Accepted July 22, 2016 ; Published July 30, 2016

Citation: Rani S, Shanthi J, Kashif M, Ayeshamariam A, Jayachandran M (20
Studies on Different Doped Zn Concentrations of CdSe Thin Films. J Powder Me
Volume 5: 143. doi: 10.4172/2168-9806.1000143

K **:** Electron beam evaporation; Doping e ect; XRD of CdSe; PEC solar cells

I

e formation of solid solutions in semiconductors is of great

$_2$S, CdTe, CuInSe$_2$ or CuInTe$_2$. in lms of these materials are usually synthesized by molecular beam epitaxy [3], electron beam evaporation [4] and chemical method [5].

Feng Ying et al. reported that few-layer graphene was prepared from highly oriented pyrolytic graphite by micromechanical cleavage

area (0.25 cm^2) of CdSe:Zn lms on conducting coated glass substrates.

D

Zn doped CdSe lms were deposited using electron beam evaporation (EBE) technique with optimized substrate temperature 100°C. Di erent concentrations of zinc (10%, 20% and 30%) were introduced into the CdSe matrix. Figure 1 shows XRD spectra of CdSe:Zn lms with Zn concentrations 10%, 20% and 30% deposited at 100°C, respectively. All peaks are well de ned and sharp peak

CdSe:Zn lms might be due to the presence of high energy gap material (ZnSe) than that of undoped CdSe. e variation of E_g shows a sub-linear behaviour, a lowering phenomenon in the alloy lms of CdSe:Zn [15]. e as-prepared lms exhibited direct band-gap transition and the absorption edge shows a blue-shi with increasing 'Zn' content due to the increase in band gap value. e continuous variation of E_g with Zn concentrations con rms the solid solution formation between CdSe and ZnSe so that their optical and electronic properties can be tailored according to the need for device developments.

e electrical resistivity and the interface behaviour of semiconductor thin lms with solid solutions are vital in photo-electrochemical solar cell applications. At room temperature the observed resistivity of CdSe:Zn lms with 10%, 20% and 30% Zn content was 8.2×10^{5}, 5.3×10^{6} and 3.5×10^{6} ohm cm respectively. e increase in resistivity is attributed to fact that band gap increases with introduction of more zinc into the lattice of CdSe. e higher resistivity CdSe:Zn lms nds an application as a bu er layer for solid state solar cells. It is attributed to excess of Cd in the compostion over Se, which well separates conduction and valence bands in the crystal lattice [16]. e calculated carrier concentration values are 7.0×10^{18}, 5.4×10^{18} and 3.4×10^{18} cm^{-3} for CdSe:Zn lms with zinc content 10%, 20% and 30% respectively are shown in Figures 6-8.

Figure 9a shows XPS spectra of CdSe:Zn lm with zinc content 20% deposited at 100°C. It shows the presence of Cd '3d, Zn '2p and Se '3 peaks con rming the formation of Zn doped CdSe lm. Figure 9b-9d shows the narrow spectra of Cd 3d, Zn 2p and Se 3d present in the lm. e spectral shi along with the abscissa due to the sample charging is eliminated by moving the measured C 1s peak to the binding energy value of 284.8 eV [17]. In Figure 9b, binding energies of Cd $3d_{5/2}$ and $3d_{3/2}$ are observed at 405.14 and 411.74 eV which con rms the presence of Cd with [illegible] peak is seated at 55.08 eV. This may be assigned to T j onic 3d

prepared by the EB evaporation technique which is con rmed by the line pro le curves given under each 2D AFM pictures. Figure 9a-9c shows the elemental analysis of CdSe:Zn lms with zinc content 10%, 20% and 30% respectively. It is found that ratios of Cd and Zn elements are in fewer amounts than the percentage present in the initial material but selenium content is always present in stoichiometric percentage.

It is well observed that zinc atoms replace cadmium atoms in the crystal lattice and size of the grain is decreased with increasing the Zn contents. It might be caused by the addition of CdSe to ZnSe that reduce the dimension of the lattice leading to the formation of linear grains with reduced grain size. It shows the compactness, pinhole free and well adherent nature of these lms on glass substrates which are very useful for PEC devices. is is attributed to the fact that the CdSe is consequently sublimation takes place rst, and then reaches the substrate over which ZnSe gets deposited when they are grown by EB evaporation technique [19,20].

Photoluminescence properties depend on the lateral size of

a pseudo-smooth interface applies when the exciton size is larger. is results in a relatively narrow single PL line, because the exciton properties are averaged over a number of defects. Ternary alloy semiconductor lms has provided possibility of making their band gap (E_g) adjustable in the visible wavelength range and it is therefore useful for optoelectronic applications and devices as laser diodes and light emitting devices operating in the spectral region from red to green [21]. For such applications, a good PL e ciency is required for the CdSe:Zn system to assess them for optoelectronic applications.

Figure 12a-12c shows the PL emission spectra recorded at room temperature. PL peak are observed at 622, 519 and 482 nm while E_g

zinc concentration which is attributed to the increase in band-gap caused by ZnSe composition. Each PL spectrum is characterized by its near band edge (NBE) recombination as suggested for the Se_xCdS_{1-x} lms prepared by pulsed laser deposition technique [22]. PL peak attained at 5K for $Cd_{0.23}Zn_{0.77}Se$ single quantum well (QW) at about 2.77 eV with 0.4 ML (monolayer) and at 2.73 eV with 1.15 ML [23]. Photoluminescence results con rm solid solution CdSe:Zn lms deposited by EB evaporation technique can e ciently be used for PEC solar cells and light emitting diode studies.

C

Using EB evaporation technique CdSe:Zn thin lms were prepared on glass substrates at 100°C with Zn concentration of 10%, 20% and 30%, respectively. Nanocrystalline nature of as-prepared lms was characterized using XRD analysis. Optical studies were conducted to record absorbance and transmittance spectra of CdSe:Zn lms. e absorbance curves, band gap values calculated from ^{2} (vs)(h) curves showed direct band gap nature of all the lms with band gap values varied from 1.90 eV to 2.42 eV. is con rmed solid solution formation between CdSe and ZnSe compounds and the lattice modi cation is e ected by zinc incorporation. Elemental analysis was carried out by EDAX and XPS. e surface morphology explored by SEM analysis showed highly ne granular grain formation distributed uniformly over the entire surface. e in uence of the variation of zinc content can be explicitly seen by the changing surface grain patterns from AFM studies. Photoluminescence (PL) technique is used to assess for material application to certify that CdSe:Zn lms are good for the fabrication of PEC cell.

References

1. Gupta P, Maiti B, Chaudhuri S, Pal AK (1995) Photoconductivity and Thermoelectric Power of ZnxCd1-xSe Films. Jpn J Appl Phys 34: 4658.

18. Eser E, Hall RB (1981) Grain Structure of CdS and (CdZn)S Films. Thin Solid Films 86: 31.

19. Islam R, Banerjee HD, Rao DR (1995) Structural and optical-properties of cdsexte1-x thin-ýlms grown by electron-beam evaporation. Thin Solid Films 266: 215.

20. Burmeister RA, Stevenson DA (1967) Phase Equilibria in the Cd-Se System. J Electrochem Soc 114: 394-398.

21. Perma G, Pagliana S, Capozzi V, Ambrica M, Pallana M (2000) Solid State Comm. 114: 161.

22. Perma G, Pagliara S, Capoyzi V, Ambrico M, Ligonzo T (1999) Thin Solid Films 349: 220.

23. Toropov AA, Shubina TV, Socokin SV, Kyutt RN, Ivanov SV, et al. (2000) Appl Surf Sci 166: 278.

Citation: Rani S, Shanthi J, Kashif M, Ayeshamariam A, Jayachandran M (2016) Studies on Different Doped Zn Concentrations of CdSe Thin Films. J Powder Metall Min 5: 143. doi:10.4172/2168-9806.1000143