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A STUDY OF $CuInS_2$ THIN FILMS FOR PHOTOVOLTAIC APPLICATIONS

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Thin films of copper indium disulphide ($CuInS_2$) on Ti substrate were prepared by annealing potentiastatically electrodeposited Cu–In alloy in H_2S gas at 550° C. Films were characterised by X-ray diffraction (XRD), scanning electron microscopy (SEM), and spectral response in a polysulphide electrolyte. XRD measurements revealed the formation of the polycrystalline $CuInS_2$ thin films and the absence of any other phases. SEM showed the formation of crystallites having the size about 0.2 μm. Variations of spectral response, open-circuit voltage (V_{oc}) and short-circuit current (I_{sc}) with annealing in air have been studied. As deposited $CuInS_2$ films exhibit a direct band gap of 1.5 eV, and shows n-type behaviour when used in a Photoelectrochemical (PEC) cell. Heat treatment shows a considerable enhancement of the photoresponse.

1. INTRODUCTION

Copper indium disulphide is a semiconductor with the direct band gap of 1.5 eV[1,2], which matches the solar spectrum. This compound does not contain any toxic constituents. Therefor, it is a promising candidate for application in solar energy converting devices. The highest energy conversion efficiency reported up to now for devices fabricated using this material is 12.5%[3]. Further improvements in the efficiency are expected through improvements in the electronic properties of this material by optimising the preparation conditions. Among the various techniques available for the preparation of $CuInS_2$ thin films[4-7], the method of electrodeposition of Cu-In alloy and sulphidation is an attractive technique[8] because of its simplicity and the possibility in making large area thin films.

In this investigation Cu-In alloy films were electrodeposited on Ti substrates using an aqueous bath. Subsequently the films were annealed in hydrogen sulphide (H_2S) gas for the sulphidation and the formation of $CuInS_2$ thin films. As prepared and annealed films were investigated using XRD spectra, scanning electron micrographs and photoresponse measurements in a photoelectrochemical cell. This paper reports the optical, structural, morphological properties of $CuInS_2$ films.