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Synthesis of an Off-stoichiometric Polycrystalline Layered Compound, $EuSn_2P_2$

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Abstract

Bi_2Te_3-based materials have been widely studied as practical thermoelectric materials. $EuSn_2P_2$ is a promising candidate for thermoelectric applications because it crystallizes in a layered hexagonal structure with the same space group as Bi_2Te_3. In this study, polycrystalline hexagonal $EuSn_2P_2$ was synthesized by a solid-state reaction method using Eu ingots and pre-reacted Sn–P pellets as starting materials. The obtained samples were characterized by X-ray diffraction to evaluate the phase formation and lattice parameters. Polycrystalline $EuSn_2P_2$ samples with different lattice constants were successfully synthesized under different reaction conditions. The variation in lattice constants suggests possible off-stoichiometry in $EuSn_2P_2$. These results provide fundamental information for controlling the synthesis conditions and chemical composition of polycrystalline $EuSn_2P_2$.

Keywords: $EuSn_2P_2$; off-stoichiometry; layered compound; solid-state reaction; thermoelectric material

1. Introduction

Thermoelectric (TE) materials, which directly convert heat into electricity, have attracted considerable attention for waste-heat recovery and energy-harvesting applications. The performance of TE materials is evaluated using the dimensionless figure of merit, *ZT*, which is defined as: $ZT = \rho S^2 T \kappa^{-1}$ where *S*, *T*, *ρ*, and *κ* are the Seebeck coefficient, absolute temperature, electrical resistivity, and thermal conductivity, respectively [1]. Therefore, a high Seebeck coefficient, low electrical resistivity, and low thermal conductivity are required to achieve high *ZT* values and develop high-efficiency TE devices.

$EuSn_2Pn_2$ compounds, where Pn = P or As, crystallize in a layered hexagonal structure (Fig. 1) similar to that of Bi_2Te_3. Sakagami *et al*[2]. reported the synthesis of polycrystalline $EuSn_2As_2$ and its high-temperature transport properties [3] in the temperature range of 300 – 673 K, suggesting that $EuSn_2As_2$ is a potential TE material.

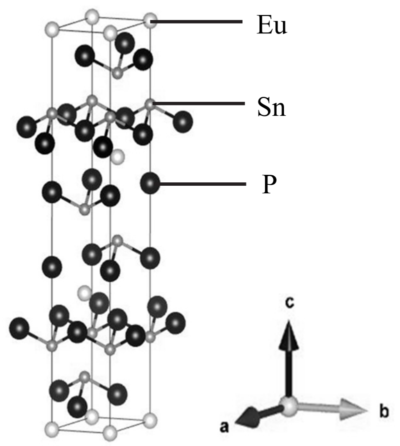

Fig. 1 Crystal structure of $EuSn_2P_2$ from different viewpoints. Drawn using VESTA [6].

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