Low Thermal Conductivity in Thermoelectric Materials and High Thermal Conductivity in Boron Arsenide

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Abstract

Bi_2Te_3-based p-type $Bi_{0.5}Sb_{1.5}Te_3$ and n-type $Bi_2Te_{2.7}Se_3$ have been the only materials for thermoelectric cooling for decades. Even though the progress on advancing the thermoelectric figure-of-merit (ZT) has been significant especially the materials with peak ZT at high temperatures, materials with high enough ZT around room temperature are very rare. Up to now, in addition to Bi_2Te_3-based ones, the only reported is p-type MgAgSb with ZT of ~0.8 at room temperature. There is rare report on any n-type material exhibiting ZT similar to that of the n-type $Bi_2Te_{2.7}Se_3$. In this talk, I will present a new n-type material that has a ZT of ~0.7 at room temperature, which is comparable to that of n-type $Bi_2Te_{2.7}Se_3$. The cooling performance of a unicouple consisting of the new n-type material and the p-type $Bi_{0.5}Sb_{1.5}Te_3$ is also in par with the commercial legs consisting of the p-type $Bi_{0.5}Sb_{1.5}Te_3$ and n-type $Bi_2Te_{2.7}Se_3$. In addition I will also discuss the recent progress on realizing thermal conductivity above 1200 W m^{-1} K^{-1} at room temperature in Boron Arsenide single crystals.