

3.16 Growth of CuInS₂ thin films by annealing Cu-In stack layers with elemental sulphur for photovoltaic applications

W.P.M.R. Pathirana*, R.P. Wijesundera, W. Siripala
Department of Physics, University of Kelaniya, Kelaniya

ABSTRACT

Copper Indium Disulphide (CuInS₂) is a promising material as an absorber layer in photovoltaic devices since it has a direct band gap of 1.5 eV and a high absorption coefficient. Among CuInS₂ preparation techniques, annealing of Cu-In stack layers in hydrogen sulphide (H₂S) gas is attractive because it produces high quality CuInS₂ thin films. In this investigation, CuInS₂ thin films were prepared by annealing sequentially electrodeposited Cu-In stack layers (copper plating followed by indium plating) in elemental sulphur without using toxic H₂S gas. Thin films of copper were potentiostatically electrodeposited on smooth Ti substrates using an aqueous solution of 0.1 M sodium acetate and 0.01 M cupric acetate at -800 mV Vs SCE for 20 min. Thin films of indium were potentiostatically electrodeposited on Ti/Cu films using an aqueous solution of 25 mM InCl₃ at -1.5 V Vs SCE for different durations, in order to change Cu/In atomic ratio of Cu-In stack layers. The temperature of the electrolyte was maintained at 55° C and it was stirred continuously using a magnetic stirrer. After each deposition, films were washed with distilled water. For the sulphidation, Cu-In stack layers were annealed at 550° C for 20 min with 0.08 g sulphur. Optoelectronic properties of the films were studied using I-V measurements and spectral response was obtained in a PEC containing an aqueous solution of polysulphide. Optoelectronic properties suggest that good n-CuInS₂ thin films can be grown by maintaining Cu/In atomic ratio of ~ 0.7.

The preliminary results of this study suggest the possibility of growing photoactive CuInS₂ thin films by annealing electrodeposited Cu-In layers with sulphur.