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Co-electrodeposition of Zn-rich Cu-Zn-Sn metallic alloy and its conversion to Cu_2ZnSnS_4 and $Cu_2ZnSnSe_4$ photovoltaic absorber films

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Cu_2ZnSnS_4 (CZTS) and $Cu_2ZnSnSe_4$ (CZTSe) compound semiconductors are promising absorber materials for thin film solar cells due to their intrinsic p-type conductivity, high optical absorption coefficient, and suitable band gap energy. Furthermore, these absorber films are composed from the abundant and non-toxic elements. Among different techniques which can be used for the preparation of these two absorber layers, solution processed techniques are very attractive due to their simplicity and low cost advantages. Here, we report the results of our study on the co-electrodeposition of a Zn-rich precursor metallic alloy Cu-Zn-Sn film from a single water-based solution with a composition not previously reported. The precursor films were converted to CZTS and CZTSe by vapor phase sulfurization and selenization processes. The synthesized films were characterized for their surface morphology and structure by using scanning electron microscopy (SEM) and X-ray diffraction (XRD), respectively. Raman spectroscopy was employed for the identification of films and the detection of impurity phases which could exist. Photocurrent spectroscopy was used to measure the films optical transition energies, including the band gap energy. Heterojunction CdS/CZTS and CdS/CZTSe devices with the typical diode-type current-voltage characteristics could be prepared and their device parameters were evaluated. The results revealed that device-quality absorber films can be synthesized successfully by co-electrodeposition from a single bath solution used in this study.

Biography

Ali Rakhshani is an educator and researcher working at Kuwait University (department of Physics). He obtained his PhD and MTech degrees in the field of Semiconductor Physics and Technology from Brunel University (UK) and BSc degree in Physics from Tehran University (Iran). He gained his postdoctoral research experience on photovoltaic devices in Wayne-State University (USA) and in Queensland University (Australia). His research expertise is in the field of thin film semiconductor materials and devices with orientation towards the synthesis of thin optoelectronic films and the fabrication of related devices. He and his collaborators are currently working on the development of solution-grown light absorber films for photovoltaic applications.

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