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RESEARCH ARTICLE

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EFFECTS OF BATH TEMPERATURE ON ELECTRODEPOSITED CdTe THIN FILMS

BARIŞ ALTIOKKA[1]* AYÇA KIYAK YILDIRIM[2]
Bilecik Şeyh Edebali University, Bilecik 11210 Turkey,
(baltiokka@gmail.com) Tel: +90 228 214 1607–1607 Fax: +90 228 214 1332
(ayca.kiyak@bilecik.edu.tr) *Tel: +90 228 214 1607–1607 Fax: +90 228 214 1332*
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ABSTRACT
In this work, thin films of CdTe were obtained electrodeposition technique. The samples were obtained at 40, 60 and 80 °C of bath temperature. The structural analyses were performed by using a XRD device. The optical properties of the films were carried out from absorbance measurements. The morphological properties of the samples were analysed by using SEM images.
Keywords: CdTe**;** electrodeposition**;** thin films

1. Introduction

For several decades, huge attention has been focused on the development of thin film semiconductors using inorganic binary compounds in order to develop low-cost and high efficiency photovoltaic thin-film solar panels. CdTe has been recognized as a suitable candidate and promising material among the group II-VI compounds to convert light into electricity due to its near-ideal direct energy band gap and high optical absorption coefficient [1]

Various techniques have been reported for preparation of CdTe thin films such as physical vapour deposition (PVD), RF sputtering, spray pyrolysis, close-space sublimation (CSS) and electrodeposition (ED) [2]. For electrodeposition of thin films, electrodeposition technique was used for due to its comparative advantages with respect to deposition process continuity, low-cost, simplicity, scalability and Cd-containing waste reduction amongst other advantages [3].

2. Experimental Procedure

CdTe films were produced by electrodeposition. Before the depositions, bath contained and ITO coated glass substrates were washed by using acetone. After the washing, they were left to dry under room condition. The bath container consisted of mL deionized water, 1.5 M $CdCl_2$ and 0,03 M Na_2TeO_3. The pH of the solutions were adjusted to 2.75 by dilute nitric acid. The depositions were completed in 1750 s. Besides, the experiments were stirred at 600 rpm.

A JASCO V–530 double beam spectrophotometer device was employed to determine absorbance values. Wavelengths of the absorbance were chosen as to be range of 300 and 600 nm. A PANalytical empyrean X-ray diffractometer was used to determine structural analysis. The morphologic characterizations of the CdTe films were investigated with a Zeiss supra 40VP SEM.

3. Result and Discussion

3.1. Structural studies of CdTe thin films

The thickness of the films were calculated by using gravimetric method. The thicknesses of the films were calculated average 450 nm. Fig. 1 shows the XRD pattern. According to the Fig. 1, all the films formed in cubic crystal. Among these patterns, the film obtained at 40 °C has telluride peaks.

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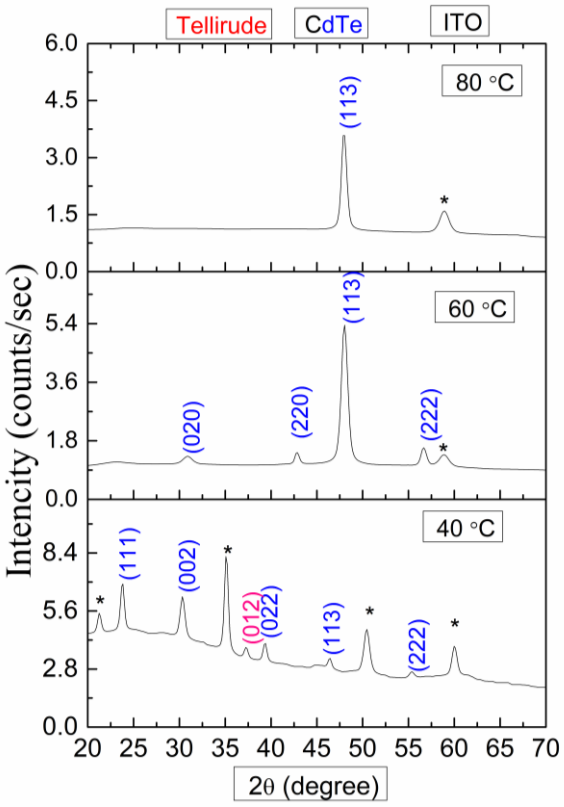

Figure 1. XRD patterns according to potantial

3.2. Optical properties of the films

The optical behaviors of the films were recorded by a UV-vis device. The absorbance measurements were given in Fig. 2. According to the absorbance plots, when the film obtained at 80°C, the absorbance values were relatively high. It is concluded that this film may be good crystallized and has relatively high thickness. The band gap of the films were estimated Tauc plots and these plots were given in Fig. 3.According the plots, the band gap of the films obtained at 80 °C is 1.57 eV. This result was nearly matched band gap of the literature (1.47 eV). [4].

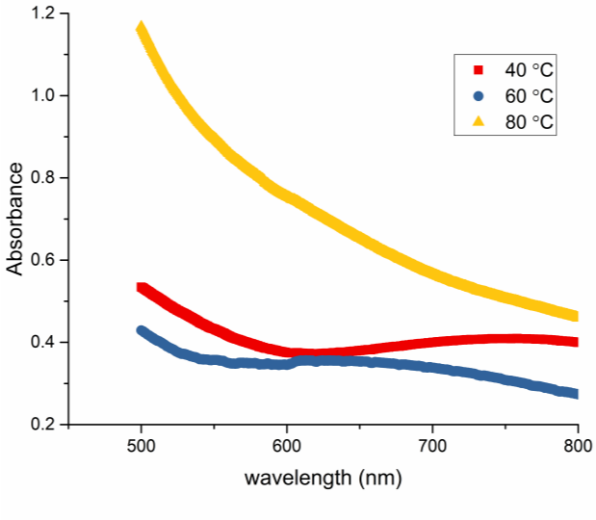

Figure 2 Absorbance measurements of the films

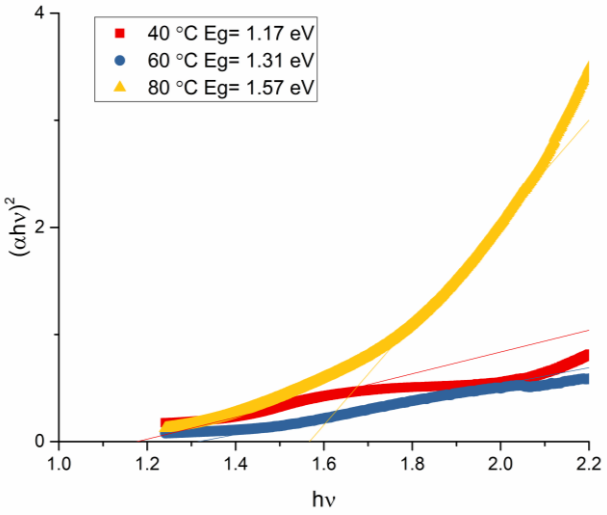

Figure 3. Tauc plots of the films.

3.2. Surfaces of CdTe thin films

The 20,000 magnified SEM images were given in Fig.4. According to the SEM images, the surfaces of the films are very compact and smooth. There are crystal grains on the surface of the film obtained at 40 °C. The films are pinhole free and there are no voids and cracks.

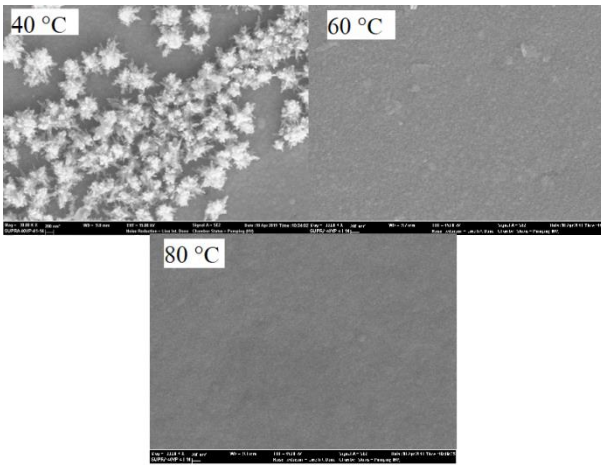

Figure 3 The 20000 times magnified SEM images

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Conclusions

In this work, CdTe films were produced by using chronaamperometry method of electrodeposition. The effects of bath temperature were investigated. According to the XRD patterns all films formed in cubic crystal. The band gaps of the films were estimated by using Tauc plots. The band gap of the film obtained at 80 °C is closely to the literature. The surface images showed that all films formed in compact and pinhole free.

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