INFLUENCE OF SUBSTRATE TEMPERATURE ON THE STRUCTURAL AND PHOTOCONDUCTIVE PROPERTIES OF VACUUM EVAPORATED CdSe THIN FILMS

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CdSe films are intensively studied for their application in photoconductive and photoelectrochemical devices. In this work, the influence of substrate temperature on the properties of vacuum evaporated CdSe films are presented.

High purity CdSe powder has been prepared by the reaction of aqueous solutions of AR grade cadmium oxide and selenium powder in the presence of oxalic acid. The mixture was heated for more than 10 hours with continuous refluxing. The resulting CdSe powder was dried and used for the deposition of films. The powder was characterized by x-ray diffraction studies. XRD pattern exhibited the formation of single phase hexagonal CdSe. The impurities present in the samples were determined from AAS analysis and all the impurities were found to be present in the less than 10 ppm range. The results are quite comparable with the purity of the imported KOCH light powder. This powder was used as the source material and thin films were evaporated on glass and titanium substrates maintained at different temperatures in the range 30 - 200°C. The source to substrate distance was maintained as 12cm and the vacuum was 10^{-5} Torr during the evaporation of the films. Thickness of the films was estimated by gravimetry. The films were characterized by x-ray diffraction technique to determine the structure. Bandgap of the films were estimated from optical absorption measurements. Photoconductive properties were studied using illumination from a tungsten halogen lamp. The intensity of light falling on the sample was measured with the help of lux meter. Evaporated Indium served as ohmic contact for the photoconductive measurements. The I-V and lux–ampere characteristics were measured. Spectral distribution of the photoconductivity was measured using a photophysics monochromator in the wavelength range 400 – 800 nm.

The x-ray diffraction pattern of the films deposited at different substrate temperatures exhibited all the peaks corresponding to hexagonal CdSe. As the substrate temperature increased, the peak at (002) orientation was found to increase in intensity indicating the preferential growth in this direction. The full widths at half maximum (FWHM) were obtained for all the films using the Scherrer's equation. The crystallite size is observed to increase as the substrate temperature increases. The average crystallite size is around 30 nm. Optical absorption spectra was recorded in the range 550 – 800 nm. The bandgap was estimated from the $(\alpha h\nu)^2$ vs. $h\nu$ plots. A direct bandgap of 1.68 eV was obtained.

The I-V characteristics of the films was studied under an illumination of 10,000 lux. Linear characteristics were observed for all the samples. The photosensitivity of the samples is found to be in the range of 10^5, this value is comparable with the value obtained with commercial photoconductors. Lux ampere characteristics indicated the films to exhibit linear region in the 5000 – 10000 lux range. Spectral response measurements indicated maximum photosensitivity at 1.68 eV, this value agrees well with the data obtained from optical absorption measurements. The cells were found to be stable for more than a year.

* Author for Communication