

## Fabrication of $\text{Cu}_2\text{ZnSnSe}_4$ Thin Films by Selenising $\text{Cu}_{1.8}\text{Se}$ , $\text{SnSe}$ , and $\text{ZnSe}$ Precursor Layers: Effects of the Sequence of Layers

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Thin films of  $\text{Cu}_2\text{ZnSnSe}_4$  (CZTSe) with a deficiency of Cu and Zn excess are fabricated by a selenisation of precursors composed of several layers of the selenides  $\text{Cu}_{1.8}\text{Se}$ ,  $\text{SnSe}$ , and  $\text{ZnSe}$  (with different sequences of the layers), deposited on glass substrates from water-based solutions. The elemental composition of the films is examined by electron dispersive analysis and X-ray photoelectron spectroscopy whereas the structure is analysed by X-ray diffraction. Films fabricated from precursors with the selenide layer sequence  $\text{Cu}_{1.8}\text{Se}|\text{SnSe}|\text{ZnSe}|\text{SnSe}$  demonstrate the CZTSe kesterite structure, whereas those produced from precursors with other sequences of the selenides are mixtures of binary phases.

**Keywords:** CZTSe, chemical bath deposition, structure, thin films, absorber.

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