Academic Centre
for Materials and Nanotechnology AGH

We invite you to

ACMiN SEMINAR

seminar topic:

"Strategies for Engineering Complex Thermoelectric Materials"

speaker

Prof. Dr. G. Jeffrey Snyder

(Northwestern University's McCormick School of Engineering and Applied Science, Evanston, USA)

Date: 4th April 2024 at 2:00 PM
ACMiN auditorium 1.02A, bldg. D-16 (Kawiory Street 30)

online:

Abstract:

Thermoelectric (TE) energy conversion is widely studied for its potential to produce electricity from waste heat or provide cooling without the use of harmful refrigerants. There are a number of common strategies used to engineer higher thermoelectric figure of merit, zT, in complex materials. Because the properties that make up zT are all interrelated, the improvement of thermoelectric materials is best guided by the thermoelectric Quality Factor B, proportional to the weighted mobility, μW, and lattice thermal conductivity, κL, as $B \sim \mu W/\kappa L$. The weighted mobility is a better measure of the relevant electronic properties than the power factor because it is a constant material property. Strategies to reduce κL, must not significantly reduce μW for there to be a net improvement in B and therefore zT.

The weighted mobility, μW, is related to the mobility measured by the Hall effect and density of electronic states measured by the Seebeck effective mass m^*. This can be used to identify high effective band degeneracy and band convergence which is known to lead to high B and zT with examples of $zT > 1$ found in $PbTe$, $GeTe$, and Mg_3Sb_2.

In this context, we review the strategies of energy filtering with grain boundaries, band engineering with topological band structures, and phase boundary mapping to engineer dopants and avoiding excessive grain boundary electrical resistance. Finally the method to easily calculate device ZT will be introduced to accurately compare the maximum efficiency of a new material with others in a thermoelectric device.