

## Electrodeposition of (n-type) cadmium zinc sulphide thin film semiconductors for photovoltaic applications

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Electrodeposition of thin film semiconductors have drawn increasing attention in the fabrication of solar cells due to its low cost and easy fabrication methodologies applicable in large scale production, compared to that of conventional Si solar cells. Among different types of semiconductor thin films, cadmium zinc sulphide ( $\text{Cd}_x\text{Zn}_{(1-x)}\text{S}$ ) thin film is one of the promising wide band-gap window materials which can be used in fabrication of hetero-junction solar cells.

Electrodeposition of ( $\text{Cd}_x\text{Zn}_{(1-x)}\text{S}$ ) on fluorine doped tin oxide conducting glass working electrode was carried out using aqueous solution of electro-purified salts of  $\text{CdSO}_4$ ,  $\text{ZnSO}_4$  and  $\text{Na}_2\text{S}_2\text{O}_3$ . An EG & G model 636 bipotentiostat comprising of a graphite counter electrode and Ag/AgCl reference electrode were used to control the potential of the working electrode. Taking into account of the information obtained from cyclic voltammograms for the separate precursor salts, the three voltages of -0.9, -1.0 and -1.1 V were selected for electrodeposition. Thin films were deposited at each of the above voltages, using solutions with various proportions of Cd and Zn but the same concentration of  $\text{Na}_2\text{S}_2\text{O}_3$  for three deposition time periods of 1, 2 and 3 hours. The pH and temperatures for all solutions used for depositions were maintained at 2.5 and 27 °C respectively. Photo-electrochemical cell measurements in  $0.1 \text{ mol dm}^{-3}$   $\text{Na}_2\text{S}_2\text{O}_3$  electrolyte and UV-visible absorption spectroscopy were used to measure the open circuit voltages ( $V_{oc}$ ), short circuit current densities ( $J_{sc}$ ) and band gaps of the electrodeposited thin films.

The thin films with the highest observed photovoltaic activity of average  $V_{oc}$  of - 0.156 V,  $J_{sc}$  of  $2.6 \mu\text{A cm}^{-2}$  and a band gap in the range of 2.05 to 2.28 eV were produced from electro-deposition solutions containing  $\text{CdSO}_4$ ,  $\text{ZnSO}_4$  and  $\text{Na}_2\text{S}_2\text{O}_3$  with 0.06, 0.04 and  $0.10 \text{ mol dm}^{-3}$  respectively when deposited over a one hour period.

*Keywords: electrodeposition,  $\text{Cd}_x\text{Zn}_{(1-x)}\text{S}$ , n-type conductivity, band gap*

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