

New technique for efficiency enhancement of film electrodes deposited by argon gas condensation from metal chalcogenide sources

Abstract

This work describes a new technique to enhance photoactivity of metal chalcogenide-based semiconductor film electrodes deposited by thermal vacuum evaporation under argon gas flow. The experimental work involves controlling a number of parameters such as type of source material (SM = SnSe, Cu₂SnSe₃ and Cu₂ZnSnSe₄), substrate temperature (TS = room temperature RT, 100, 200, 300°C), argon gas flow rates (VA = 5, 10, 15, 25 cm³/min) and temperature of annealing (TA= 150, 250, 350, 450 °C) under nitrogen atmosphere. The effects of varying each parameter on structural, morphological, compositional, photoresponse and optical properties of the deposited electrode were studied. The film deposited at TS = 100 °C under VA = 25 cm³/min from Cu₂ZnSnSe₄ (CTZSe) source showed highest photoactivity (p %) value 55.7 % compared to films deposited from SnSe (TSe) and Cu₂SnSe₃ (CTSe) sources, with p % values of 8.3 % and 34.8 %, respectively. Thus, using the quaternary Cu₂ZnSnSe₄ compound as a source material, offered a new inroad to prepare photoactive thin film electrodes using the argon gas condensation (AGC) technique, simply by varying argon gas flow rate.

Keyword: Argon gas condensation; Thermal evaporation; Photoelectrochemical; Photoactivity, Source materials.