

Film electrodes deposited from Cu_2SnSe_3 source in comparison with those deposited from SnSe and $\text{Cu}_2\text{ZnSnSe}_4$ sources by thermal vacuum evaporation: effect of argon gas flow rate

Abstract

Addition of argon gas, with different flow rates, to vacuum evaporation deposition of film electrodes from Cu_2SnSe_3 source, affect nature and properties of the resulting films. While keeping other factors constant, it is possible to control nature and properties of the resulting films simply by controlling the argon gas flow rate. This work shows that films deposited from Cu_2SnSe_3 under high argon gas flow rate (25 cm³/min) involved SnSe as a major compound, with low concentration of Cu dopant. The film showed higher photoresponse than those deposited from pristine SnSe source. Under lower argon gas flow rates, the resulting films were dominated by the ternary source compound itself, which also showed lower photoresponse than that deposited under higher flow rate. Structure, morphology, chemical composition, optical and photo-electrochemical characteristics have all been studied for films deposited from Cu_2SnSe_3 under different argon gas flow rates, in parallel with earlier films deposited from SnSe and $\text{Cu}_2\text{ZnSnSe}_4$. The films deposited from Cu_2SnSe_3 or $\text{Cu}_2\text{ZnSnSe}_4$ under high argon gas flow rate showed a p-type semiconductor behavior with energy gap of about 1.0 eV which confirms the existence of SnSe as a dominant component in each case. A mechanism, which is mainly based on a model of elastic collisions, is proposed to explain the production of SnSe films from the ternary and quaternary sources. On the other hand, the presence of low concentrations of Cu or/and Zn species in the resulting SnSe films is presumably responsible for enhanced photoresponse, as compared to films deposited from pristine SnSe .

Keyword: SnSe ; Cu_2SnSe_3 ; Argon gas; Photoelectrochemical; Photoactivity