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Thermoelectric Phenomena, Materials, Devices, and Applications

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Thermoelectric materials, which can generate electricity from waste heat or be used as solid-state Peltier coolers, could play an important role in a global sustainable energy solution. However, advanced materials with improved conversion efficiency are required for widespread implementation. Improving thermoelectric efficiency requires reconciling competing electronic and thermal transport properties - a material must have both a large carrier effective mass and mobility and low lattice thermal conductivity. Historically, this has been achieved through engineering carrier scattering rates. This talk will focus on new approaches that achieve these conflicting properties through modifications of the electron and phonon band structures. Example materials such as $Yb_{14}MnSb_{11}$ and $Ba_8Ga_{16}Ge_{30}$ will be discussed and pathways towards further material improvements will be highlighted. Such tailored control of transport properties will be vital to realize the next generation of energy materials.