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Synthesis and Characterization of Cds on Glass by Chemical Bath Deposition Method

Shinde Priyanka and Bhise RB

Department of Physics, B. J. College, Ale, Tal: Junnar, Dist: Pune 412411, MS, India
Email: priyanka20591shinde@gmail.com , bhiseramesh@gmail.com

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ABSTRACT
Synthesis of CdS was monitored by scanning the spectrum of material from 200 to 800nm by using glass as blank. The fundamental properties of CdS thin film, prepared using CBD method were investigated. UV-Visible spectroscopy analysis was performed at room temperature with last cuvette of 1 cm path length as a sample holder. The maximum absorbance was observed at 620nm which indicated the synthesis of CdS. The band gap energy is calculated and it is found to be 2.39eV. Which is in good agreement with theoretical band gap values of CdS is 2.4eV. XRD pattern clearly illustrated that, the CdS synthesized by the present method were slightly crystalline in nature. The crystalline size is found to be approximately 30nm. The morphology and the size of the synthesized CdS were determined by SEM image. The smaller grains are distributed all over the structure in uniform size distribution. The properties studied include thickness, bandgap, crystal structure and morphology energy of CdS thin film were determined.

Keywords: CdS synthesis,CBD Method,SEM image.

INTRODUCTION

Thin film technology has drawn a considerable amount of interest after its application in different electronic, optoelectronic and photovoltaic device application. Research has been going on this field for quite some decades now but it's slowly picked up the place in the last quarter especially in photovoltaic and optoelectronic sector due to the demand and need of renewable energy

resources uses in recent years. Initially, with respect to the photovoltaics research, it all began when Einstein discovered the photoelectric effect during the 1900. But device fabrication applications started to emerge during the sixties with the CdS/Cu2S binary structures being a possible candidate for optoelectronics and thin film applications, subsequently followed by the heterojunction ternary structures of CdS/CZT & CdS/CuInSe2 era. However, currently in the twenty first century a whole new gamut of organic and inorganic materials has come up for PV & other branches of electronics related research. It is proving to be an exciting and challenging time for researchers ushering a newera for electronics as experimentations are going on presently all over the world with different methods of fabrication methodologies to produce a cheap, sustainable, environment friendly, high efficiency solar cell and other Nano electronic devices. In recent years, there has been growing interest in II-VI semiconductor materials for their potential applications in optoelectronic and photovoltaic industries. One of the most promising alternative materials is a cadmium sulphide (CdS) thin film, which is a chalcogenide n-type semiconductor having a direct energy band gap between 2.28 eV and 2.45eV. Owing to its interesting structural, optical and electrical properties that are much different compared to bulk materials, these films can be applied to many technologies such as window layer in solar cells, optical sensors, transistors, diodes, etc. Various methods such as electro-deposition, spray pyrolysis, successive ionic layer adsorption and reaction (SILAR), pulsed laser deposition, vacuum evaporation and chemical bath deposition (CBD), etc. are used to obtain CdS thin films. Among these fabrication methods, CBD is known as the simplest and most economical method for the large-area productions in obtaining semiconductor thin films. It is well known that CdS thin films may be exist in either cubic or hexagonal phase or as a mixture of bath phases depending on many factors including deposition technique. The difficulty in the formation of monocrystalline CdS thin films stems from a strong self-compensation effect due to sulfur cacncies and the depth of the acceptor level in CdS. Therefore, it is very important to var morphological, optical and electrical properties of CdS thin films by adjusting the grain size for technological applications using low cost and an easy method. Hence, nanocrystal line CdS thin films are deposited on glass substrates using CBD method.

METHODOLOGY

a) Cleaning of substrates:

Glass slides of dimension 75 mm x 5 mm x 1.1mm were used as substrate. The substrates were cleaned in the freshly prepared piranha solution (3:1 mixture of conc. (H_2SO_4 and H_2O_2)). The substrate was kept in the solution for 20 to 30 minutes. It removed all the dust and organic substances. After removing the glass substrates from the mixture, they were washed thoroughly in running tap water and then in distilled water. Finally, they were dried and stored for future uses.

b) Preparation of the bath solution:

Two washed beakers (say b1 and b2) were taken, each were filled with 100ml of deionized water. In bl, 0.48 gm of cadmium chloride (NH_4Cl_2) were taken. In b2, 2.24gm of thiourea ($(NH_2)_2CS$) was taken. Both the solutions were heated separately to about 40^0 C and then mixed together with constant stirring. To the resultant solution, liquid ammonia solution (NH_4OH) was added dropwise to raise the Ph between 10.5 and 11.

c) Chemical reactions involved:

The preparation of cadmium sulfide involves the reaction of cadmium ions (Cd^{2+}) with sulfide ions (S^{+}). The reactions involved in the process can be presented as follows:

The decomposition of thiourea is given by

$$(NH_2)_2CS + OH^- \longrightarrow SH\text{-}CH_2N_2 + H_2O$$

$$SH^- + 2OH^- \longrightarrow S^{2-} + H_2O$$

$$Cd^{2+} + 2OH^- \longrightarrow Cd(OH)_2$$

$Cd(OH)_2$ then reacts with the ammonia buffer to form a cadmium tetra mine complex which then reacts with the sulphide ions to give cadmium sulfide. NH_3 is involved as a byproduct of the reaction.

$$Cd(OH)_2 + NH_4OH \longrightarrow [Cd(NH_3)_2]^{2+}$$

$$[Cd(NH_3)_2]^{2+} + S^{2-} \longrightarrow CdS + 4NH_3$$

The CdS thus formed sticks to the surface of the substrate mounted vertically the solution.

d) The chemical bath deposition process on glass substrate:

The glass substrates were mounted vertically in the solution and the solution was heated rapidly up to 50°C with the help of heater and then places on a hot tray plate where the temperature was maintained at 70°C. The deposition took place for 30 minutes. Colors of the solution could be observed while temperature was rising. At first the solution was transparent, then successively changed as yellowish transparent (at around 50°C), greenish yellow (at around 60°C), light orange (at around 65°C) and reddish orange (at and above 70°C). In the slow process of deposition this color change could be observed clearly. Deposition was carried out for 30 minutes in each step. Slides were then removed from the bath solution and washed in the flow of tap water and finally washed with deionizes water to remove the loosely adhered CdS particles and subsequently dried at room temperature. The deposition occurred on both sides of the glass substrates and it is to be mentioned here that the thin film deposited on the one side of the glass substrate was removed before thickness determina-tion. For multiple deposition the process was repeated several times until the desired thickness was achieved. After the deposition the back sides of the substrates were removed using dilute HCl.

RESULTS AND DISCUSSION

Result from X-ray diffraction:

Using shimadzu maxima 7000 X-ray diffractometer with CuK α radiation with the scanning range in Between 0 to 80 showed the XRD pattern of CdS. The XRD has proven to be a valuable research tool to prove the formation of CdS, determining the crystal structure and calculating the theoretical particle size of prepared CdS. XRD pattern thus clearly illustrated that, the CdS synthesized by the present method were slightly crystalline in nature. The crystalline size is calculated using Debye-Scherrer method. It is found to be approximately 30nm.

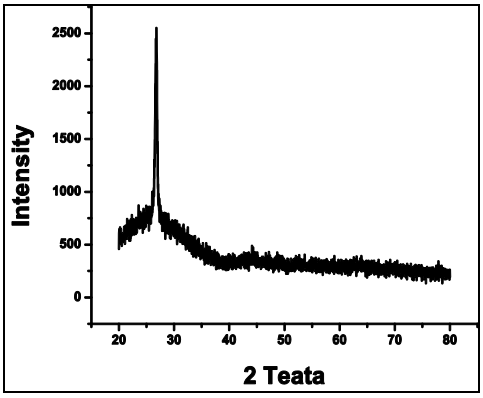

Figure-1: XRD pattern of CdS thin film

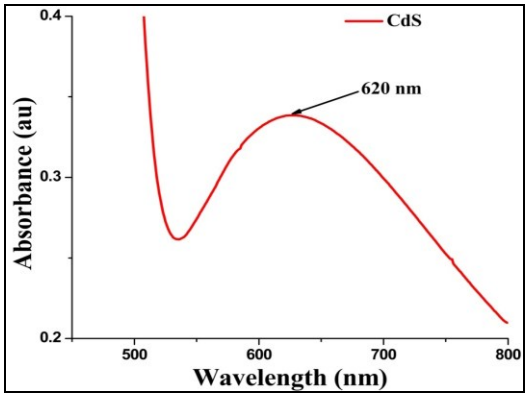

Figure-2: UV visible pattern of CdS thin film

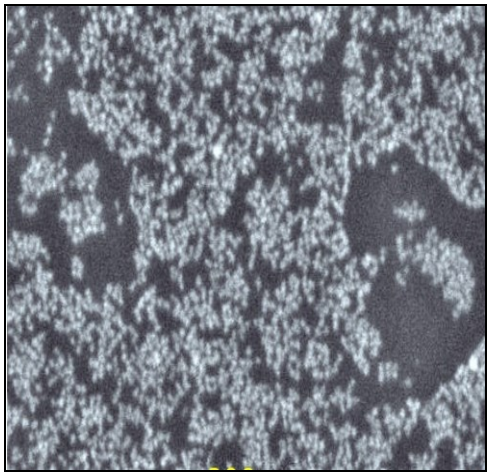

Figure-3: SEM pattern of CdS thin film

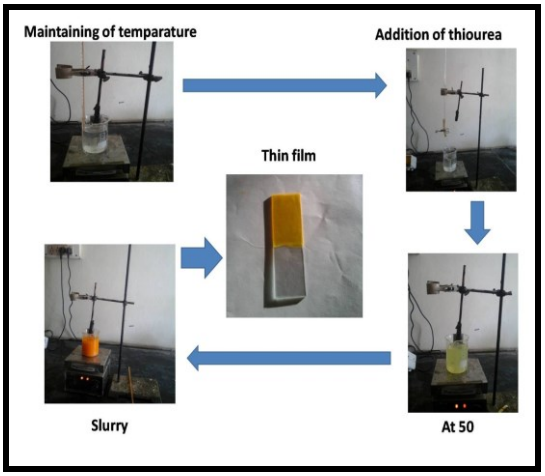

Figure-4: Experimental of CdS thin film

Morphology from SEM analysis:
SEM image were carried out by using [QUANTA-200, FEI Ltd. Netherland]. Thin film of carbon coated copper grid a sample was placed, where excess of sample was removed by using the cone of a blotting paper and sequentially arrange in a grid box. The morphology and the size of the synthesized CdS were determined by SEM image. The smaller grains are distributed all over the structure in uniform size distribution.

Band gap calculation from UV-spectrophotometry:
UV-Visible spectroscopy analysis was performed using LAB UV 3000 at room temperature with glass cuvette of 1 cm path length as a sample holder. The formation of CdS was monitored by scanning the spectrum of material from 200 to 800nm by using glass as blank. No of experimental trails confirmed that reduction and synthesis of CdS was better in starring condition as compared to open other parameters. The maximum absorbance was observed at 620nm which indicated/supported the formation of CdS.The band gap energy is calculated and it is found to be 2.39eV. Which is in good agreement with theoretical band gap values of CdS is 2.4e

CONCLUSION

UV-Visible spectroscopy analysis was performed using LAB UV 3000 at room temperature with last cuvette of 1 cm path length as a sample holder. The formation of CdS was monitored by scanning the spectrum of material from 200 to 800nm by using glass as blank. No of experimental trails confirmed that reduction and synthesis of CdS was better in starring condition as compared to open other parameters. The maximum absorbance was observed at 620nm which indicated/supported the formation of CdS. The band gap energy is calculated and it is found to be 2.39eV. Which is in good agreement with theoretical band gap values of CdS is 2.4eV. Using shimadzu maxima 7000 X-ray diffractometer with CuK $\propto$ radiation with the scanning range in between 0 to 80 showed the XRD pattern of CdS. The XRD has proven to be a valuable research tool to prove the formation of CdS, determining the crystal structure and calculating the theoretical particle size of prepared CdS. XRD pattern thus clearly illustrated that, the CdS synthesized by the present method were slightly crystalline in nature. The crystalline size is calculated using Debye-Scherrer method. It is found to be approximately 30nm. SEM image were carried out by using [QUANTA-200, FEI Ltd. Netherland]. Thin film of carbon coated copper grid a sample was placed, where excess of sample was removed by using the cone of a blotting paper and sequentially arrange in a grid box. The morphology and the size of the synthesized CdS were determined by SEM image. The smaller grains are distributed all over the structure in uniform size distribution. The fundamental properties of CdS thin film, prepared using CBD method were investigated. The properties studied include thickness, bandgap, crystal structure and morphology energy of CdS thin film were determined.

Conflicts of interest: The authors stated that no conflicts of interest.

REFERENCES

1. Kasturi LC and Inderjeet K. Thin film device applications: Plenum press New York, 1983.
2. Khomane S. Crystallographic, Morphological, Optical and electrical properties of CBD deposited, 2011.
3. Kathirvel D, Sariyanaraya N, Prabaher S. and Srikanth. Electrical properties of chemical bath deposited cadmium sulphide thin film, 2011.