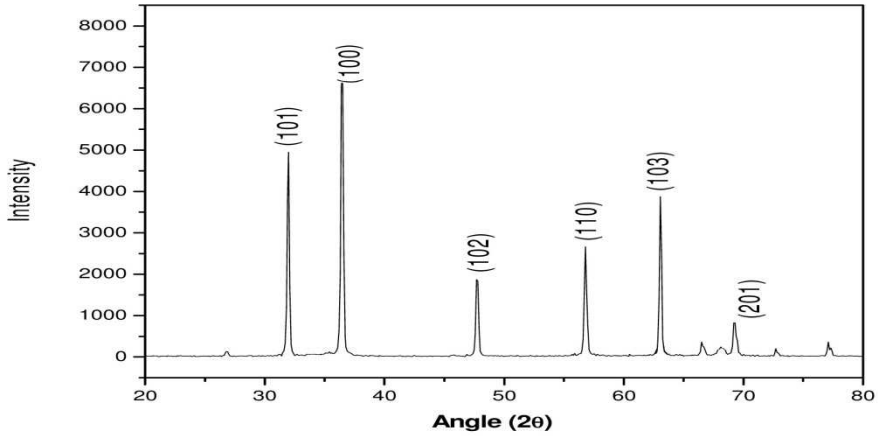

Figure 2: X-Ray Diffraction Pattern of Zns

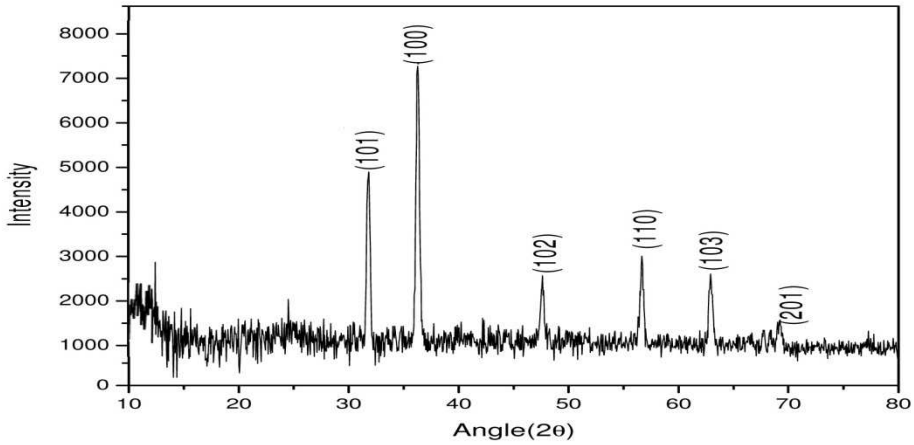

Figure 3: X-Ray Diffraction Pattern of PANI on Zns

Scanning Electron Microscopy (SEM)

The Scanning electron Microscopy provides a direct structural evidence of growth and perfection of thin film. This is one of the most useful method for the investigation of the surface topography, microstructure etc. The surface morphology of the material helps in the study of grain growth, orientation of the grains, compositional and topographical features present on the surface of the material. It is well known that different phases formed show different morphology when examined with the scanning electron microscope. From the scanning electron microscope it is possible to determine the compactness of the material, the particle size and shape etc.

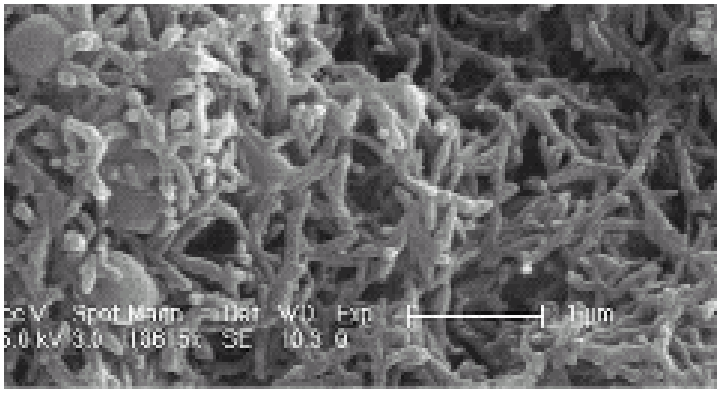

Figure 4: Scanning Electron Micrograph of PANI on Glass

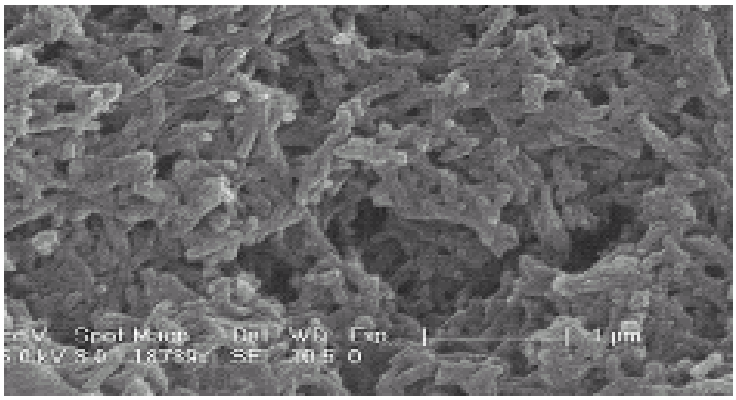

Figure 5: Scanning Electron Micrograph of PANI on Zns

The Scanning Electron micrographs obtained for Polyaniline on glass substrate and Polyaniline on ZnS thin film has been shown in figure. 4 & 5, respectively. The results of the surface morphology show that Polyaniline on ZnS shows a uniform morphology like pure Polyaniline film. It shows some grain like structure due to the ZnS surface. The grains have become more regular and systematic for PANI on ZnS.

CONCLUSION & RESULTS

The surface morphology of such surface is investigated to access. The size and morphology of the electron beam of 5KV has been used. It is observed that the surface is smooth and grassy boundaries are widens as thick lines between the grain which are connecting together. A large surface area and comparative higher degree of crystallinity has been observed. On the other hand, the surface is substantially different and remarkable results have been obtained, when we characterize the sample containing Pani/ZnS multilayered thin film on to the same glass substrate a very interesting different type of morphology can be seen.

The peaks in the XRD patterns confirm that ZnS film has a poly crystalline hexagonal wurtzite crystal structure. Through XRD patterns of ZnS the highly intense (100) peak shows the most preferred orientation. Other peaks with less intensity shows less preferred orientations. In case of PANI on ZnS same preferred orientation is observed with modified intensity. In addition there is no second phase peak in XRD patterns for ZnS-composites

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