

Oral Presentation

Combined Electrochemical and Chemical Bath Deposition Techniques to Prepare CuSe Thin Film Electrodes for Solar Energy Purposes

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Abstract

Copper selenide (CuSe) thin films were prepared using electrochemical deposition (ECD), chemical bath deposition (CBD) and combined CBD/ECD preparation techniques on fluorine-doped tin oxide (FTO) coated glass substrates. Enhancement of deposited CuSe thin film characteristics in photo-electrochemical (PEC) systems was investigated. Deposited CuSe thin films were treated by different methods. The films were annealed at 250°C under N₂ atmosphere for 1 hour. Cooling of annealed films to room temperature was done using two different methods (slow and fast cooling). K₃Fe(CN)₆/K₄Fe(CN)₆/LiClO₄ as redox couple was also used in the PEC measurements. The effect of such treatment on electrode PEC characteristics, such as: open-circuit voltage (Voc), short-circuit current density (Jsc), dark current density-potential (J-V) plots, photo J-V plots, conversion efficiency (η), fill factor (FF), Surface Morphology and stability, was studied.

The characteristics of CuSe thin films in PEC systems were enhanced by using different experimental conditions, annealing and cooling rates. Improving the stability of the prepared CuSe electrode by cleaning and using suitable redox couple was also achieved.

The dark and photo-current density versus potential plots were non-improved by annealing. Cell efficiency (η), fill factor (FF), and short-circuit current densities (Jsc) were enhanced by CuSe films annealing. The best CuSe films are naked and non-annealed CBD/ECD film for which the photo J-V plots and cell efficiency was improved significantly.

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The effect of coating the CuSe electrodes with MP/polysiloxane (1:4 ratios) was also studied. The (J_{sc}) values of coated CuSe films were significantly enhanced. The MP/polysiloxane coating introduces a charge-transfer mediator species that enhances current and electrode stability.

The PEC studies and characteristics showed that the 2 hr deposition time (prepared by CBD/ECD) gave films with more uniform, smoother, more homogeneous surfaces, higher conversion efficiency (14.6%) than other counterparts.