Necessity and relevance of precipitate free clear electrolytes for electrodeposition of CdS semiconductor materials with enhanced photovoltaic properties

H. Y. R. Atapattu[1], D. S. M. De Silva[*1], K. A. S. Pathiratne[1], O. I. Olusola[2] and I. M. Dharmadasa[2]

[1] Department of Chemistry, University of Kelaniya, Kelaniya, Sri Lanka.

[2] Materials & Engineering Research Institute, Sheffield Hallam University, Sheffield S1 1WB, UK.

Journal of Materials Science: Materials in Electronics, December 2017, Volume 28, Issue 24, pp 18592–18602

Abstract

Cadmium sulfide (CdS) is a well-known window material used for fabrication of second generation thin film solar cells including CdS/CdTe and CdS/$CuInGaSe_2$. Among the CdS fabrication techniques, electrodeposition is a simple, cost effective and scalable method that has been stepped towards large scale commercialization. However, the presence of precipitates in baths used for electrodeposition of CdS has been found to be a persistent problem which had produced CdS thin films with poor photovoltaic properties. Hence, an investigation was carried out to identify a set of optimum physiochemical conditions that can produce clear stable electrolyte for electrodeposition of CdS thin film semiconductors using $CdCl_2$ and $Na_2S_2O_3$ precursor salts. The study revealed that, electrolytes containing 0.10 mol/L $CdCl_2$ and 0.01 mol/L $Na_2S_2O_3$, within the pH range of 1.50-2.00 and the temperature range of 55-65 ºC can provide clear and stable electrolytes for electrodeposition of CdS thin films. Further, the results showed that, the electrical, optical, morphological and structural properties of CdS layers electrodeposited from electrolytes within above physiochemical conditions were remarkably better to those electrodeposited from the turbid electrolytic baths formed beyond the ranges of predetermined optimum physiochemical conditions.

Keywords: Electrodeposition; stable electrolyte; cadmium sulfide; thin film semiconductors; solar energy materials