PROPERTIES OF SPRAY PYROLYSED $CdSe_xTe_{1-x}$ FILMS

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Thin films of cadmium chalcogenides have received much attention for their application in electro – optic devices and photoelectrochemical cells. CdSe and CdTe form a solid solution in the entire composition range and the bandgap and lattice parameters can be varied by changing the relative amount of chalcogenides in the compound $CdSe_xTe_{1-x}$. CdTe has an optimum bandgap for solar cell applications but is unstable in polysulphide electrolyte. Power conversion efficiencies upto 10 % have been reported and the stability of $CdSe_xTe_{1-x}$ in polysulphide is reasonable. Several techniques have been employed for the growth of Cd(SeTe) thin films. In this work, thin films of $CdSe_xTe_{1-x}$ have been prepared by the spray pyrolysis technique using seleno sulphate and telluro sulphate as the precursors.

Thin films of $CdSe_xTe_{1-x}$ were deposited on glass and titanium substrates at different substrate temperatures in the range 350 - 475°C. AR grade cadmium sulphate and different concentrations of seleno and telluro sulphate solutions were taken. It took 30 min to spray 100 ml of the solution. The films were characterised by x-ray diffraction technique. Films grown at substrate temperatures below 450°C, indicated peaks of low intensity. The films deposited at 450°C indicated preferential orientation in the (111) direction. Single phase hexagonal structure was observed throughout the entire composition range. The calculated lattice parameters varied linearly with composition and followed Vegard's law. Composition of the films was estimated by EDAX. Optical absorption studies indicated the bandgap of the films to change from 1.44 – 1.70 eV as the value of x changed from 0 to 1. SEM studies indicated agglomeration of particles at lower substrate temperatures, as the substrate temperature increased, the grain size also increased and the uniformity of the surface was better. The thickness of the films was estimated by gravimetry was around 2.5 μm.

The films deposited on titanium substrates were used as photoelectrodes. The as deposited films did not exhibit any photoactivity. The films were annealed in argon atmosphere at 500°C for 10 min. After heat treatment, the films exhibited photoactivity. Amongst the different compositions, films with composition $CdSe_{0.8}Te_{0.2}$ exhibited maximum photoactivity; hence, further studies were carried out only on films of this composition. The load characteristics of the electrodes of the above composition were studied at different intensities. At 80 $mWcm^{-2}$, a V_{oc} of 0.6V, J_{sc} of 12 $mAcm^{-2}$, ff of 0.5 and η of 4.5 % were obtained. After photoetching the films in 1:50 HCl, the output parameters were found to increase. A V_{oc} of 0.65V, J_{sc} of 16 $mAcm^{-2}$, ff of 0.55 and η of 7.15 % were obtained. Mott-Schottky plots indicated n-type behaviour. A flat band potential of –1.15V(SCE) was observed. Spectral response behaviour indicated maximum photocurrent at 1.58 eV. This value matches well with bandgap of 1.56 eV obtained for this composition from optical absorption measurements. Maximum quantum efficiency of 0.56 was obtained at this wavelength.

The above results point to the possibility of preparing efficient photoelectrodes for PEC cells by the above method. The stability of the cells was studied under sunlight illumination, and they were found to be stable for more than one year.

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