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Prospects for nanoscale thermoelectric Bi(1-x)Sb(x) alloys
JOSEPH P. HEREMANS, The Ohio State University, Department of Mechanical Engineering and Department of Physics — Bi(1-x)Sb(x) alloys are the materials with the highest thermoelectric figure of merit at cryogenic temperatures around 100 K. Recently, Thonhauser et al. (Appl. Phys. Lett. **85** 588 2004) calculated that heavily-doped pure Bi could be an excellent thermoelectric material at 300 K. Bi doped p-type with 1% Sn to a hole concentration of about $15\text{x}10^{21}\text{cm}^{-3}$ and a Fermi level 250 meV below that of the pure semimetal could reach ZT=1.44. Unfortunately, no p-type doping has been achieved experimentally in semimetallic Bi at room temperature, not only because of the solubility limit of Sn in Bi, but mostly because the band structure is very temperature-dependent, and the energy overlap between conduction and valence band is much larger at 300 K than at 4 K. Two new approaches are suggested here. Firstly, one can attempt to use the model in dilute Bi(1-x)Sb(x) alloys. Secondly, one should be able to increase the power factor by adding nanoprecipitates to a Bi or Bi(1-x)Sb(x) alloy matrix, following a precipitation anneal similar to that used on PbTe:Pb by Heremans et al. (J. Appl. Phys. **98** 063703 2005). Model calculations, and the result of some preliminary experiments, will be given.

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