Fabrication of Thermoelectric Bismuth Telluride Films using the Novel Resin 3D Printing Technique

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Abstract

The global drive for clean energy sources to replace carbon-based fossil fuels necessitates the development of advanced fabrication processes for thermoelectric materials. Thermoelectric materials can generate electricity from ambient heat, making them promising for low-power generating devices that typically rely on batteries with limited lifespans. Compared to bulk materials, thermoelectric thin films offer enhanced performance due to increased Seebeck coefficient and reduced thermal conductivity. However, fabricating high-quality thermoelectric thin films often involves complex and costly vacuum deposition techniques, hindering their widespread application. This study explores the fabrication of thermoelectric Bismuth Telluride (Bi_2Te_3) films using a resin-based 3D printing method aimed at reducing synthesis costs while enhancing

thermoelectric properties. Bi_2Te_3 films were synthesized via photopolymerization, commercially known as resin 3D printing. In this method, Bi_2Te_3 was mixed with a flexible photopolymer resin to facilitate film formation. Ratios of resin to Bi_2Te_3 tested were 60:40, 70:30, 80:20, and 90:10. As the resin content increased, the films became more durable and sturdier, despite a potential trade-off in performance. Phase analysis of the films was conducted using X-ray diffraction (XRD), confirming the presence of Bi_2Te_3 peaks. Elemental and microstructural characterization via Scanning Electron Microscope (SEM) revealed the presence of Bi_2Te_3, including pores that are potentially associated with the resin content. This study demonstrates a novel and cost-effective approach to fabricating Bi_2Te_3 thermoelectric films using photopolymerization 3D printing, maintaining desirable thermoelectric properties without the need for complex fabrication processes.

Author keywords

bismuth telluride; Resin 3D printing; thermoelectric

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