

Fabrication of CZTS/Cu₂O Solar Cell

W.T.R.S. Fernando¹, K.M.D.C. Jayathileka², W. Siripala³, R.P. Wijesundera⁴

Cu₂ZnSnS₄ (CZTS) and Cu₂O are two promising materials for application in low-cost and environmentally-friendly thin film solar cells due to their optoelectronic properties. Among the various growth techniques available for CZTS and Cu₂O, electrodeposition is an attractive technique because of its simplicity, low-cost and easy to control the properties of the deposits. In order to grow CZTS on Mo substrate, Cu thin film was electrodeposited on Mo substrate at -0.89 V vs Ag/AgCl reference electrode (RE) in an electrochemical cell containing 0.4 M CuSO₄, 3 M lactic acid and NaOH at pH of 11. Deposition of Sn thin film on Mo/Cu electrodes was carried out at -1.2 V vs Ag/AgCl RE in an electrochemical cell containing 0.055 M SnCl₂, 2.25 M NaOH and 8 ml of sorbitol. Zn thin film was electrodeposited on Mo/Cu/Sn at -1.2 V vs Ag/AgCl RE in an electrochemical cell containing 0.2 M ZnSO₄. In order to form CZTS material on Mo substrate, Mo/Cu/Sn/Zn thin film electrodes were annealed at 55 °C for 60 min in H₂S. In order to fabricate CZTS/Cu₂O heterojunction, n-Cu₂O thin film was potentiostatically electrodeposited on Mo/CZTS at -0.52 V vs Ag/AgCl RE in electrochemical cell containing 0.45 M CuSO₄, 3.0 M lactic acid and 4.0 M NaOH. pH of the bath was adjusted to 9.3 by adding NaOH and the temperature of the bath was maintained at 60 °C. In order to make front contact to the device, thin Au spots (2×2 mm²) were deposited on Cu₂O by using the sputtering technique. Materials and device were characterised using XRD, SEM, spectral response, C-V and I-V measurements. In this preliminary study, device exhibited open circuit voltage (V_{OC}) of 200 mV and short circuit current density (J_{SC}) of 0.75 mA cm⁻². This result is encouraging since CZTS/Cu₂O heterojunction haven't been reported in the literature. It is planning to improve photoactivity of the device by employing pre and post treatments (annealing and surface treatments).

Keywords: CZTS, Cu₂O, Electrodeposition, I-V Characteristics, Solar Cell

¹ Department of Physics, University of Kelaniya, Kelaniya

² Department of Physics, University of Kelaniya, Kelaniya

³ Department of Physics, University of Kelaniya, Kelaniya

⁴ Department of Physics, University of Kelaniya, Kelaniya; palitha@kln.ac.lk