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Influence of compactness and formation of metallic secondary phase on the thermoelectric properties of Cu_2ZnSnS_4 thin films

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Abstract

Thermoelectric studies of Cu_2ZnSnS_4 (CZTS) thin films deposited at different substrate temperatures by ultrasonic assisted chemical vapor deposition technique have been carried out. In order to identify the effect of compactness, crystallinity and formation of secondary phases ($Cu_{2-x}S$ and SnS_2) on the thermoelectric properties of CZTS thin films, the films were deposited at different substrate temperatures. Detailed analysis of temperature dependent electrical resistivity (ρ) and Seebeck coefficient (S) have been carried out. Significant enhancement in the value of thermoelectric power factor (S^2/ρ) is achieved in CZTS film deposited at 375°C substrate temperature, which is correlated to the compactness of thin films, improved crystallinity and presence of metallic secondary phase. Furthermore, Surface topography and surface potential studies also carried out to study the roughness and distribution of interfaces between CZTS and secondary phases ($Cu_{2-x}S$ and SnS_2) in CZTS thin films.

Key words: Copper zinc tin sulfide; Thin films; Copper sulfide; Tin sulfide; Seebeck coefficient; Electrical conductivity; Ultrasonic assisted chemical vapor deposition

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