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Comparative Analysis of Optical Properties of Cdo Annealed thin Film deposited by Spray Pyrolysis Method

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Abstract— *Cadmium oxide transparent thin film is deposited by spray pyrolysis technique on glass subtract at 400^{0}C and annealed at a temperature of 100 °C for one hour. The band gap was found depend on varius parameters is studied. It is noted that the shift in band gap i.e. decrease with the increasing film thickness in the range 2.15 eV to 2.40 eV. The optical constants such as, band gap, refractive index, extinction coefficient as a function of photon energy for all prepared films were calculated. also studied The XRD revealed of thin film of CdO shows polycrystalline in nature*

Keywords— ***CdO thin film, spray pyrolysis, optical properties, band gap, XRD.***

I. INTRODUCTION

Cadmium oxide is transparent conducting oxide having high optical transparency in the visible region and near infrared region. Due to the high conductivity of the CdO films has used to produce high-efficiency solar cells. CdO has interesting properties like large band gap, low electrical resistivity, high transmission in the visible region etc. These properties make it useful for a wide range of applications CdO thin films are promising material for various applications for electronic and optoelectronic application such as for solar cell application [1-3] ,photo diode transparent electrodes, solar cell, liquid crystal displays, , but also for photodiodes [4] and gas sensors [5]. The Cadmium oxide from group II-VI are explored in determines of thin films devices. The effect of thickness on band gap was briefly studied in this paper. The various techniques have been used for depositing CdO thin films, are available in literature such as spray pyrolysis[6], sputtering[7], sol-gel spin coating[8], activated reactive evaporation[9], metal Organic Chemical Vapor deposition [10], pulsed laser deposition[11]. In this article we studied the optical characterization of CdO thin films were prepared using spray pyrolysis technique by using UV-VIS spectrometer from its absorption spectrum in optical range (380 – 1000nm).

II. EXPERIMENTAL

The deposition system and conditions are reported elsewhere (12) The glass slide is used as a glass substrate to deposited CdO thin film. The glass substrate was cleaned in concentrated Nitrate acid, alcohol and distilled water for several times to remove the impurities on the surface of substrate before the deposition. Cadmium chloride is stirrer for 6-7 hours and the solution stirrer 10 min on electronic stirrer. Cadmium chloride (0.01N) solution was prepared in double distilled water and hydrogen peroxide 3 to 4 ml was mixed together with cadmium chloride precursor in the sprayer. The weight of the glass substrate before spraying & after spraying was measured using electron unipan microbalance to measure thickness of fim by weighing method.The clean substrate was arranged on hot metal plate on heating coil with controlled variac. This glass substrate is heated at constant suitable temperature 400^{0}C. The nozzle-to-substrate distance was approximately 15 cm, and the spraying time was around 10 min.The solution sprayed on the glass slide was to form uniform CdO thin film on the substrate with high pressure through a fine sprayer bore. After the solution finished the substrate was allow to cool up to room temperature then annealed at 100^{0}Cfor 1 hour. The CdO thin film is then used to study optical properties and energy gap measurement. After preparation the CdO annealed thin films by spray pyrolysis technique , the optical absorption & percentage transmission were

measured by UV – VIS Spectrophotometer ELCO (SL-159) in the wavelength range 380 – 1000 nm. The XRD patterns of annealed CdO thin films were recorded with Phillips X-ray diffractometer wavelength 1.542 A^o was used

III. RESULT AND DISCUSSION

The semiconductor band gap Eg was determined by analysis the optical data with the expression equation 1 for the optical absorption and photon energy his using relation

Energy band gap of materials is related to absorption coefficient α [13-14] as

$$\alpha = \frac{A}{h\nu}(h\nu - E_g)^{1/2} \quad \text{----------(1)}$$

where A is constant , ν is incident photon energy, h is the Plank's constant and Eg is band gap. the plot of $(\alpha h\nu)^2$ verses photon energy $(h\nu)$ for CdO thin film shows straight line Hence, a straight line tangent to a linear portion which gives the band gap energy

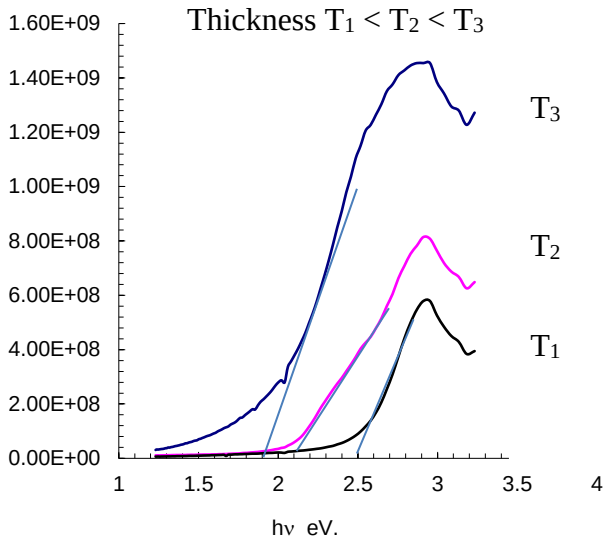

Fig.1 Direct band CdO thin films

The energy band gap obtained in this work is 2.25 eV(BG) This is in good agreement with the previously reported values of 2.4 ev and 2.42 eV [15,16] It is observed that as thickness increases $T_1 < T_2 < T_3$ that the transmission decreases with increase in thin film thickness. And hence it is concluded that as the band gap energy of the thin films decreased as the film thickness of the samples is increased and the grain size above increases.

The refractive indeed (μ) with wavelength were calculated by using relation (17)

$$\mu = \frac{(1+\sqrt{R})}{(1-\sqrt{R})} \text{-----(2)}$$

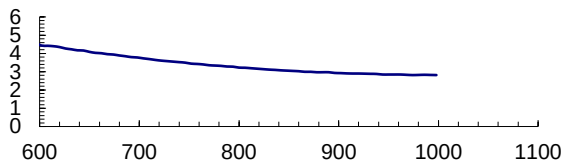

Fig.2: Refractive index (μ) vs. wavelength (λ)

It observed that the extinction coefficient and refractive index was high in the wavelength range of 325 - 400 nm and low in the in the range 650-900 nm The refractive index of the films was found to be decreasing with an increase in the wavelength

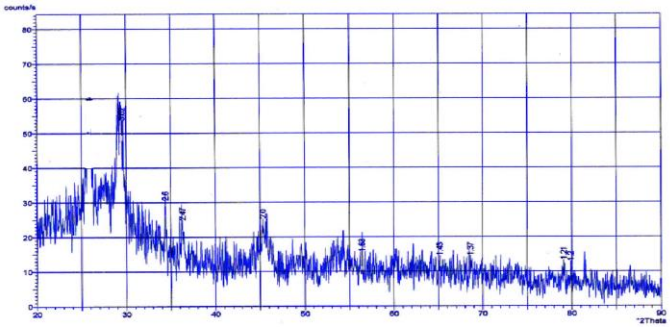

Fig.3. XRD Pattern of CdO

Figure 1 shows the XRD patterns of CdO films prepared at 400°C on glass substrates. CdO sample shows that the film peaks at 30.540, 34.120, 36.500,47.660,52.830

IV. CONCLUSION

The optical and structural analysis of the CdO thin film suggests were crystalline in structure and the band gap are in the range 2.15 eV to 2.40 eV. This process has good control over the thickness uniformity. it is observed that films show normal dispersion behavior i.e. refractive index of the films falls as the wavelength increases over the visible region The films prepared by this method are pin hole free and have good adherence to the substrate The strong and sharp diffraction peaks indicate the good polycrystallization

REFERENCES

[1] T.L. Chu, S.S. Chu, J. Elect. Mater. 19 (1990) 1003.
[2] C.H. Champness, C.H. Chan, Solar Energy Mater. Solar Cells 37
[3] A.A. Al-Qurani, C.H. Champness, in: Proceedings of the 26th IEEE Photovoltaic Specialists Conference, Anaheim, CA, 1997,p. 415.
[4] R. Kondo, H. Okhimura, Y. Sakai, Jpn. J. Appl. Phys. 10 (1971) 547.
[5] A. Shiori, Japanese Patent 7, (1979). 909-995
[6] Dong Ju Seo, Structural and Optical Properties of CdO Films Deposited by Spray Pyrolysis, J Korean Phys Soc, 2004, 45,1575-1579.
[7] T. K Subramanyam, S Uthanna and B Srinivasulu Naidu, Mater Lett, 1998, 35, 214–220.
[8] D. M Carballeda, R CastanedoPérez, O Jiménez-Sandoval S Jiménez Sandoval, G Torres- Delgado and C. I Zúñiga-Romero, Thin Solid Films, 2000, 371, 105–108.
[9] X. R. Ye, C. Daraio, C. Wang, and J. B. Talbot, J. Nanoscience and Nanotechnology, (2006) 6
[10] Z. Guo-hua, L. Ming-fang, and L. Ming-Li CEJC, 5 (2007)
[11] N. Ahmed Abd, A. Raid Ismail and F. Nadir Habubi ,Journal of Materials ScienceMaterials in Electronics, 25(2014)
[12] R.S. Meshram, R.M. Thombre International Journal of Bioscience, agriculture and Technology, Jan 2024 Issue 2 Vol 1 pp854
[13] K.T. Ramakrishna Reddy, G.M. Shanthini, D. Johnston, R.W. Miles, Thin solid films 427(2003) 397-400.
[14] M.M. Islam, J Podder, M.R.Islam, Optoelecronics and Advanced Rapid Communication Vol. 4, No. 7, July 2010, p.968-972.
[15] B.G. Jeyaprakash,K. Kesavan, R. Ashok kumar, S Mohan and A Amalarani, Bull Mater Sci., Vol. 34, No. 4, July 2011, 99. 601-605.
[16] Dong Ju, Journal of the Korean Physical Society, Vol. 45, No. 6, Dec 2004, pp. 1575
[17] Swanepoel R. J. Phys. E. Sci Instrum, 16, (1983.) 1214
[18] M. Azizar Rahman , M.K.R.Khan Materials Sciencein Semiconductor Processing 24,(2014),26–33