n-Cu_2O/p-Cu_xS Thin Film Heterostructures for Solar cells

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The need for sustainable energy technologies has invigorated research in many photovoltaic systems with increasing emphasis placed on balancing cost and performance. To this end there has been a renewal of interest in solar cells based on cuprous oxide (Cu_2O) as the active layer because this semiconductor shows many important characteristics useful for solar cell production.

In this study, the n-type cuprous oxide films were electrodeposited potentiostaticaly on Ti substrate in acetate bath [1]. XRD and SEM analysis revealed that the films were of good structural quality with the substrates being well covered by the films. A Junction of Cu_2O/Cu_xS was formed by partially sulphiding the Cu_2O films using an aqueous sodium sulphide solution. The EDX spectrum of the sulphided film confirms that S is incorporated into the film due to the sulphidation of the film. A Cu_xS XRD peak that was absent in previously reported XRD patterns [2] could be observed using synchrotron-based high-energy XRD experiments. It was found to be due to the formation of crystalline Cu_xS phase after the sulphidation. Good photovoltaic properties and diode characteristics of Cu_2O/Cu_xS heterojunction structures were obtained. Resulting Ti/Cu_2O/Cu_xS/Au solar cell structure produced V_{oc} = 520 mV and J_{sc}= 11.4 mAcm^{-2}, under AM 1.5 illumination (see Fig. 1). The obtained cell yielded a power conversion efficiency of 3.64%, which to the best of our knowledge is the highest reported efficiency for electrodeposited Cu_2O based solar cells.

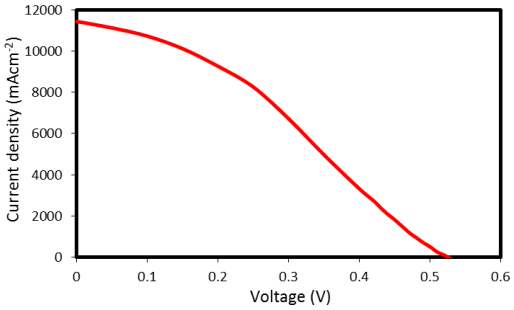

Figure 1: Current density–voltage characteristics of Ti/n-Cu_2O/p-Cu_xS/Au solar cell structure.

[1]. W. Siripala et al., Solar Energy Mater. 14, (1986) 23.

[2]. K.M.D.C. Jayathilaka et al., Semicond. Sci. Technol. 27, (2012) 125019.