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Study of Optical and Solid State Properties of annealed CdO and ZnO thin films

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Abstract: -

The CdS and ZnS thin film synthesized by chemical bath deposition have been extensively studied by many researchers. The quality, efficiency and reliability of the thin film can be enhancing by annealing of the synthesized thin films. In the present work CdO and ZnO thin films have been obtained from thermal annealing of chemically deposited CdS and ZnS thin films. The Optical and solid state properties of thermally annealed CdO and ZnO thin films have been studied. From the UV-VIS data it is observed that annealing of the thin films at a particular temperature enhance the optical properties and solid state properties.

Key Words: - CdO, ZnO, annealing, Optical properties, solid state properties, chemical bath deposition

Introduction: -

CdO and ZnO thin films are transparent conducting in nature, inexpensive, mechanically stable and highly resistance to oxidation. These films are an n-type semiconductor belonging to II-VI group of periodic table. These materials possess wide band gap of approximately 2.4eV and 3.3eV at room temperature. Films are semitransparent in nature have been widely used in a flat panel displays, solar cells and gas sensing applications. The CdS and ZnS thin films prepared by chemical bath deposition technique on the glass substrate. In the present work we have attempted to annealed CdS and ZnS films prepared by chemical bath deposition to form CdO and ZnO thin films [1-5].

The CdO and ZnO films obtained by annealing were characterized for investigation of optical and solid state properties. It is observed that annealing effect improve optical properties and solid state properties of thin films [6-7].

Experimental:-

The CdS and ZnS thin films synthesized by chemical bath deposition technique. In the apparatus of chemical bath deposition there is a facility for rotating the substrate using d. c. motor, stirring the solution using the magnetic stirrer, change the temperature of the entire assembly and stabilized it at a particular value etc. In order to get uniform film thickness the film substrate is continuously rotated and the solution is continuously stirred using magnetic stirrer. The temperature of assembly is maintained by heating arrangement and temperature controller. The thickness of the films governed by controlling the deposition time and the concentration of the solution [8-10].

The prepared samples of CdS and ZnS by chemical bath deposition were taken for annealing and kept into muffle furnaces Biotech of India of 2500 watts at 15 amperes which can withstand maximum temperature of 1000^0c. The temperature of the furnaces was maintained at 400^0C, 600^0c and 750^0C for more than 8 hours. After annealing sulfide ions converted into oxide ions by converting CdS into CdO and ZnS into ZnO [11-14].

The prepared films of CdO and ZnO with annealing effect were taken for characterization to determine optical and solid state properties.

Result and Discussion: -

The optical and solid state constants such as refractive index, extinction coefficient, real dielectric constant, imaginary dielectric constant and optical conductivity of the annealed CdO & ZnO thin films were studied. From the figure 1 and 2 it is observed that refractive index of CdO & ZnO change between 1.5 and 2.5 in visible and near infrared. This means that electromagnetic radiation is 1.5 to 2.5 times slower in the oxide films than in the free space [15-20]. There is a change in refractive index due to films annealed at three different temperatures. The values of refractive index of CdO and ZnO thin films are quite different than those the value of CdS and ZnS thin films. The refractive index was found to shift towards the higher wavelength region [21-25].

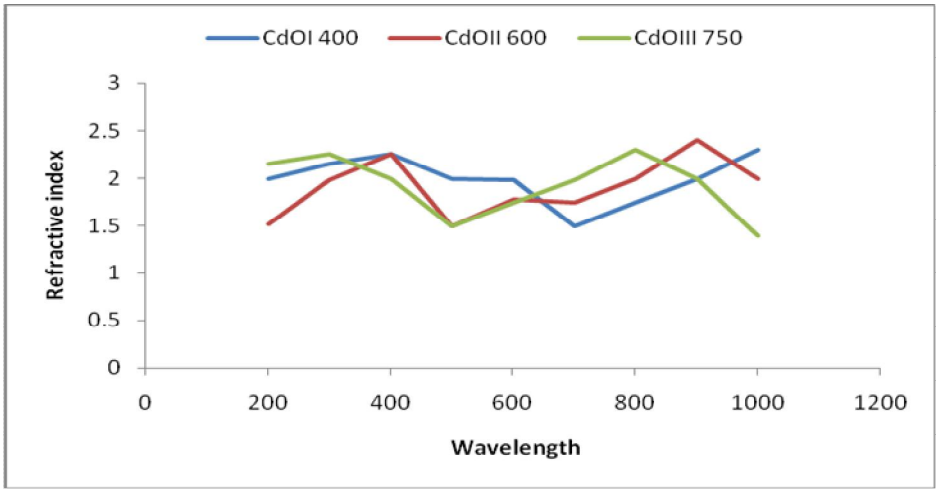

Figure1: Variation of the refractive index as a function of wavelength for CdO thin film.

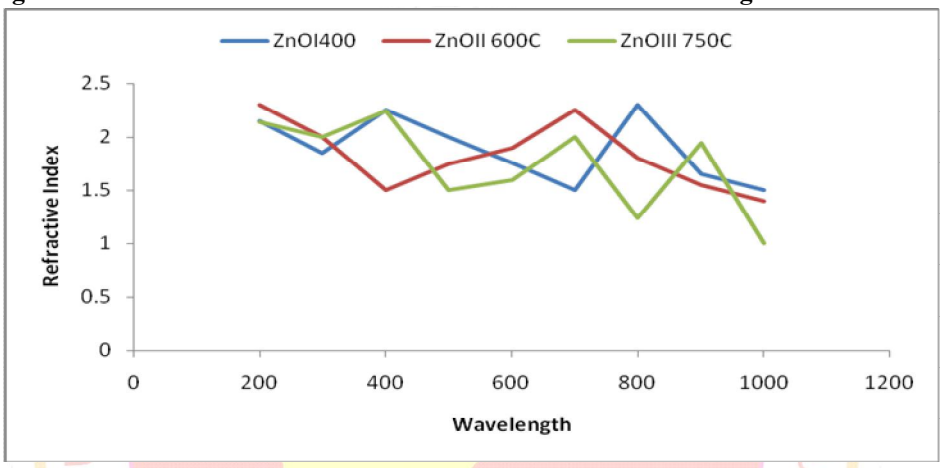

Figure 2: Variation of the refractive index as a function of wavelength for ZnO thin film.

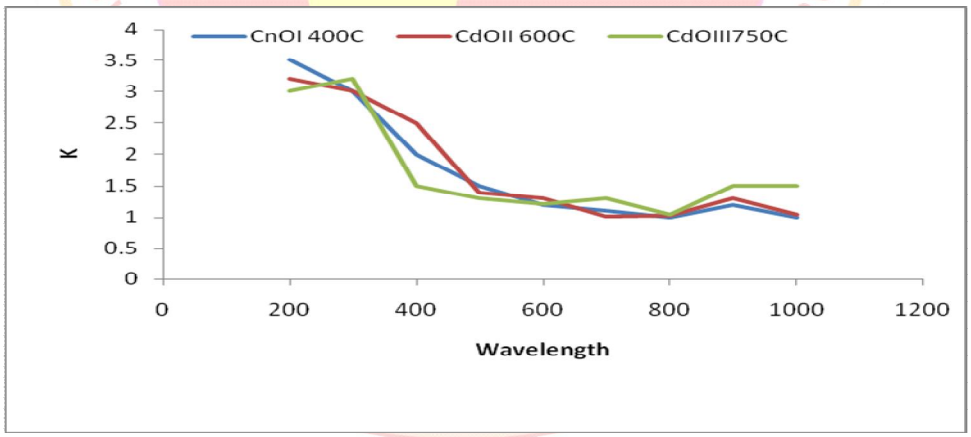

Figure 3: The examination of the extinction coefficient as a function of wavelength for CdO thin film.

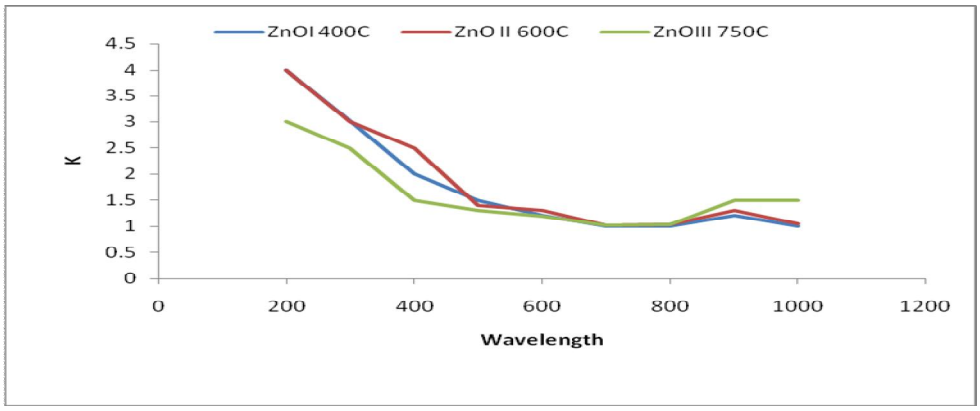

Figure 4: The examination of the extinction coefficient as a function of wavelength for ZnO thin film.

From the figure 3 and 4 it is observed that extinction coefficient varies with the wavelength. Its value is found to decrease with increase in wavelengths. The annealing effect is effective for the values of extinction coefficient. The extinction coefficient of CdO & ZnO thin films is quite different as compared to the values of extinction coefficient of CdS & ZnS thin films [26-27].

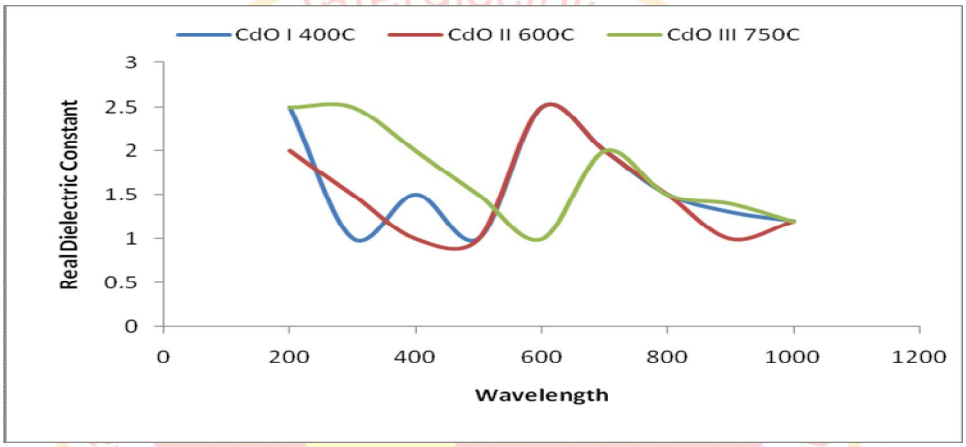

Figure 5: Variation of the real dielectric constant as a function of wavelength for CdO thin film.

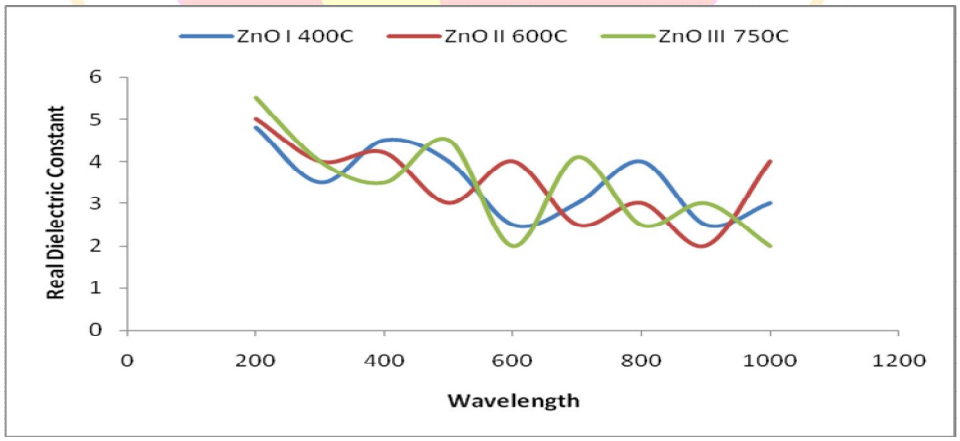

Figure 6: Variation of the real dielectric constant as a function of wavelength for ZnO thin film.

From the figures 5 and 6 it is observed that real dielectric constant of CdO and ZnO thin films varies with the wavelength. The annealing effect influences the value of real dielectric constant. These values are quite different from those of CdS and ZnS thin films. Data of real and imaginary dielectric revealed that the value of the real part is higher than that of the imaginary part [28-29].

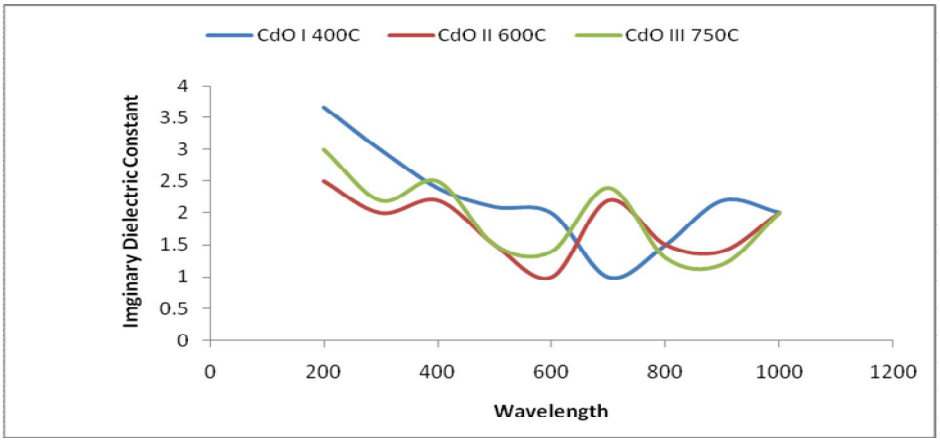

Figure 7: Variation of the imaginary dielectric constant as a function of wavelength for CdO thin film

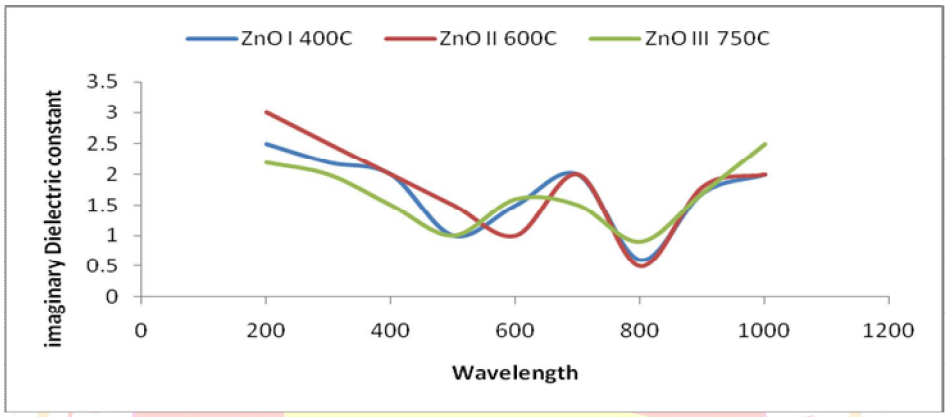

Figure 8: Variation of the imaginary dielectric constant as a function of wavelength for ZnO thin film.

From the figures 7 and 8 it is observed that imaginary dielectric constant of CdO and ZnO thin films varies with the wavelength. The annealing effect influences the value of imaginary dielectric constant. These values are quite different from those of CdS and ZnS thin films [30-31].

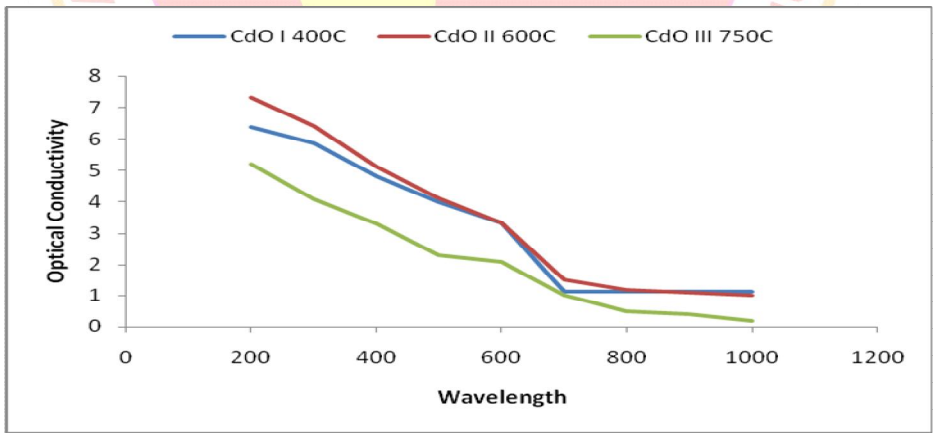

Figure 9: Variation of the optical conductivity as a function of wavelength for CdO thin films

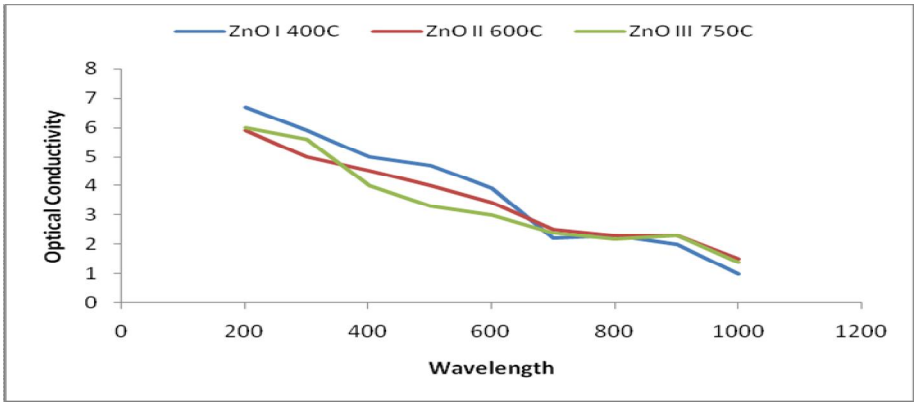

Figure 10: Variation of the optical conductivity as a function of wavelength for ZnO thin films

From figures 9 and 10 it is observed that optical conductivity of CdO and ZnO thin films is found to decrease with increase in the wavelength. The annealing effect influences the value of optical conductivity. The optical conductivity is found to decrease with increase in the annealing temperature. These values are quite different as compared to those of CdS and ZnS thin films [32-35].

Conclusion: -

The thin film of CdO and ZnO successfully obtained by thermal annealing of CdS and ZnS. The UV-VIS study of CdO and ZnO thin film conclude that the refractive index changes due to films annealed at three different temperatures. The refractive index was found to shift towards the higher wavelength region. The extinction coefficient varies with the wavelength. Its value is found to decrease with increase in wavelengths. The real and imaginary dielectric constant of CdO and ZnO thin films varies with the wavelength. Data of real and imaginary dielectric revealed that the value of the real part is higher than that of the imaginary part.

The optical conductivity of CdO and ZnO thin films is found to decrease with increase in the wavelength. The annealing of the CdS and ZnS thin film influences the refractive index, extinction coefficient, real and imaginary dielectric constant and optical conductivity

References:

1. Daniel Abou-Ras et al. Advanced Characterization Technique for Thin Film Solar Cells, Wioley- VCH (2011).
2. Lokhande C. D., Material Chemistry and Physics, 27, 1-43, 1991.
3. Nadeem M.Y., Waqas Ahme, Turk J Phy 24, 625 (2008)
4. Dr. Abdulhussein K. Eltkayef, et al Int. Jou. of App. or Inn. In Eng. & Management (IJAIEM) Volume V, Issue 7 July 2015
5. Ubale A.U. et al Study of Structural, Optical and Electrical Properties of CdO thin film. Archives of Physics Research, 2014, 5(6) 43-48.
6. Ahmed K. Abbas, Huda M. Multak Int Jou. In Eng. And Management, Volume v, Issue 7, July2015
7. Pandya S.G., Influence Of Growth Process On The Properties Of Chemically Prepared Sulphide Thin Films, International Journal of Scientific *Research vol.7 Issue 12, pp. 14765-14768, December, 2016.*
8. Dilip Maske, Growth and Characterization of CdS Thin Films by Chemical Bath Deposition, International Journal of Scientific and Research Publications, Volume 6, Issue 6, June 2016.
9. Sanap V.B., Pawar B.H. chalcogenide letters vol.6, 8 415 -419 (2009).
10. Sanap V.B.,Pawar B.H. chalcogenide letters vol.7, 3, 227-231 4 (2010).
11. Pawar S.H., C. H. Bhosale C.H., Bull Matter sci., 8 (3) 419 (1986)
12. Hall B.D. et al, J. Innovative Sci. Engin. Technol. 2 No. 3 886 (2015)
13. Chung Y.D. et al Curr. Appl. Phys. 11, S65 (2011)
14. H. Li. X. Wang, et al Adv. Mater. 25, 3017(2013). K. Deng, Li, Adv. Mater. 26, 2619 (2014).
15. Sanap V.B., Pawar B.H., Chalcogenide Letters Vol.7, 3, 227-231(2010).

16. Ghoneim D., J of Optoelect. Adv. Mat. Vol. 12,5 (2010).Saliha Ilican, Muhsin Zor et al, Optica Applicata, Vol XXXVI,1(2006).
17. Okoli D.N., et al Academic Open Internate Journal, 18(2006).
18. Jiyon Song, Sheng S Li et al, IEEE, 449-452(2005).
19. Sanap V.B., Pawar B.H., Chalcogenide Letters Vol.6, 8, 415-419 (2009).
20. Feitosa A.V., et al, Brazilian Journal of Physics, vol. 34, 2B (2004).
21. Pawar S.H., Bhosale C.H., Bull. Mater Sci. 8(3), 419 (1986).
22. Salazar Y.A. et al., Brazalian Journal of Physics, 36(3B), (2006).
23. Ubale A.U.,et al Bull Matter Sci.,(30), 147(2007).
24. Ravangave L.S. et al Int. Jour. Of Sci. and Research Publications, Vol.2, Issue 6, (2012).
25. Buba A.D.A. and Samson D.O. Synthesis and Characterization of Cadmium Oxide (CdO) Deposited by Chemical Bath Deposition Technique *Int.J.Curr.Res.Aca.Rev.2015; 3(9):* September-2015) pp. 116-123
26. Barote, M.A., Masumdar, E.U. 2014. Electrical properties of spray deposited CdO thin films: effects of substrate temperature. *JAAST: Mater. Sci.,* 2: 44–48.
27. Champness, C.H., et al 1985. Optimization of CdO layer in Se-CdO photovoltaic cell. *Can. J. Phys.,* 63: 767.
28. Ellis, D.M., Irvine, J.C. 2004. MOCVD of highly conductive CdO thin films. *J. Mater. Sci. Mater-E.,* 15: 369–372.
29. Ezekoye, B.A., et al S.C. 2013. Synthesis, structural and optical characterization of cadmium oxide (CdO) thin films by Chemical Bath Deposition (CBD) technique. *Inter. J. Phys. Sci.,* 8(3): 1597–1601.
30. Taunk P.B., et alSynthesis and optical properties of chemical bath deposited ZnO thin film, Karbala International Journal of Modern Science 1 (2015) 159e165.
31. Ziaul Raza Khan, et al Optical and Structural Properties of ZnO Thin Films Fabricated by Sol-Gel Method *Materials Sciences and Applications*, 2011, 2, 340-345 doi:10.4236/msa.2011.25044 Published Online May 2011
32. Sarika Singh,Shrivastava A.K. Synthesis, Growth and Characterization of Rare Earth Doped (CdZnS) Thin Films International Journal of Innovative Research in Science, Engineering and Technology Vol. 3, Issue 6, 2014.
33. Sanap V. B., Pawar B. H., Study Of Chemical Bath Deposited Nan crystalline CdZnS Thin Films, Journal of Optoelectronics and Biomedical Materials Vol. 3 Issue 2, April-June 2011 p. 39-43
34. Di Xia, et al Structural and optical properties of Cd0.8Zn0.2S thin films, Journal of Semiconductors, Vol. 32, No. 2 February 2011.
35. Bandyopadhyay R. V., Structural and Optical Properties of CdS Thin Film Grown by Chemical Bath Deposition. , *Journal of Nano- Electronics and Physics* Vol. **5** No 3, 03021(3pp) (2013) Том **5** No 3, 03021(3cc) (2013)