

CuInSe₂ films prepared by three step pulsed electrodeposition. Deposition mechanisms, optical and photoelectrochemical studies (Conference Paper)

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Abstract

p-Type semiconducting copper indium diselenide thin films have been prepared onto In₂O₃:Sn substrates by a recently developed pulse electrodeposition method that consists in repeated cycles of three potential application steps. The Cu-In-Se electrochemical system and the related single component electrolytes were studied by cyclic voltammetry to identify the electrode processes and study the deposition processes. In situ atomic force microscopy measurements during the first 100 deposition cycles denote a continuous nucleation and growth mechanism. Particles removed by film sonication from some of the films were characterized by transmission electron microscopy and determined to consist in nanoscopic and crystalline CuInSe₂. The remaining film is still crystalline CuInSe₂, as assessed by X-ray diffraction. The chemical characterization by combined X-ray photoelectron spectroscopy, X-ray fluorescence and inductively coupled plasma optical emission spectroscopy, showed that films were Cu-poor and Se-poor. Raman characterization of the as-grown films showed that film composition varies with film thickness; thinner films are Se-rich, while thicker ones have an increased Cu-Se content. Different optical absorption bands were identified by the analysis of the UV-NIR transmittance spectra that were related with the presence of CuInSe₂, ordered vacancy compounds, Se, Cu_{2-x}Se and In₂Se₃. The photoelectrochemical activity confirmed the p-type character and showed a better response for the films prepared with the pulse method. © 2011 Elsevier Ltd. All rights reserved.

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