506/E1

# Growth of photoactive CZTS thin film by using spin coating technique

W. M. N. D. Kulasinghe,* W. T. M. A. P. K. Wanninayake, K. M. D. C. Jayathilaka, and L. B. D. R. P. Wijesundera,

*Department of Physics, Faculty of Science, University of Kelaniya, Kelaniya*

As a promising absorber material in thin film solar cells, the CZTS ($Cu_2ZnSnS_4$) has sparked a growing interest over the recent years in the production of low cost solar cells, due to its favorable direct band gap, high optical absorption coefficients, abundance and the non-toxicity of the base materials. A simple and low cost growth technique that offers favorable optoelectronic properties is a prime requirement to lower the cost of solar cells. In this respect, the CZTS thin films havebeenprepared using a sol-gel method. The solution was made from metal salts of copper (II) chloride ($CuCl_2$), zinc (II) chloride ($ZnCl_2$), tin (IV) chloride ($SnCl_4$), and thiourea ($CS(NH_2)_2$) dissolved in a mixture of ethanol and water, mixed in 7:3 ratio,as the solvent. Thin films were grown using the spin coating technique on titanium (Ti) substrates followed by thermal annealingin a nitrogen ($N_2$) environment. The concentration of the constituents, annealing temperature and the annealing time were variedto identifythe optimum photoactive properties of CZTS. Optimumgrowth conditions of CZTS were investigated based on photoelectric measurements ($V_{oc}$, $I_{sc}$) obtained from the dark and light I-V characterization in a photoelectrochemical cell (PEC) containing 0.1 M sodium acetate ($CH_3COONa$).The results revealed that the best growth conditions were [$CuCl_2$] = 1.7 M, [$ZnCl_2$] = 1.2 M, [$SnCl_4$] = 1.0 M, [$CH_4N_2S$] = 7.2 M, spin coating speed = 2000 rpm, spin coating duration = 10 s, annealing temperature = $350^0$C and annealing duration = 15 min. The maximum $V_{oc}$ and $I_{sc}$were recorded as 2.820 mV and 26.46 µA respectively with a Fill Factor of 0.273 by an area of 70 $mm^2$. Scanning Electron Microscopy (SEM) revealed that the film was uniformly grown on the substrate and the grain size is of the order of 1 µm. Energy Dispersive Spectroscopy (EDS) revealed that the stoichiometric ratios of Cu/(Zn + Sn) and Zn/Sn were 3.20 and 1.22 respectively. Manipulation of the stoichiometry and the handling of the phases of the formation reaction using the proper growth conditions will be subject for further studies.

**E-mail**: dananjaya.kulasinghe@gmail.com