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Resonant Energy Levels and the Thermoelectric Figure of Merit[1]

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Distortions of the electronic density of states are a potent mechanism to increase the thermopower and ZT of thermoelectric semiconductors. Band-structure engineering approaches will be reviewed that can be used to do this, namely quantum size effects, hybridization effects in strongly correlated electron systems, and resonant impurity levels. The properties of known resonant impurities for PbTe, SnTe, Bi_2Te_3 and GaSb will also be reviewed. They can increase the thermoelectric power through 2 mechanisms, (1) the increase in density of states, and (2) resonant scattering. The first increases the thermopower in a nearly temperature-independent way; the second results in an electron energy filtering effect that increases the thermopower, but only at cryogenic temperatures where the electron-phonon interactions are weaker. An analysis of the thermomagnetic tensor components makes it possible to dissociate the two contributions experimentally.

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