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Microstructure and thermoelectric properties of doped p-type CoSb₃ under TGZM effect

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Abstract:

The Co-96.9wt%Sb hypoeutectic alloy doped by 0.12wt% YbFe was solidified in a Bridgman-type furnace based on temperature gradient zone melting (TGZM) effect. A mushy zone was observed between the complete liquid zone and the solid zone at different thermal stabilization time ranging from 15 min to 40h. The mushy-zone solidified microstructures of the alloy only consist of CoSb₃ and Sb phase. After 40h thermal stabilization time, the volume fraction of CoSb₃ in the mushy zone increases significantly up to 99.6% close to the solid-liquid interface. The hardness and fracture toughness of doped CoSb₃ can reach 7.01 ± 0.69 GPa and 0.78 ± 0.08 MPa·m^{1/2}, respectively. Meanwhile, the thermoelectric properties of the alloy were measured ranging from room temperature (RT) to 850K. The Seebeck coefficient of the specimen prepared by TGZM effect after 40h could reach 155 μ V/K and the *ZT* value is 0.47 at 660K, showing that it is feasible to prepare CoSb₃ bulk material via TGZM effect. As a simple and one-step solidification method, the TGZM technique could be applied in the preparation of skutterudite compounds.

Key words: TGZM effect; thermal stabilization; CoSb₃; thermoelectric properties

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