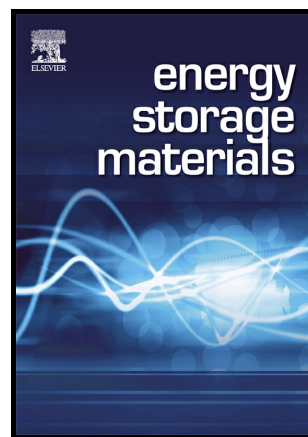


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Achieving high Figure of Merit in p-type polycrystalline Sn_{0.98}Se via self-doping and anisotropy-strengthening

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Abstract

In this study, we report a record peak Figure of Merit (ZT) of 1.36 ± 0.12 in polycrystalline Sn_{0.98}Se macro-sized plates, fabricated via a facile solvothermal method. The obtained exceptional thermoelectric performance comes from their high power factor of $6.95 \mu\text{Wcm}^{-1}\text{K}^{-2}$ and ultra-low thermal conductivity of $0.42 \text{ Wm}^{-1}\text{K}^{-1}$ at 823 K. Through our Hall measurements, we found the high carrier concentration of $1.5 \times 10^{19} \text{ cm}^{-3}$ derived from the self-doping, which contributes to a high electrical conductivity and a moderate Seebeck coefficient. Moreover, detailed structural characterizations reveal a strong preferred orientation in our sintered Sn_{0.98}Se pellets. The phonon scattering sources such as grain boundaries, synergistically coupled with the anharmonicity bonding of Sn_{0.98}Se crystals with a high density of 98.5%, result in an intrinsic ultra-low thermal conductivity. This study provides a new perspective to achieve high thermoelectric performance in polycrystalline SnSe materials.

Keywords: Thermoelectric materials, Tin Selenide, Solvothermal Synthesis, Self-doping, Anisotropy-strengthening

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