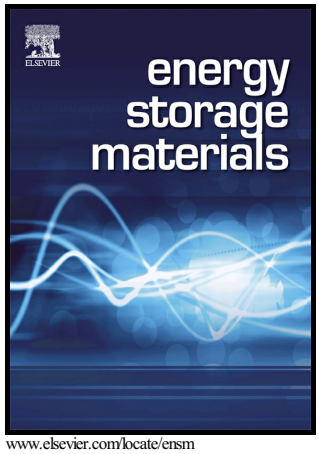

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Achieving high Figure of Merit in p-type polycrystalline $Sn_{0.98}Se$ via self-doping and anisotropy-strengthening

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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 $\mu Wcm^{-1}K^{-2}$ and ultra-low thermal conductivity of 0.42 $Wm^{-1}K^{-1}$ at 823 K. Through our Hall measurements, we found the high carrier concentration of 1.5×10^{19} 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 boding 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