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RESEARCH ARTICLE

Structural Properties of $Pb_xCd_{1-x}S$ Thin Films Prepared by Chemical Bath Deposition technique

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Abstract

In this study $Pb_xCd_{1-x}S$ thin films are prepared by Chemical Bath Deposition having composition ranges of $0.05 \leq x \leq 0.25$ on corning glass substrate at 75°C. The structural properties of $Pb_xCd_{1-x}S$ (X = 0.20) film studied by using XRD. The x-ray diffraction result shows that films are contain composition PbS-CdS. The thin films were polycrystalline in nature and doping with Pb causes shifts in peak position and with change in intensity.

1. INTRODUCTION

The ternary semiconductor thin films are well thought-out to be a key hi-tech material due to its major applications in various optical and electronic devices such as photo detectors, photovoltaic devices, photo-electrochemical cells, lasers, IR devices or detector, solar control coatings and solar cells [1-6].

These materials can be deposited by using various tecquenics, such as, electro-deposition [6-8], spray pyrolysis [9], vacuum deposition [10] and chemical bath deposition [11-17], CVD [18], successive ionic layer and reaction (SILAR) [19], sol-gel methods [20].

Lead sulphide (PbS) is IV- VI semiconductor with band gap 0.41 eV. The PbS materials has many applications such as solar absorber [21], photography [22], sensors [23], optical switch [24], infra-red detectors [25-26] among others.

Cadmium sulphide (CdS) is n- type material with wide direct band gap (2.42 eV) so has been used in piezoelectric, optoelectronic devices [22]. It is also useful in visible light emitting diode and laser [27-28].

2. EXPERIMENTAL

$Pb_xCd_{1-x}S$ thin films were deposited on glass substrate by using the chemical bath deposition technique. A bath containing 0.1M lead acetate [$Pb(CH_3COO)_2.2H_2O$], 0.1M cadmium acetate [$Cd(CH_3COO)_2.2H_2O$], 6M ammonia (NH_3), 1M Thiourea [$(NH_2)_2.CS$]. The cadmium acetate, Thiourea, lead acetate, act as source of Cd, S and Pb, respectively. Ammonia was used to maintain pH of solution.

Ultrasonically cleaned glass substrates were used for deposition of lead cadmium sulphide thin film. The glass substrates were immersed vertically in the reaction bath, and set to the desired temperature. Deposition was carried out at 75°C for 70min. and the slides were left in the bath for 24hrs at room temperature. The deposited films were then washed with distilled water and dried in air.

The crystallinity phases of the $Pb_xCd_{1-x}S$ (X = 0.20) film were determined by XRD using Advance D8 instrument having wavelength 1.54060.

3. XRD STUDIES

The structural properties of the lead cadmium sulphide thin film were studied using XRD. The XRD results for film $Pb_xCd_{1-x}S$ show that the film is polycrystalline. Fig.1 shows the scan over a range of 10 °≤ 2θ≤79 °.Both CdS and PbS exhibit hexagonal and cubic structure respectively. In XRD analysis it is found that some peaks of PbS and CdS may be form intermetallic compound $Pb_xCd_{1-x}S$. The observed and reported values are very well match given in the Table 1.The same result is reported by Modaffer. A. Mohammed et al. [17]

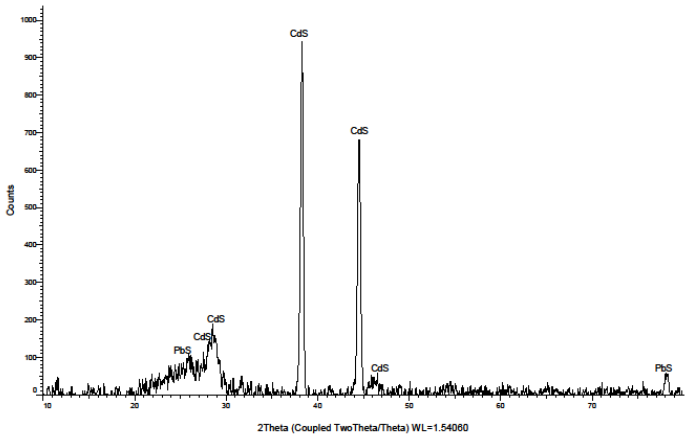

Fig 1: -XRD of $Pb_xCd_{1-x}S$ thin film.

Table.1. XRD analysis of $Pb_xCd_{1-x}S$ (X = 0.20)

Composition	d(A°) observed	d (A°) Reported	2θ degree	hkl planes		
				h	k	l
$Pb_xCd_{1-x}S$(x = 0.20)	3.43	3.42	25.95	1	1	1
	3.17	3.16	28.03	1	0	1
	3.12	3.16	28.53	1	0	1
	2.38	2.45	38.29	1	0	2
	2.03	2.06	44.53	1	1	0
	1.22	1.21	78.23	4	2	2

4. CONCLUSION

Lead cadmium sulphide thin films were successfully prepared by chemical bath deposition method on corning glass substrate. XRD analysis shows hexagonal and cubic structure of the film.

REFERENCE

[1] M. A. Barote, A. A. (Feb2011). Chalcogenide Letters, Vol. 8, No. 2, p. 129 – 138
[2] A. K. Sood, K. Wu, J. N. Zemel, Thin Solid Films, (1978): 48, 73.
[3] T. M. Razykov. Thin Solid Films, (1989): 164, 421.
[4] L. P. Deshmukh, B. M. More, S.G. Holikatti, P. P. Hankare, Bull. Mater. Sci., (1994): 17(5), 455.
[5] P. K. Nair, M. T. S. Nair, J. Phys. D: Appl. Phys. (1990): 23, 150.
[6] P. K. Nair, M. Ocampo, A. Fernandez, M. T. S. Nair, Sol. Energy Mater. (1990): 20, 283.
[7] H. Elabd, A. J. Steckl, J. Appl. Phys. (1980): 51(1), 726.
[8] N. Chaudhari, B.K. Sharma, Ind. J. Pure Appl. Phy. (2008): 46, 261.
[9] T. Elango, S. Subramanian, K. R. Murali, Surf. Coat. Technol. (2003): 123, 8.
[10] V.D. Das, K.S. Bhat, J. Mater.Sci. (1990): 7, 169.
[11] E. U. Masumdar, L. P. Deshmukh, Turk. J. Phys. (2003): 27, 271.
[12] E. U. Masumdar, S. H. Mane, V. P. Pujari, L.P. Deshmukh, Ind. Jour. Pure App. Phy., (2002): 40, 624.
[13] E. U. Masumdar, S. H. Mane, V. S. Karande, V. B. Pujari, P.N. Bholsale, L.P. Deshmukh, J. Mat. Sci. Mater. Elect; (2003): 14, 43.
[14] E. U. Masumdar, V. B. Gaikwad, V. B. Pujari, P. D. More, L. P. Deshmukh, Mat. Chem. Phys. (2003): 77, 669.
[15] I. Pop, C. Nascu, V. Lonescu, E. Indvea, I. Bratu, Thin Solid Films, (1997): 307, 240.
[16] N. Chaudhary, B. K. Sharma, Bull. Mater. Sci. (2009): 32, 43.
[17]Modaffer. A. Mohammed, Ali M. Mousa, and J. P. Ponpon, J. Semiconductor Technology and science Vol.9, No.2, June, 2009
[18] D.H. Frigo, O.F.Z.Khan, P.Obrien, and J.Crtystal Growth 6 (1989): 989.
[19]Y.F.Nicolou and M.Dupuy, J.Electrochemicalsoc., 137(1990): 2915.
[20] S.C. Ray, M.K. Karanjai, and D. Dashupta, Thin Solid Films, 322(1998):117.
[21] T. K. Chaudhuri and S. Chatterjee, Design of thin film solar thermoelectric generator. Proc.Int. Conf. Thermo electronic, (Arlington, USA) 11, 40 (1992).
[22] P. K. Nair, O. Gomezdaza and M. T. S. Nair, Adv. Mater. Opt. Electr., 1, 139 (1992).
[23] H. Hirata and K. Higashiyama, Chem. Soc. Jpn., 44, 2420 (1971).
[24] R. S. Kane, R. E. Cohen and R. Silbey, J. Phys. Chem., 100, 7928 (1996).
[25] H. Kanazawa and S. Adachi, J. Appl. Phys., 83, 5997-6001 (1998).
[26] R. K. Joshi, A. Kanjilal and H. K. Sehgal, Appl. Surf. Sci., 221, 43 (2004).
[27] A. Pan, H. Yang, R. Yu and B. Zou, Nanotechnology, 17, 1083 (2006).
[28] Y. Gu, E. S. Kwak, J. L. Lensch, J. E. Aller, T. W. Odom and L. J. Lauhon, Appl. Phys. Lett.,87, 43111-3 (2005).