Theme: Renewable Energy Sources

Electrodeposition of ZnS thin-films: Influence of Organic Acids on the Structural and Optical properties

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II-VI semiconductors are widely studied materials for various optoelectronic applications. Among the available sulfides/selenides, cadmium sulfide (CdS) and zinc sulfide (ZnS) are the most explored semiconductors as buffer layers in thin film solar cells [1]. The buffer layer optimizes the band alignment of the device while also protecting the absorber from mechanical damage during subsequent processes. Although CdS with a bandgap of 2.4 eV is the most commonly used as buffer layer, its usage at larger scale is not preferred due to the toxicity of Cd. In such scenario, materials like ZnS containing environmentally friendly earth abundant elements have attracted the photovoltaic community[2]. ZnS aids in enhanced short circuit density due to its wide bandgap and also eliminates the additional layer of intrinsic ZnO in the device and exhibits cubic and hexagonal phases with a bandgap of 3.5 and 3.9 eV, respectively. ZnS is widely deposited using chemical bath deposition (CBD) where the highest obtained efficiency for CIGS solar cells is about 18% [3]. However, electrodeposition technique is efficient for the fabrication of ZnS thin films due to its ability to deposit considerably at low temperatures, cost – effective method and easy control over the deposition parameters to obtain smooth and uniform films.

In the present work, ZnS thin films are fabricated using electrodeposition technique by employing a two–electrode system with FTO and graphite as working and counter electrodes in an acidic electrolyte containing Zn^{2+} and $S_2O_3^{2-}$ ions. The pH of the electrolyte is adjusted using organic acids such as tartaric and citric acids which form complexes with the metal ions. The structural, morphological and optical properties of the electrodeposited ZnS thin-films and the influence of the organic acids on the formation of the different phases will be discussed.

References

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