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Structural and Optical Properties of Cd0.5Zn0.5S: Sn Nanocrystalline Thin Films Deposited By Chemical Bath Technique

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Abstract:- Nanocrystalline Cd0.5Zn0.5S:Sn thin films were prepared by chemical bath deposition at 80± 5℃ from an aqueous bath containing zinc chloride, cadmium chloride tin chloride and thiourea in the presence of ammonia solution . the optical characteristics of the prepared thin films have been investigated by UV-VIS spectrophotometer in the wave length range (200 – 1100 nm).The energy gap(Eg) decreased from (4.1 to 2.2 eV) with increased doping by Sn. Also the optical constants such as refractive index ,extinction coefficient , real and imaginary dielectrics constants were investigated.The structural properties of obtained films were studied by X-ray diffraction analysis.the diffraction peak existed at 2θ=28.06 of plane (111).no change in the characteristic peak positions was observed in sampls doped with Sn.

I. INTRODUCTION

Cadimium zinc sulphide Cd0.5Zn0.5S thin films have received great attention due to their various optoelectronic applications .They have been used as a wide band-gap window material for hetrojunction solar cells [1,3]. The production of thin films with tailored optical properties is an important challenge for research in optoelectronic application [4,5] . Cd0.5Zn0.5S films are widely used for different applications , especially in photodiodes for solar cell [6,8]. Group 11-V1 compounds can form ternary and quaternary alloys with a direct fundamental band gap assignment over entire alloy composition range and high absorption coefficients , which can be used as materials for fabricating hetero-junction photovoltaic devices [9] .

II. EXPERIMENTAL

The cdcl2 ,zncl2 andbNH2-CS-NH2 were used as the source materials of Cd2+ , zn2+ and s2- ions ,respectively. A catalyst mixture was prepared by dissolving the appropriate amount of cdcl2 and zncl2 in distilled water .The Cd0.5Zn0.5S ternary thin film was co- precipitated by slowly adding aqueous solution of NH3 to the mixture of cdcl2 and zncl2 aqueous solution which was kept stirring with constant 60 rpm through out the reaction . Before making the final solution for the preparation of the films , each of the elemental solutions was stirred for 30 min to obtain homogeneity among the constituents of the solution for uniform coating .for the preparation of good quality films , the concentration of (0.1M) cdcl2 ,(0.1M) zncl2 and (0.1M) NH2 – CS –NH2 were optimized and used as stock solution .The appropriate amount of cdcl2 , zncl2 and NH2 – CS –NH2 solutions were mixed in a 100ml beaker , and made alkaline by the addition of a few drops of NH3 solution .The mixture we again stirred to form a homogeneous mixture . An appropriate amount of water was added to control the growth kinetics on the formation of Cd0.5Zn0.5S thin films .The glass substrates are cleaned by using hydrofluoric(HF)acid and water having the ration 1:3 volume ratio for 5 min at room temperature and placed vertically inside the chemical bath with the help of Teflon disc .The disc was attached with the constant rotating at 60 rpm and was kept immersed inside the chemical bath. Finally we doping the thin film by 1%,3% and 5% Sn.

Results and discussion

1.X-ray Diffraction Results

The x-ray diffraction patterns are shown in fig (1) .no charge in the character eristic peak positions was observed in samples doped with sn . the diffraction peak existed at 2θ=28.o6 of plan (111). Such results suggest the formation of solid solutions between ZnS and CdS in general .However , due to the poor crystillinity the formation of single metal sulfides can not be completely ruled out . these results good agreement with results of Wii et all [11].

2.Opticl properties

A representative plot of optical absorbance of film versus wave length of light is shown in the fig(1).the optical studies revealed that the films were highly absorptive with a direct type of transition, which allowed the optical band gap(Eg)to be determined using the following relationship.

$\alpha = A/h\upsilon(h\upsilon - Eg)^{1/2}$ ……..(1)

Where A is a constant.

The experimentally observed value of $(\alpha h\upsilon)^2$ plotted against $h\upsilon$ is shown in fig(2)for different doping . The linear nature of the plots at the absorption edge confirmed that Cd0.5Zn0.5S is a semiconductor with a direct band gap. The optical band gap is decreased from (4.1to2.2)eV but at 5% doping by Sn the energy gap increased to 3.9 eV thats may be due the polarization or new orientation of the atoms.The extinction coefficient have been calculated by using the following relation [10] .

$K = \alpha\lambda/4\pi$ ……(2)

Fig (5) show the spectral dependence of extinction coefficient for Cd0.5Zn0.5S:Sn thin films.

The real part of refractive index (n) of thin films can be calculated for the relation .

$n = [(1+R/1-R) + [4R/(1-R)^2 - K^2]^{½}$ …….. (3)

fig (4) show the variation of the (n) with wavelength . the real and imaginary parts of dielectric constants were determined by the following relations in the absorption region .

$\varepsilon_1 = n^2k^2$ ……(4)

where ε1 is the real part of the dielectric constant represents the normal dielectric constant

$\varepsilon 2 = 2ink$……..….(5)

ε2 is the imaginary part of dielectric constant represent the absorption associated of radiation by free carrier .figures (6 and 7) show the variation of ε1 and ε2 respectively .

REFERENCES

[1]. M.celalettin Baykul , Nilgun orhan , Thin solid films 518(2010)1925-1928 .

[2]. O.Akinci , N.H.Gurel , H.Unlu,The solid films 511-512(2006)694 .

[3]. H.Zang ,X.Ma , D.Yang ,Mater. Lett , 58(2003)5 .

[4]. N.Barreau , J.C.Bernede , S.Marsillac ,A.Mokrani ,J.Cryst, Grouth235(2002)439 .

[5]. S.Stolyarova ,M.Weinstein , Y.Nemirovsky , Journal of crystal growth 310(2008)1674 -1678 .

[6]. T.Chardra , S.Bhushan , J.Mater.sci.39(2004)633 .

[7]. T.Cailsson , A.Brinkman , Prog.photovolt .14(2006)213 .

[8]. t.Prenkumar , S.Sararanakumar , K.Sanranaryanan , Applied surface science 257(2011)1923-1927 .

[9]. Proceedings of the 10th international conference on 11-V1 compounds , phys , status solidi , B.Basic Res .229,2002(Bremen , Germany 2001) .

[10]. pankaj Sharma and sckatyal J.phys.D:Appl.phys.40(2007)2115-2120.

[11]. weizhang,Rong xu," surface engineered active photo catalysts without noble metal:cus-znx cd1-x nano spheres by one-step synthesis" international journal of hydrogen 34.(2009) 8495-8503.

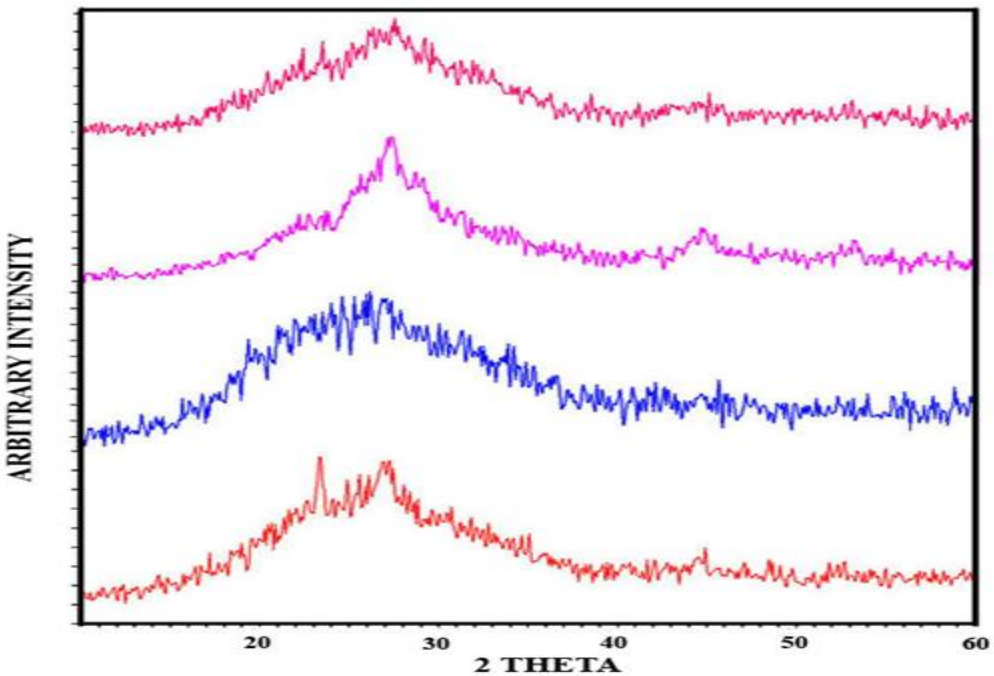
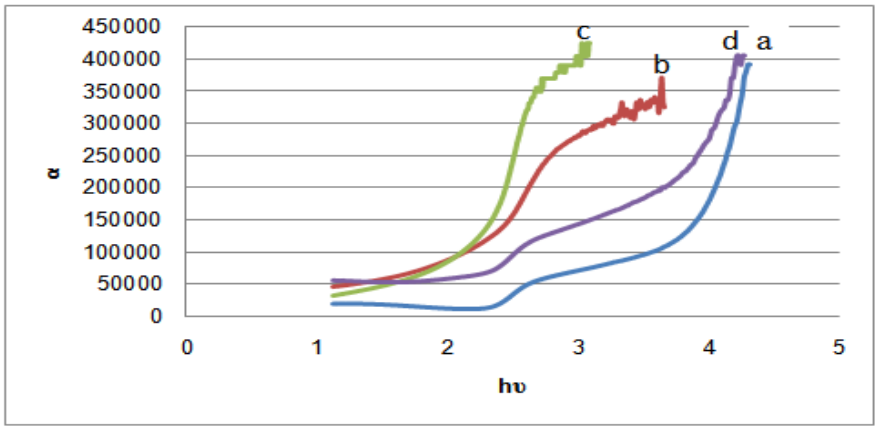
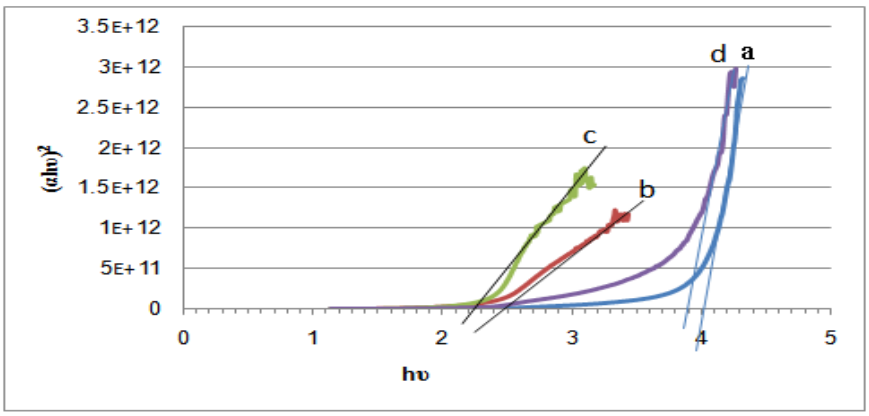


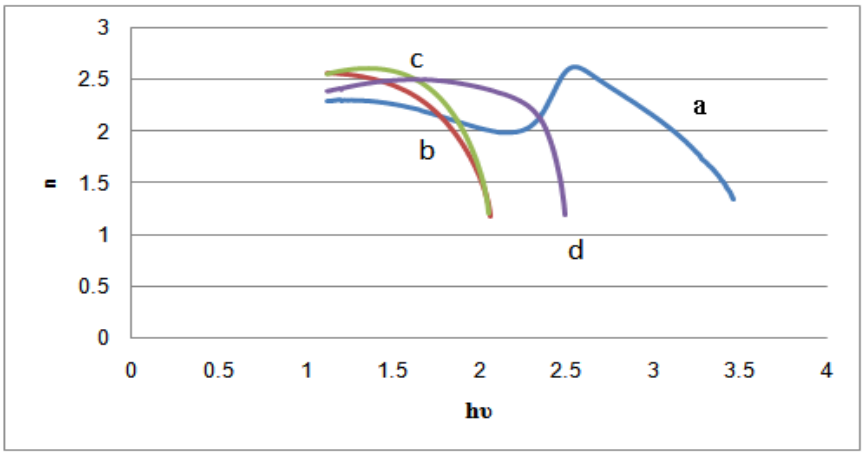
fig (1) x-ray diffract grams of $cd_xzn_{1-x}S$:Sn films at X=0.5 a-without doping b- doping 1% by Sn c- doping 3% by Sn d- doping 5% by Sn .



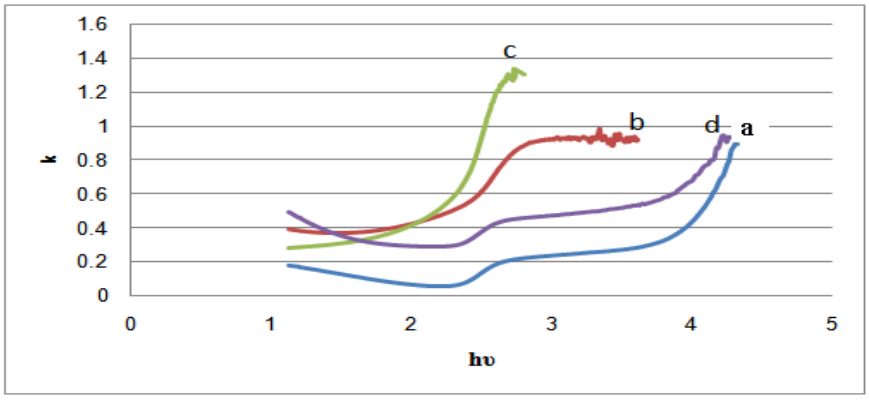
Fig(2) the variation of the absorption coefficient (α) with (hυ) for thin films at X=0.5 a-without doping b- doping 1% by Sn c- doping 3% by Sn d- doping 5% by Sn.



Fig(3)the optical energy gap(E_g) value of films at X=0.5 a-without doping b- doping 1% by Sn c- doping 3% by Sn d- doping 5% by Sn .



fig(4) the refractive index (n) with (hυ) at at X=0.5 a-without doping b- doping 1% by Sn c- doping 3% by Sn d- doping 5% by Sn .



fig(5) the extinction coefficient (K) with (hυ) at X=0.5 a-without doping b- doping 1% by Sn c- doping 3% by Sn d- doping 5% by Sn.

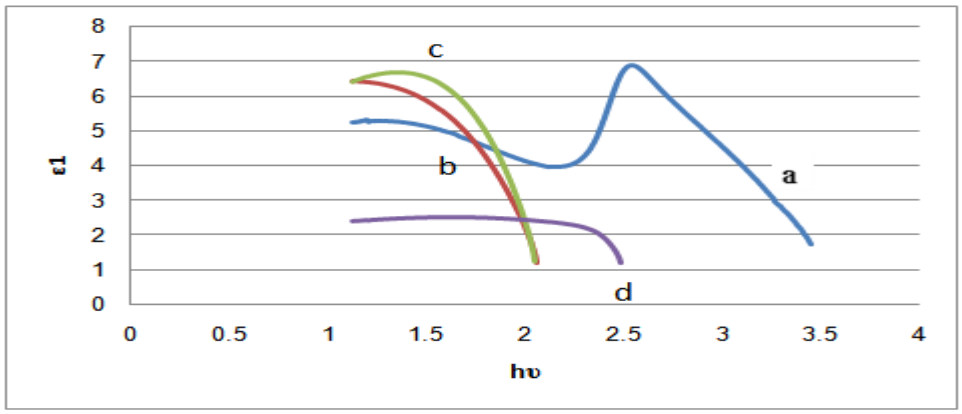


Fig (6) the real part of dielectric constant ε_1 with (hυ) at X=0.5 a-without doping b- doping 1% by Sn c- doping 3% by Sn d- doping 5% by Sn.

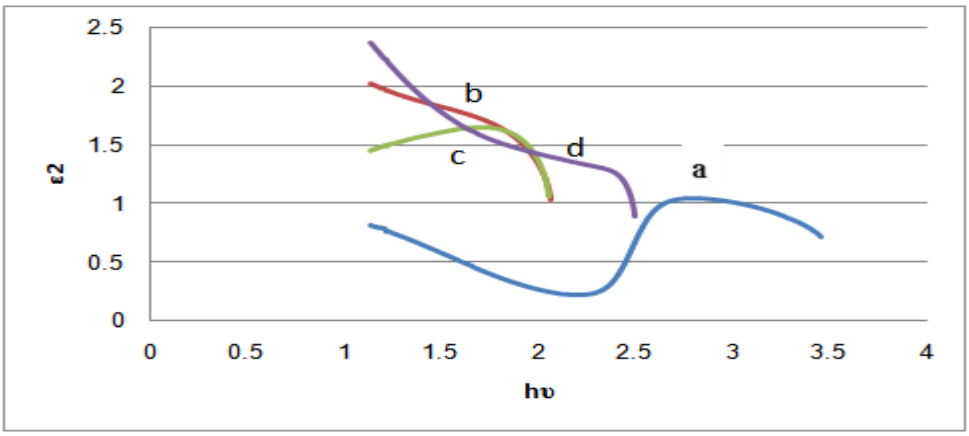


Fig (7) the imaginary part of dielectric constant ε_2 with (hυ) at X=0.5 a-without doping b- doping 1% by Sn c- doping 3% by Sn d- doping 5% by Sn