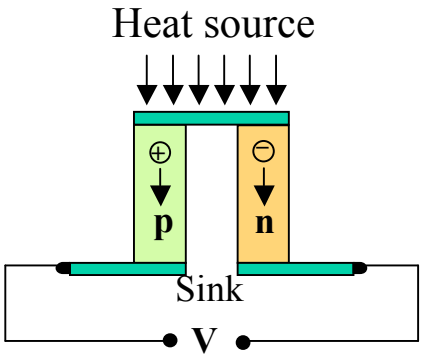
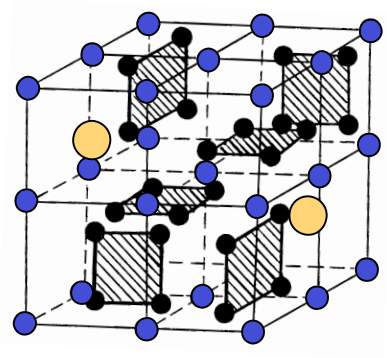
Novel materials for thermoelectric power generation

Nanostructured skutterudites

Michigan Memorial Phoenix Energy Institute



Thermoelectric couple converting heat into electricity. Efficiency of conversion depends on the figure of merit ZT = S2σT/k where S is the Seebeck coefficient, σ is electrical conductivity and k is the thermal conductivity.



Structure of filled $CoSb_3$ skutterudite showing atoms of Co in blue, square planar rings of Sb atoms, and two foreign atoms (fillers) that occupy two empty lattice sites.

Objective:

Synthesize new thermoelectric materials that achieve conversion efficiency of 15-20 percent at the operational range 500-1000K that is applicable to many sources of industrial waste heat (cars, trucks, smelters, power stations, etc.).

Approach:

Filled skutterudites based on $CoSb_3$ are among the best materials for thermoelectric power generation. To further improve their figure of merit we want to introduce nano –meter scale features into the bulk matrix. The role of the nanostructure is i) to strongly scatter heat conducting phonons that leads to a reduction in the lattice thermal conductivity and ii) to increase the Seebeck coefficient by energy filtering and carrier confinement.

Impact:

- Efficient conversion of waste heat into electricity
- Improvement of gas consumption of cars by more than 5%
- Saving huge amounts of barrels of oil

Contact:

Ctirad Uher
Physics, LS&A
(734) 764-3933
cuher@umich.edu

www.lsa.umich.edu/physics/peopleprofile/0,2708,,00.html?ID=340

Facilities and infrastructure:

- Instrumentation for complete electrical and thermal characterization of materials from 2K to 1500K.
- Equipment for synthesis and fabrication of bulk thermoelectric materials.