Properties of CdS thin film deposited by Chemical Spray Pyrolysis

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Abstract- CdS thin films have been deposited on bare glasses by Chemical Spray Pyrolysis technique. $CdCl_2$ and (NH_2) CS have been used as precursor solution in case. The molarity of the solution has been 0.01 M and molar ratio has been 1:1. The temperature of substrate has been set at 400 ^{0}C. The crystalline quality and the surface morphology of the deposited CdS thin film have been characterized using X-ray diffraction and Atomic Force Microscopy.

II–VI semiconductors, such as CdS, CdSe and $CdS_xSe_{(1-x)}$, are among the most frequently studied materials **[1]**. As a direct band gap material with E_g of 2.42 eV at room temperature, cadmium sulphide (CdS) is one of the most the important groups II–VI semiconductors **[2].** A variety of techniques, such as spray pyrolysis **[3],** sputtering **[3],** Chemical Bath Deposition **[2**], PLD, evaporation **[3]** etc., have been reported for CdS thin film synthesis.Among them, spray pyrolysis method is best suited for thin film deposition because it is simple, convenient, least expenses to produce uniform and can be easily applied to industrial scale**.** In the experiment, the CdS films were synthesized by spray pyrolysis. Bare glasses were used as substrates. Once, they were cleaned by acetone for ten minutes and thoroughly washed in deionizer water for 480 minutes. Substrates were dried by drying oven for 20 minutes.Aqueous solutions of cadmium chloride ($CdCl_2$ Anhydrous, purity 99%) and thiocarbamide ($(NH_2)_2CS$, were chosen as main precursors for the preparation of CdS films by using this technique. The sprayed CdS films were deposited using $CdCl_2$ and TU aqueous solution. The volume of the solution for deposition was 50 ml.

CdS thin Film exits in two modifications: the hexagonal (wurtzite) phase and cubic (zincblende) phase ,it is believed that the hexagonal phase is stable in between 25 and 900 ^{0}C **[4].** At the **fig.1**, All the peaks can be indexed to hexagonal phase of CdS thin film with lattice constants of $a = 4.1354$ Å and $c = 6.715$ Å and these are very close to the values in the literature Reference 3. The intensities of as-deposited CdS thin film corresponding to the (100), (002), (101), (103), (112) planes are obvious . At the **fig. 1**, The (002) diffraction peak in hexagonal CdS is most intensive.

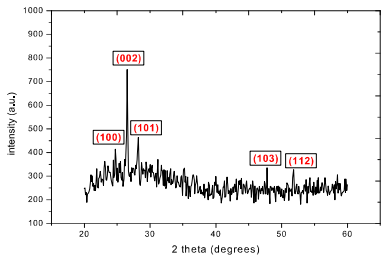


Figure 1.X-ray diffractogram of CdS thin film deposited by CSP at 400 ^{0}C

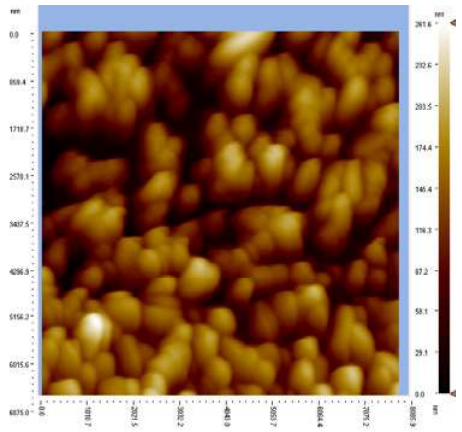


Figure 2. Two -dimensional AFM micrographs of as-deposited CdS

The images were recorded from area of 10x10 μm^2 on the film and obtained in AFM tapping mode. **Fig. 2** shows that grains which were recorded at 6.875 x 8.085 μm^2 area. It can be seen several size grains at the images which had probably tendency to be directed along (002) plane . Consequently, AFM studies also sustain XRD information.

In summary, the CdS thin film has been deposited successfully on bare glasses by a simple chemical spray pyrolysis technique using $CdCl_2$ and TU precursor solution at 400 ^{0}C. After deposited process, the CdS film has been characterized by XRD and AFM. XRD patterns show that the obtained CdS thin film is of hexagonal polycrystalline phase. AFM studies also sustain XRD information.

References

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