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Research Article

OPTICAL PROPERTIES OF CADMIUM SULPHIDE THIN FILMS DEPOSITED BY SPRAY PYROLYSIS TECHNIQUE

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ABSTRACT

CdS thin films have been prepared by Spray pyrolysis technique on glass substrate at 300^0 c temperature. The films exhibited high optical transmittance T, 50-95%, low reflection in the wavelength(500-900)nm. which makes them useful transparent window in solar cells. The value of the optical energy gap for the as deposited films was in the range(2.35-2.39)eV. Optical characterization of prepared films was performed by using UV visible spectroscopy.

INTRODUCTION

Several methods are reported for the preparation of CdS thin films such as electrodeposition [1], Pulse lasor deposition [2], Physical Vapour desosition [3], Vaccum evaporation[4], Close space sublimation [5] But all these methods have sophisticated requirement in order to precise temperature control, high pressure etc. Besides all above methods, Spray pyrolysis technique, convenient and cheaper [6]. The aim of this paper is to prepare CdS thinfilms by Spray pyrolysis technique.Thin films now occupy a prominent place in basic research and solid state technology . The use of thin film semiconductors has attached much interest in an expanding variety of applications in various electronic and optoelectronic devices due to their low production costs. Cadmium sulphide (CdS) is one of the most promising II-VI compound materials because of its wide range of applications in various optoelectronic (Iyechika *etal* 1988; Dhumure and Lokhande 1993; Lee *etal* 2003) [7-9].

In recent years, there has been a rapid development in the field of II-VI semiconductors for their use in solar cells. Cadmium sulphide belonging to the II-VI group is the most widely used material for CdS/CdTe and CdS/Cu_2S heterojunction solar cells. It is because of the fact that CdS has intermediate energy band gap, reasonable conversion efficiency, stability and low cost (Lee and Im 1980; Nakayama *etal* 1980)[10-12].

CdS thin films are regarded as one of the most promising materials for heterojunction thin film solar cells. Wide band CdS(Eg=2.42 eV) has been used as the window material together with several semiconductors such as CdTe, Cu_2S and InP with 14-16/ efficiency [13-16].

MATERIALS AND METHODS

Spray pyrolysis involves the application of a fine mist of very small droplets containing the reactants onto the hot substrate in the atmospheric conditions. The critical operations of the spray pyrolysis technique are the preparation of uniform and fine droplets and the controlled thermal decomposition of their droplets.

The CdS thin films were prepared by spraying an aqueous solution of $CdCl_2$ and thio urea on the high cleaned glass substrate kept at 300^0C. The atomization of the chemical solution into a spray of fine droplets is effected by the Spray nozzle, with the help of compressed air by the air pump as carrier gas. The solution was sprayed through a nozzle onto glass substrate using air as carrier gas with a pressure[17].

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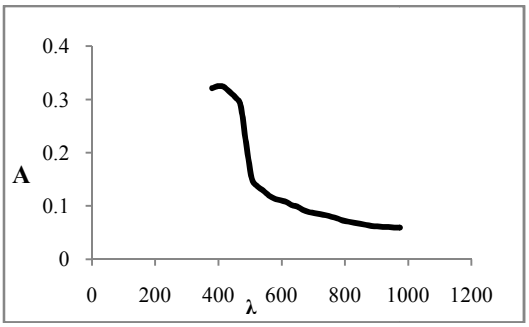


Fig 1 a Absorption Spectra of CdS thin film t =0.6283µm.

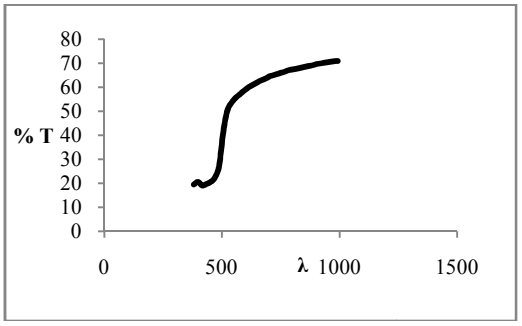


Fig 1 b Transmission Spectra of CdS thin film, t =0.6283µm.

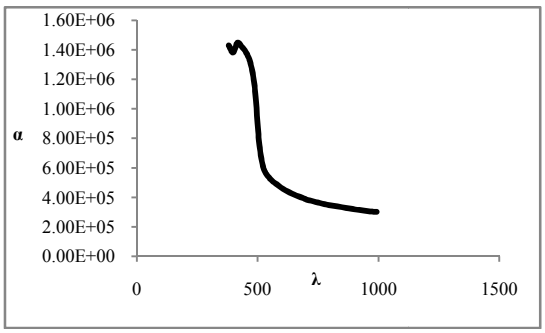
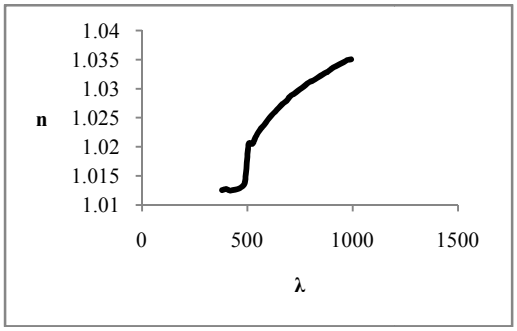


Fig. 1 c Variation of α as a function of wavelength of CdS thin film,t



F**ig 1 d** Variation of Refractive index with wavelength, t=0.6283µm.

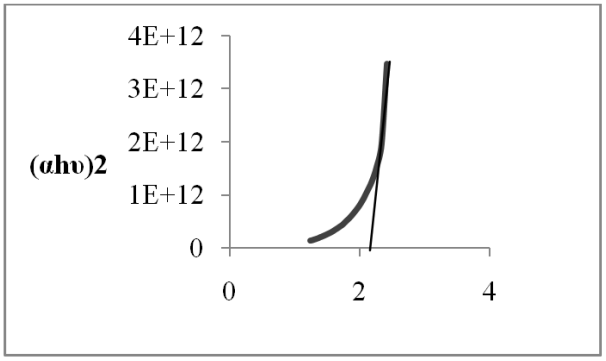


Fig. 1 e Photon energy hνVs $(\alpha h\nu)^2$, t =0.6283µm.

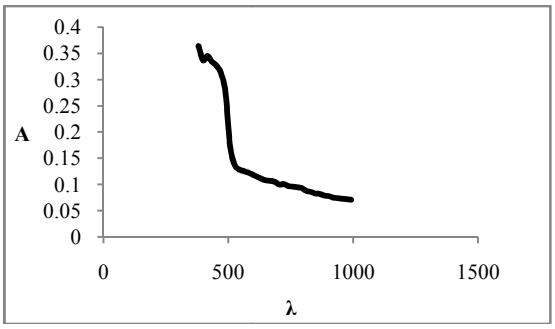


Fig. 2 a Absorption Spectra of CdS thin film,t =0.6048µm.

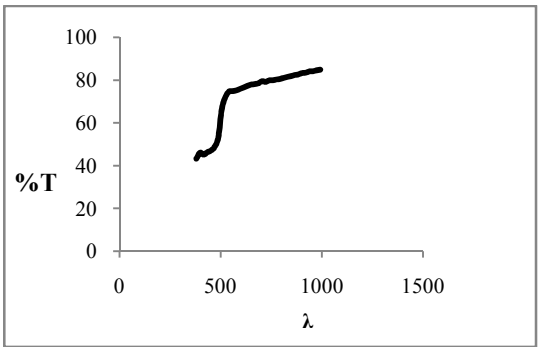


Fig. 2 b Transmission Spectra of CdS thin film, t =0.6048µm.

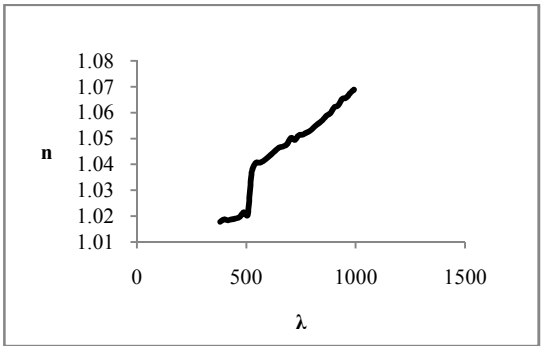


Fig. 2 d Variation of Refractive index with wavelength, t=0.6048µm.

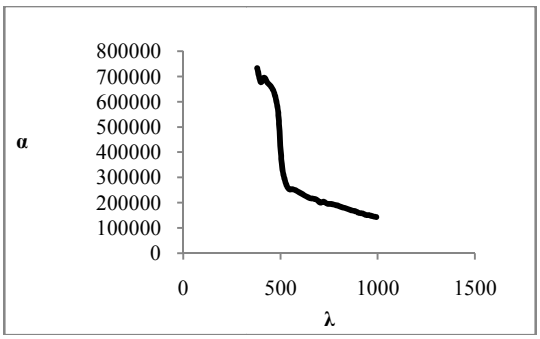


Fig. 2 c Variation of α of as a function of wavelength, t=0.6048µm.

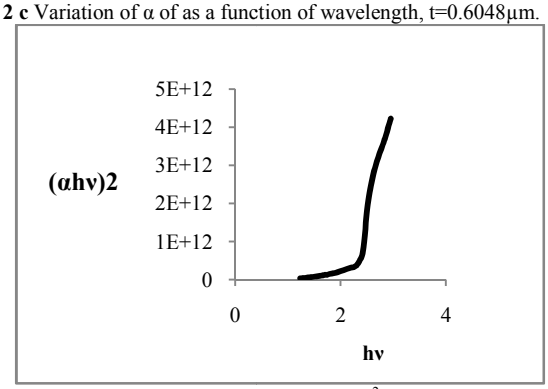


Fig. 2 e Photon energy hνVs $(\alpha h\nu)^2$ t=0.6048µm.

RESULT AND DISCUSSION

The optical absorbance of CdS thin films deposited by Spray pyrolysis technique are shown in fig. 1c and 2c.From the spectrograph the absorption edge of sample found to be in the range of 445-560 nm.

The optical band gap Eg, can be estimated from Taue relation,

$(\alpha h\upsilon)= A (h\upsilon-Eg)^n$ ….[1]

Where Eg is the band gap corresponding to particular transition occurring in film, A is a constant,υ is transition frequency and the exponent n characterizes the nature of band transition. The graph between hυ Vs $(\alpha h\upsilon)^2$ plotted and shown in fig. 1e and 2e, the extrapolation of straight line to $(\alpha h\upsilon)^2=0$ axis, gives the value of energy band gap of CdS thin films. The band gap in thin films observed to be 2.35 eV and 2.39eV [18]. We found that all films have light transmission in the visible region so CdS thin films which deposited by spray pyrolysis technique actively used as the window material in solar cells. From figures 1b and 2b, it is found that the films exhibited high transmittance from 50-95%.This property makes these films a good candidate as transparent window in solar cells[19].

CONCLUSION

CdS thin films were prepared by Spray pyrolysis technique using a solution of cadmium chloride and thio urea. We have studied the absorption spectrum of CdS thin films deposited by Spray pyrolysis technique in the wavelength range 380-1000 nm for determining the optical band gap values and calculating other optical parameters. The films has good optical quality properties and are well-suited for solar cell application. The films exhibited a direct transition 2.35-2.39 eV. These results suggest that the method of spray pyrolysis for the deposition of CdS thin films should be further investigated for application towards the fabrication of solar cells. Absorption edge as observed in the range 450-550 nm has been used for determination of optical of CdS thin films. The values of optical band gap for deposited thin films decreases with increase in thickness of thin films. Refractive index decreases with in visible wavelength range. These properties making the films suitable for optoelectronic devices, as window layers in solar cells.

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