Abs. 99, 204th Meeting, © 2003 The Electrochemical Society, Inc.

PROPERTIES OF VACUUM EVAPORATED CdS_XSe_{1-X} THIN FILMS

K.R.Murali and S.Muthukumaran*
Electrochemical Materials Science Division
Central Electrochemical Research Institute
Karaikudi – 630006, India

- Dept of Materials Science, Madurai Kamaraj University,Madurai,India

The ternary compound CdS_xSe_{1-x} is a highly photosensitive material, so it is used in many practical application such as discrete and multi element photo resistors, in optical filters, signal memory devices, laser screens, LSI circuits, Infrared imaging devices, Optoelectronic switches, linear image sensor for digital facsimile page scanners, Electro photography, Image intensifiers and exposure meters.

In the present work, CdS_xSe_{1-x} films were deposited by thermal vacuum evaporation using the powders of CdS and CdSe synthesized in our laboratory. The films were characterized by x-ray diffraction, optical studies, photoconductivity studies and photo electrochemical studies.

By using the appropriate amount of pure selenium powder, sodium sulphite and triply distilled water, we have a sodium selenosulphate after nearly 20 h heating at 95 ^{0} C. Cadmium acetate was dissolved with sodium selenosulphate and ammonia solution to maintain the PH. CdSe powder was formed after 4 h heating. And then the powder was filtered. CdS powder was prepared with the help of the cadmium acetate, thiourea, ammonia solution and triply distilled water, cadmium sulphide was obtained after two hours heating with magnetic stirrer. After ageing of 12-16 hours and filtration pure CdS powders was obtained.

Before the preparation of the CdS_xSe_{1-x} thin films, CdS_xSe_{1-x} powder was prepared by sintering the appropriate ratio of CdS and CdSe powders in argon atmosphere of 550^0 C for 20 min. The deposition was carried out under a vacuum of 10^{-5} Torr, the source to substrate distance was 12 cm. The substrates used were glass and titanium, the substrate temperature was varied in the range of 300 to 473 K. The thickness of the films were found to be 2.5 µm from weighing method.

X-ray diffractograms of the CdSe, CdS and CdSSe films deposited at different substrate temperatures in the range 30 - 200°C.indicated reflections corresponding to single phase hexagonal structure, as the substrate temperature increased, the intensity of the peaks are found to increase. Films prepared at a substrate temperature of 200°C indicated maximum intensity with better crystallinity**.**

The band gap of the films was determined by plotting $(\alpha h\nu)^2$ vs hν. The extrapolation of the straight line to the hν axis gives the band gap of the material.

The films were used as the working electrode. Graphite was used as counter electrode. The electrolyte was 1M polysulphide (1M NaOH,1M Na_2S,1M S). The light source used for illumination was an ORIEL 250 W tungsten halogen lamp. The power output characteristics were found to be maximum for the films prepared at a substrate temperature of 200°C. The load characteristics for this film was studied at different intensities in the range 20 – 80 mW cm^{-2}. Both open circuit voltage and short circuit current were found to increase with intensity. Photoetching was carried out by shorting the photo electrodes and the graphite counter electrodes under an illumination of 100 mW cm^{-2} in 1 : 100 HCl for different durations in the range 0-60 sec. Both photocurrent and photo voltage are found to increase up to 40 sec photo etch, beyond which they begin to decrease. ing . From a plot of ln I_{sc} vs V_{oc}, the ideality factor was calculated from the slope of the straight line. An ideality factor of 2.22 was obtained.

Mott-Schottky plots($1/C^2$ vs V) were studied using 1M sodium sulphate as blocking electrolyte. The frequency was fixed at 1 kHz and the bias voltage was varied in the range – 1.2 to + 0.4 V(SCE), the nature of the plots indicate n-type behaviour. The N_D value estimated from the slope of the plots are around 10^{17} cm^{-3}. Extrapolation of the plots to the voltage axis yields V_{FB} in the range – 1.10V(SCE). Spectral response measurements were carried out using Photophysics monochromator and 1 M polysulphide as electrolyte. The photocurrent was noted at each wavelength in the range 0.4 – 0.65µm. The photocurrent reacged a maximum at 0.52µm, this matches well with the bandgap value obtained from optical absorption measurements.