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Anisotropic Two-band Transverse Thermoelectrics in Zero Magnetic Field CHUANLE ZHOU, Y. TANG, K. HEINSELMANN, M. GRAYSON, EECS Dept., Northwestern University, S. BIRNER, Walter Schottky Institut, Tech. Univ. Munchen — Narrow gap materials with anisotropic electron and hole band conductance are shown to function as anisotropic two-band transverse (A2T) thermoelectrics, whereby longitudinal electrical currents generate transverse Peltier heat flow. Unlike the Ettingshausen effect which requires external magnetic field, a large transverse Seebeck coefficient in A2T thermoelectric results from the anisotropic electron and hole mass tensors without magnetic field. Compared to synthetic transverse thermoelectrics, A2T thermoelectric coolers can be scaled to nanoscale, and the intrinsic nature of this phenomenon is promising for cryogenic applications. With exponentially tapered coolers, arbitrary ΔT can be reached with sufficiently thick layers and a small electric field. Equations for A2T thermoelectric transport from an electron-hole band model yield the optimal orientation to achieve maximum transverse figure of merit $Z_{\perp}T$. The InAs/GaSb type II superlattice is shown to have the appropriate anisotropic band structure, and bandgaps of order kT are calculated to give a competitive ΔT = 14 K at room temperature. Thermal conductivity of the superlattice is 4 W/m·K at 300 K using 3ω method. Preliminary data on in-plane Seebeck coefficient will also be presented.

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