International Journal of Scientific Engineering and Technology
Volume No. 7, Issue No. 1, PP : 5-6
ISSN : 2277-1581
1 Jan. 2018

Growth and Characterization of CdO Films By Chemical SILAR

Schelza C Mandrakis
Materials Division, Niotech, North Ga, Goa, India
E-Mail: scmandrakis@gmail.com

Abstract: ***Thin films of cadmium oxide (CdO) were grown on borosil glass substrates by successive ionic layer adsorption and reaction method. The films were found to be amorphous. The thickness of the films increased with deposition cycles and concentration of the source solutions. Bandgap of the films were found to decrease from 2.7 eV to 2.5 eV as the thickness of the films increased. The films had almost stoichiometric composition. The films were found to form ohmic contacts with aluminium and showed a resisitivity of 0.47 ohm-cm.***

Keywords: CdO, SILAR, Solar cells, Chemical , thin films, bandgap

I. Introduction:

Cadmium oxide is a II-VI semiconductor which has a wide bandgap suitable for absorption in visible region. The material is therefore useful in large range of applications such as solar cells, photo detectors and so on [1-10]. Thin films of CdO have been obtained by many methods such as spray pyrolysis [1,2], sputtering methods [5], chemical methods [3,4, 10]. In the work reported here we have grown CdO films on borosil glass substrates by SILAR method using cadmium acetate and NH_4OH source solutions. The SILAR method is very low cost and simple method. It does not require high temperatures as spray pyrolysis and unlike sputtering method, it does not require vacuum. Hence SILAR method is more advantageous than the previous methods employed for CdO films.

I. Material and Methodology:

Borosil glass substrates needs to be cleaned thoroughly before the SILAR process. The substrates were first cleaned in distilled water to remove water-soluble impurities and then kept immersed in acetone and HCl acid (10 minutes each) to remove impurities which do not dissolve in water. They were then cleaned in ultrasonic cleaner. The source solutions for the process (cadmium acetate and NH_4OH) were taken in two separate vessels. The substrates were dipped in cadmium acetate and then in NH_4OH for 10 seconds each and then they were dipped in de-ionized water maintained at 80C. This process was repeated several times. The thickness of the films were determined by profilometer. The concentration of the source solution was varied from 0.1 M to 0.4 M. The number of cycles was varied from 100 to 300. The structural characterization was performed by XRD (Rigaku) and optical absorption studies were performed to determine the bandgap.

II. Results

The XRD patterns of the films (fig 1) showed that the films are amorphous. The number of deposition cycles and concentration of the solution does not affect the XRD patterns of the film. The chemical composition of the films were found by EDAX and the films were found to have almost stoichiometric composition.

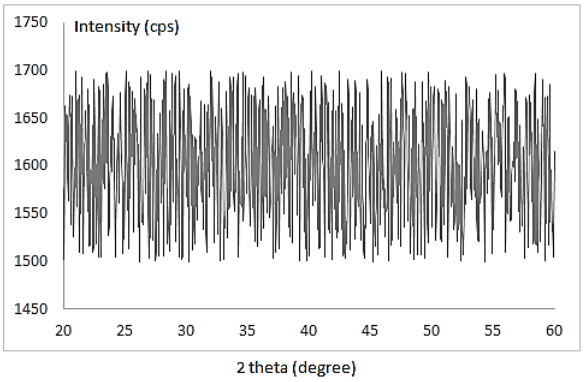

Fig 1. XRD pattern of CdO film

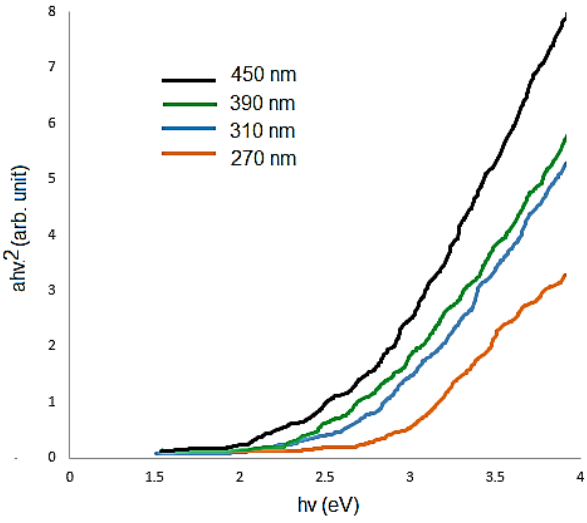

Fig 2. Absorbance spectrum of CdO films

The optical absorbance of the films was studied to determine the band gap (Fig 2). The bandgap of the films was found to be high (2.7 eV) when the thickness of the films was low. It decreased to 2.5 eV as the thickness increased. The thickness of the films was directly proportional to number of cycles and concentration of the source solutions. When the number of

deposition cycles increases, the number of ions adsorbing on the substrate also increases. Hence the thickness of the films increases. When the concentration of the source solution is increased, then also the number of ions adsorbed increases and thickness increases.

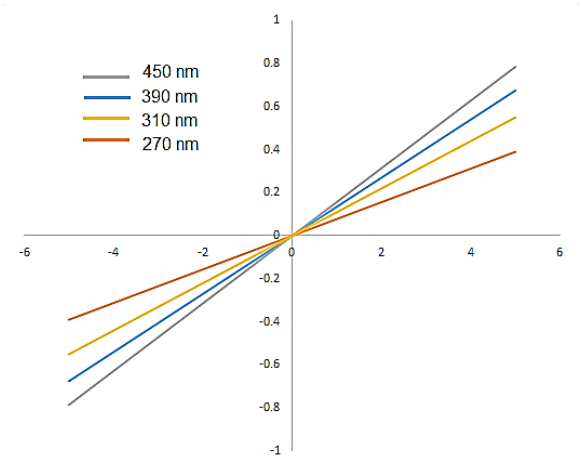

Fig 3. I-V curves of CdO films

Electrical properties of the films were studied by four probe method at room temperature. Silver and aluminium metal contacts were made on the films by vacuum deposition. The silver did not make ohmic contact with CdO. But, aluminium was found to make good ohmic contact (Fig 3). The resistance of the films was found to be about 0.47 ohm-cm.

III. Conclusion

Amorphous CdO films were grown on borosil glass substrates. The growth parameters such as deposition cycles, concentration of the solution were varied. Thickness of the films increased with increase in both these parameters. Crystal structure was unaffected by thickness of the films. But, the bandgap of the films was found to decrease with the increase in the thickness. The films formed ohmic contact with silver and their resistivity was found to be 0.47 ohm-cm.

References

i. *Gurumurugan K, Mangalraj D and Narayanandas S K, "Correlations between the optical and electrical properties of CdO thin films deposited by spray pyrolysis" Thin Solid Films, vol 251,no. 7, 1994 pp 7-9* https://doi.org/10.1016/0040-6090(94)90831-1

ii. *Girish Phatak, Rakesh Lal "Structural and electrical properties of cadmium oxide films deposited by the activated reactive evaporation technique" Thin Solid Films, vol 209, 1992, pp 240-249* https://doi.org/10.1016/0040-6090(92)90681-Z

iii. *Verkey A J and Fort A F, "Transparent conducting cadmium oxide thin films prepared by a solution growth technique" Thin Solid Films, 239, pp 211-13 1994* https://doi.org/10.1016/0040-6090(94)90853-2

iv. *Kanniainen T, Lindroos S, Ihanus J, Leskela M, "Growth of lead selenide thin films by successive ionic layer reaction and reaction(SILAR) technique", J.Mater.Chem.6, 1996*

v. *Phatak G and Lal R, "Deposition and Properties of Cadmium Oxide Films by Activated Reactive Evaporation" Thin Solid Films, vol 245, pp 17-26. 1994* https://doi.org/10.1016/0040-6090(94)90871-0

vi. *Lanje A S, Ningthoujam R S, Sharma S J, Pode R B, Vatsa R K, Int. J Nanotechnol. Vol pp 979 2010*

vii. *H. Jadduaa, Muneer & Habubi, Nadir & Z. Ckal, Alaa. Preparation and Study of CdO-CdO2 Nanoparticles for Solar Cells Applications. International Letters of Chemistry, Physics and Astronomy. 69. 34-41 2016.* www.scipress.com/ILCPA.69.34.

viii. *Zahra Ganjiani, Farid Jamali-Sheini, Ramin Yousefi Superlattices and Microstructures, 100, 2016, pp 988-99* https://doi.org/10.1016/j.spmi.2016.10.064

ix. *K. Gurumurugan, D. Mangalaraj, Sa.K. Narayandass, Y. Nakanishi, Y. Hatanaka "Composition studies on CdO thin films formed by spray pyrolysis and sputtering", Applied Surface Science, vol 113, 1997, pp 422-42* https://doi.org/10.1016/S0169-4332(96)00840-9

x. *Jeevitesh K. Rajput, Trilok K. Pathak, Vinod Kumar, L.P. Purohi "Influence of sol concentration on CdO nano structure with gas sensing application" Applied surface science, vol 409, 2017, pp 8-16* https://doi.org/10.1016/j.apsusc.2017.03.019