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Optical characterization of CdTe sintered films

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ABSTRACT

Cadmium Telluride (CdTe) films find application in solar cells and electro-luminescent devices. Films of CdTe are deposited on glass substrate by sintering technique. The band gaps of these films are studied by reflection spectra in wavelength range of 800-1000nm. The X-ray diffraction pattern of these films for structural analysis is also reported in this work.

Key words: Solar cells, sintering technique, energy band gap, reflection spectra, X-ray diffraction pattern

INTRODUCTION

In recent years there has been considerable interest in the field of thin film semiconductors for the use in solar cells devices.[1,8] CdTe belonging to group is one of the suitable material for low cost photovoltaic devices. The deposition of CdTe films has become increasingly important in recent years due to its application, as a window material in hetrojunction solar cells. Cadmium telluride has been the subject of intensive research, because of its intermediate band gap, reasonable conversion efficiency, stability and low cost.[2]

EXPERIMENTAL DETAILS

In the study presented CdTe film is prepared by sintering (screen printing) technique. To prepare sintered films of CdTe an appropriate amount of CdTe $CdCI_2H_2O$ and ethylene glycol are thoroughly mixed. The paste thus prepared is screen printed on glass substrate which has been cleaned properly. The samples thus prepared are dried at 110ºC for 4 hours in air and then sintered at 500^0 C for 15 minutes to remove the organic material left.[3,4,7]

CHARACTERIZATION OF SAMPLES

Reflection spectra of these films are taken at room temperature with the help of Hitachi Spectrophotometer model U-3400 Energy band gaps of these films are calculated with help of reflection spectra.

To measure the energy band gap the Tauc relation[3] is used in which a graph between $(\alpha h\upsilon^2$ vs $(h\upsilon)$ is to be plotted where α is the absorption coefficient and $h\upsilon$ is the photon energy. Absorption coefficient α is proportional to $[(R_{max} – R_{miin}) / (R – R_{min})]$, where reflection falls from R_{max} to R_{min} due to absorption by the material, R is the reflectance for any intermediate energy photons. So α is used in terms of reflectance as Ln $[(R_{max} – R_{min}) / (R – R_{min})]$ and the energy band gaps are computed for the film material. The X-ray diffraction patterns of these films for structural analysis are also reported in this work. The d-values are calculated by calculating θ values from the peaks of the x-ray by using the relation $2d \sin\theta = n\lambda$ (n = 1 in the present case). These d-values are compared with the standard ASTM data to confirm the structure of CdTe.[4,10, 11]

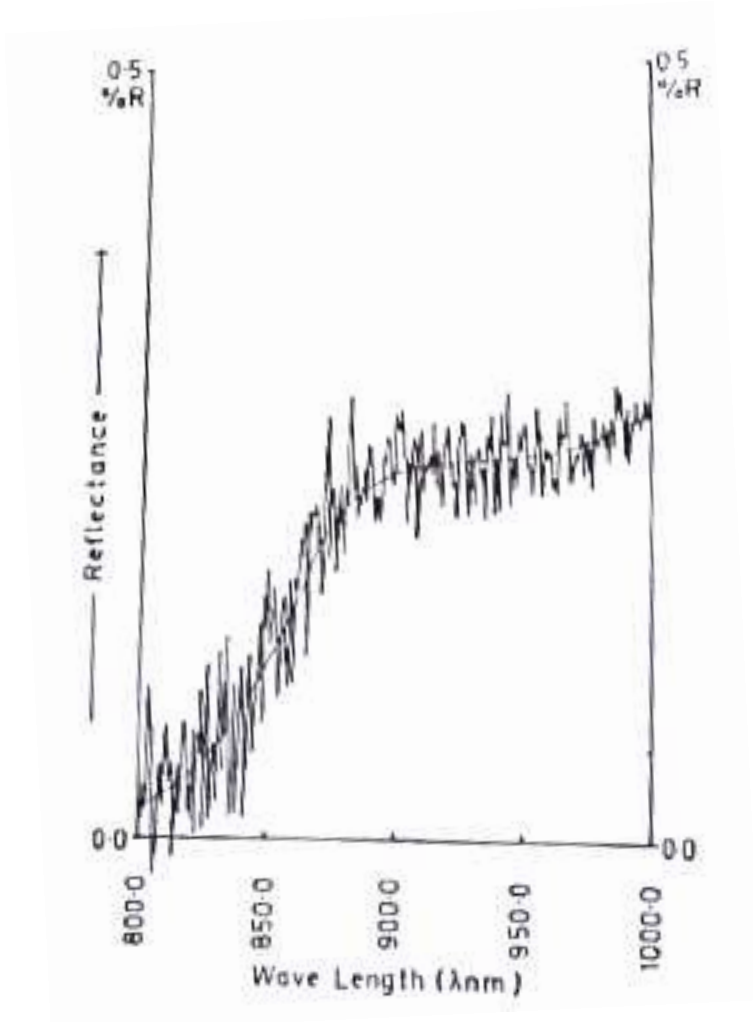

Figure-1: Reflectance spectra of CdTe sintered film

Results and Discussion

Figure 1 represents the reflection spectra of sintered CdTe film. Figure 2 shows a plot of Ln $[(R_{max} - R_{min}) / (R - R_{min})]$ vs hυ for the sintered film of CdTe. From this graph, the value of energy band gap of the film materials comes out to be 1.4 eV.[5,6,7] The structure of sintered CdTe film is confirmed by x-ray analysis. The X-ray of one of these sintered CdTe films is shown in Fig. 3.

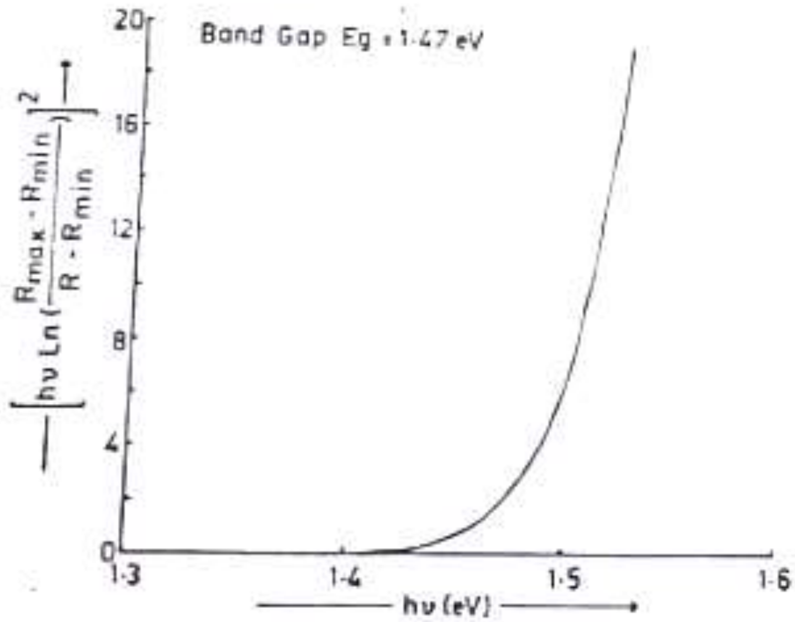

Figure-2: Energy band gap of sintered CdTe film by Reflectance spectra

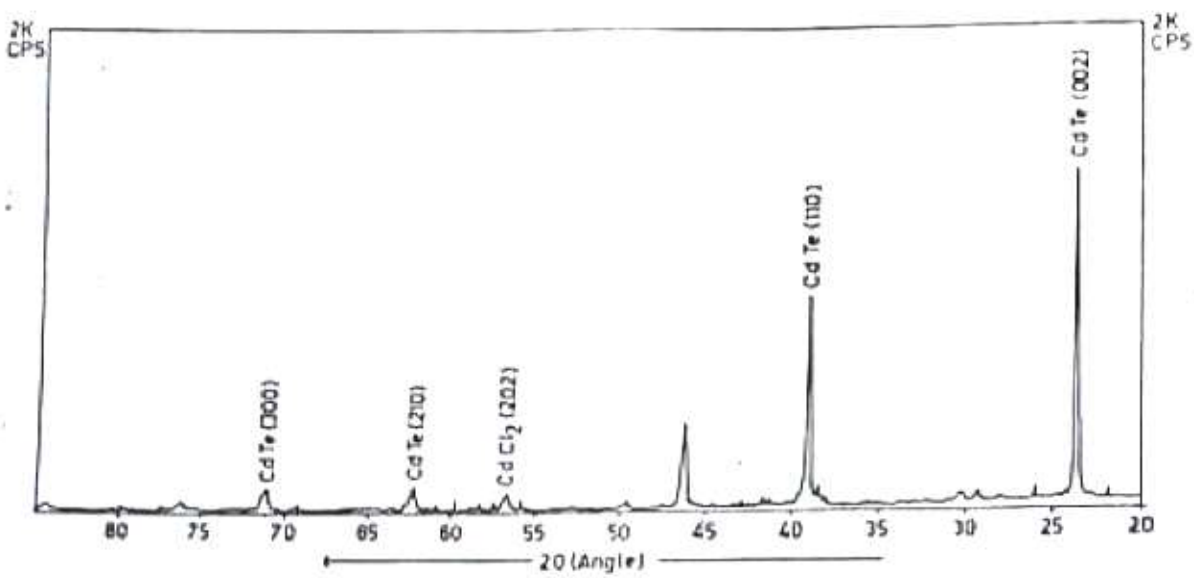

Figure-3: X-ray diffraction pattern of CdTe film

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