

## 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, Cu<sub>2</sub>SnSe<sub>3</sub> and Cu<sub>2</sub>ZnSnSe<sub>4</sub>), substrate temperature (TS = room temperature RT, 100, 200, 300°C), argon gas flow rates (VA = 5, 10, 15, 25 cm<sup>3</sup>/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 cm<sup>3</sup>/min from Cu<sub>2</sub>ZnSnSe<sub>4</sub> (CTZSe) source showed highest photoactivity (p %) value 55.7 % compared to films deposited from SnSe (TSe) and Cu<sub>2</sub>SnSe<sub>3</sub> (CTSe) sources, with p % values of 8.3 % and 34.8 %, respectively. Thus, using the quaternary Cu<sub>2</sub>ZnSnSe<sub>4</sub> 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.