CHARACTERISTICS OF SWAB PLATED CdS_xSe_{1-x} FILMS

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The ternary chalcogenide CdS_xSe_{1-x} is one of the most interesting materials amongst the II-VI family owing to its interesting optoelectronic properties [1,2]. Several techniques have been adopted for the deposition of CdS_xSe_{1-x} films. In this work another technique, namely the swab plating technique also called selective plating, which is a simple, convenient and low cost method for obtaining large area films is employed for the first time by the author in producing these films for application in solar energy conversion. Compared with the conventional electrodeposition technique which takes about one hour to obtain 2.0μm thick films, the brush plating technique takes only 20 min to obtain 5 μm thick films on account of the high current densities employed.

The object of the present paper is to study the structural, morphological, optical and photoelectrochemical properties of CdS_xSe_{1-x} films obtained by the swab plating technique.

CdS_xSe_{1-x} films were swab plated on titanium, conducting glass, nickel and SS substrates at room temperature using cadmium sulphate (0.5M), sodium thiosulphate (0.03M), selenium dioxide (0.01M). A current density of 50 $mAcm^{-2}$ was employed and the plating time was 20 min. Thickness of the films was estimated by gravimetry and found to be 3.0 μm. The films were heat treated at 525° C in argon atmosphere for 10 min under a controlled rate of heating and cooling, the argon used in the present investigation contained a few ppm of oxygen. Structural characterization was carried out by x-ray diffraction (XRD) studies using CuKα radiation. Morphological studies were carried out by employing a 35 CF JEOL scanning electron microscope. Optical studies were made employing a Hitachi 3400 UV VIS NIR spectrophotometer with the films deposited on tin oxide coated conducting glass substrates. The PEC cell consisted of the heat treated CdS_xSe_{1-x} films and a graphite sheet as a working and counter electrodes respectively in 1 M alkaline polysulphide solution, which is a 1 M solution with respect to NaOH, Na_2S, and S. The light source was a 250 W ORIEL quartz tungsten halogen lamp. The photon flux was measured by a CEL suryamapi instrument.

The films were characterized by x-ray diffraction technique. XRD patterns indicated the polycrystalline nature of the films with peaks corresponding to the hexagonal phase. Compositions of the films were estimated from EDAX measurements.

Photoelectrochemical cells were made using these electrodes with 1 M polysulphide solution as the redox electrolyte. Under an illumination of 60 $mWcm^{-2}$, a V_{oc} of 0.66 V, J_{sc} of 10 $mAcm^{-2}$, FF of 0.5 and η of 5.5 % were obtained for the electrodes of composition $CdS_{0.66}Se_{0.34}$. The electrodes were photoetched in 1:50 HCl at 100 $mWcm^{-2}$ for 30 min. The photo output parameters were found to improve. Under 60 $mWcm^{-2}$ illumination, a V_{oc} of 0.7 V, J_{sc} of 15 $mAcm^{-2}$, FF of 0.6 and η of 10.5 % were obtained. Photo etching of the surface leads every time to a renewal of the semiconductor surface with the corresponding constancy in photoresponse. Spectral response measurements indicated response maxima at 1.83 eV corresponding to the band gap, coinciding with the value obtained from optical measurements. The cells were stable for more than a year under sunlight illumination.

REFERENCES:

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