MAR15-2014-020039

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Some Interesting Physics in Tetrahedrite-Based Thermoelectrics

DONALD MORELLI, Michigan State University

Thermoelectric materials require a unique combination of fundamental thermal and electronic transport properties in order to function efficiently. These conditions can largely be achieved through careful design and synthesis of compounds that minimize thermal conductivity while allowing for good charge carrier transport, using techniques such as phonon-glass-electron-crystal, hierarchical nanostructuring, and energy filtering. While successful, these approaches often rely upon the use of sophisticated synthesis methodology and low abundance or toxic elements such as tellurium and lead that calls into question their use on a large scale. In order to address this concern, a completely new approach to synthesizing high efficiency thermoelectrics based on compositions of naturally occurring and earth abundant minerals has recently been realized. The family of compounds based on tetrahedrite, the most widespread sulfosalt mineral on Earth, can exhibit thermoelectric performance comparable to that of PbTe. These compounds, comprised predominantly of copper, zinc, and sulfur, display much interesting physics that is at the root of their favorable thermoelectric properties. Here we describe some of this physics that has been revealed through a combination of theoretical calculations, x-ray and neutron probes, and thermal and electronic characterization. Tetrahedrites offer the potential of a low-cost, environmentally benign material for use in thermoelectric power generators on a large scale.