Producing and Investigating Structural Properties of the Semiconductor Thin Layer of Zinc Sulfide on Glass

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ABSTRACT

Background: Thin-film technology is rapidly developing today. They are used to improve the surface properties of thin films. Usefulness of the properties of thin layers and interesting study on the behavior of two-dimensional solid led to the special interest both in science and in technology of thin films. Atomic Force Microscopy (AFM) and X-Ray diffraction (XRD) are two effective methods, for obtaining nano structures of nano layers and nano particles. Also by AFM method we can calculate roughness, image profile, image voltage profile and phase images. XRD method also can obtain crystallographic of produced layers and nano particles and Miller indices. There for these two analysis along with each other can determine the properties of productions. For example electric conductivity, height of grains, homogeneous and heterogeneous productions.

Objective: To investigate about structural properties of ZnS/glass thin layers at 100 Celsius degree temperature, a physical vapor deposition method (heat evaporation) were used for production of semiconducting nano layers on glass substrates. The thickness of nano layer is about 90 nm.

Results: Two and three dimensional AFM images of ZnS/glass under HV conditions at 100 Celsius degree were obtained. Two and three phase images of produced nano layer were obtained. Image profiles and image voltage profiles also XRD patterns were obtained.

Conclusion: Voltage curve for ZnS / glass is almost equal. Voltage is increasing in spikes areas and this pick of voltage has been increased to 6.5 microvolt. XRD diagrams are very noisy that it was due to the used substrate of amorphous (glass) in the experiment.

INTRODUCTION

Today's thin-film technology is very broad and now nano thin film making has developed toward nanotechnology. But nanotechnology is the interesting field of science and technology that can replace surprisingly large and unprecedented chance on the horizon, i.e. the chance of ordering and restructuring of molecular structures(Jesse, A., 2010). Nanotechnology will make a great effect on anything. Nano technology motivates the application of new technology, because it will emit new optical, magnetic, electrical characteristics (Akbarzadeh, A., 2010). In fact the thin layer is said to a material or substance to be cause a new mechanical and physical and electronically properties with a coating surface or other material which neither has it the properties of the constituent layers and not the properties of surface layer accumulated on it. Basically layers composed of metal layers, semiconductor and insulator layers which in this study the emphasis is on semiconductors. Semiconductor layers have been used in this article are one of the most widely used layers in the industry. Intrinsic semiconductors are structurally similar to the semiconductor at very low temperatures. With the addition of the semiconductor gross, a new state is created within the energy band gap (Bilberq., et.al., 2010). If the giver atoms are added to a semiconductor, it is n-type semiconductor and if acceptor atoms are added, it is p-type semiconductor. A special characteristic of multilayers is rising semiconductor band gap with decreasing particle size (Balaraju., J.N., and Rajam K.S., 2007).

Semiconductors are paid special attention due to their extensive applications that in this direction, ZnS among semiconductors with extensive energy gap is attracted due to its optical and electrical applications (Fanglin., et.al., 2000). The ZnS crystals with high refraction index and also high conduction as it have in observed range and the range near to far red are widely used in electrical reflections (Dobrzanski., et.al., 2007).The ZnS crystals are used in instruments like electronic reflections as well as solar cells (Clark. F.,
Youngx., C., 2012). ZnS is also a very important matter of the anti-reflection coatings that are used to connect heterogeneous solar cells (Izajac., A., 1987).

MATERIALS AND METHODS

To make the layer of the study physical thermal evaporation technique (PVD) and the evaporation resistance were selected. Sub layers were selected from glass substrates (slide test). The reason for this choice is the availability and cost of glass in order it will be easy to replicate the experiment due to the above-mentioned reasons. Plant needed to replace the springs on zinc sulfide was selected Tungsten plant. Zinc sulfide spring was the white powder. Vertical deposition angle for all layers was considered in ideal conditions. Deposition temperature of 100 Celsius degree was selected for the accumulation of zinc sulfide. Initially the layer of ZnS was made on a glass substrate and its thickness was determined by Krystal quartz thickness and its thickness determined 90 nm. Then advanced laboratory tech and nano-level technology used to determine the structural properties of layers. Advanced atomic force microscopy (AFM), X-Ray diffraction (XRD) analysis have been fully examined.

RESULTS AND DISCUSSION

Figure 1 shows two-dimensional image of atomic force microscopy for the sample ZnS / glass. The average thickness is 9.66 nm. Dimensions of measurement are 2μm * 2μm. Surface is full of high levels of fine-grain ZnS and black spaces between the grains are clear.

Fig. 1: Two-dimensional image of AFM in ZnS / glass.

Figure 2 shows three-dimensional image of atomic force microscopy for the sample ZnS / glass. Dimensions of measurement are 2μm * 2μm from the same area of Figure 1. In this Figure seeds and empty spaces are clearly visible.

Fig. 2: Three-dimensional image of AFM in ZnS / glass.

Figure 3 shows two-dimensional phase in layer ZnS / glass with a thickness of 90 nm in size 2μm * 2μm. As you can see the surface is in the three colors that it is due to the impurity of layer.
**Fig. 3:** Two-dimensional phase in ZnS / glass.

Figure 4 shows three-dimensional phase for layer ZnS / glass with a thickness of 90 nm in size 2μm * 2μm. Rhomboid-shaped spaces between the grains are markedly visible.

**Fig. 4:** Three-dimensional phase in ZnS/glass.

Figure 5 shows two-dimensional phase for layer ZnS / glass with a thickness of 90 nm in size 2μm * 2μm. As it is visible, an area with pink arrow is determined that it is for distinguishing the voltage in the determined grains.

**Fig. 5:** Two-dimensional phase in ZnS / glass.

Graph 1 shows the profiles of marked grains in Figure 5. Voltage in the determined area is the same. In the clustering areas voltage has a visible increase and this voltage increased even 6.5 microvolt.
Graph 1: The profiles of marked grains in Figure 5.

Figure 6 shows X-ray diffraction diagrams for samples of ZnS / glass. Considering that the thickness of all layers and accumulation temperature have shown themselves in the form of amorphous, there is no specific structural peaks, broad peaks in the range of 20 to 30 degrees is due to the glass structure and the reason for being noisy is because of amorphous substrate (glass) used in the experiment.

Fig. 6: XRD pattern of ZnS/glass.

Conclusion:
The film layer ZnS / glass was constructed on glass substrates using (ETS160) under high vacuum conditions at room temperature with vertical angle by physical thermal evaporation method. Nano layers' thickness was determined by a quartz crystal device. Thickness of 90nm was obtained for multi-layer. To examine the structure of a multi-layer, analysis of atomic force microscopy (AFM), X-ray diffraction (XRD) were used.

Voltage curve for ZnS / glass is almost equal. Voltage is increasing in spikes areas and this pick of voltage has been increased to 6.5 microvolt.

XRD diagrams are very noisy that it was due to the used substrate of amorphous (glass) in the experiment.

REFERENCES