

Effects of annealing temperature on $\text{Cu}_2\text{ZnSnS}_4$ (CZTS) films formed by an electro spray technique

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In this work, CZTS films were deposited on glass using an electro spray method and effects of annealing temperature on CZTS films was investigated. The precursor solution was prepared using metal-chlorides (CuCl_2 , ZnCl_2 and SnCl_2), thiourea as sulfur source, solvents with different boiling points (methanol, butyl carbitol). All as-formed CZTS films exhibited a kesterite structure with preferred orientation of (112), (220) and (312), and there was no phase transition with the rise of annealing temperature. The grain size of CZTS films had a substantial growth when the annealing temperature increased from 200 °C to 450 °C, and then it saturated as the annealing temperature above 450 °C. All the samples showed the Raman characteristic peak of CZTS at 336 cm^{-1} . The optical band-gap of CZTS films under different annealing temperatures decreased from 1.71 eV to 1.42 eV. The results described that the CZTS films can be successfully deposited by electro spray method and the annealing process can improve the crystallinity and optical properties for the films to become suitable for photovoltaic applications.