FALL 2025

MSE 690 SEMINAR SERIES

FRIDAY, OCT 3RD | 3:30 REFRESHMENTS | 3:45PM SEMINAR

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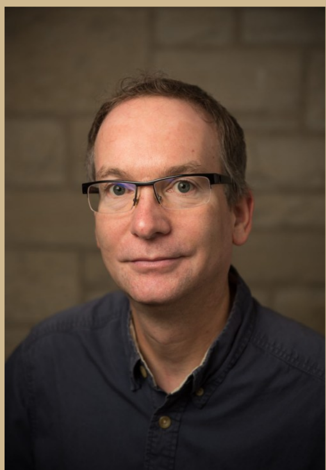

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Interface and Grain Boundary Effects on Thermal, Electrical and Magnetic Properties

Abstract:

Defects and Grain boundaries have a remarkable effect on the thermal and electrical transport properties of polycrystalline materials but are often ignored by prevailing physical theories. The concentration of point defects can be altered with phase boundary mapping considering the defect thermodynamics. Thus the properties can be engineered with careful processing control. Grain boundaries and interfaces can adversely alter the thermal and electrical properties of Power Electronics, Solar Cells, Batteries, Thermoelectrics and permanent magnets such as interfacial electrical and thermal resistance (Kapitza resistance). Interfacial thermal resistance limits the performance of power electronics because of overheating. New scanning thermal reflectance techniques can image the thermal resistance of interfaces and boundaries directly. The Thermal conductivity suppression at grain boundaries can even be imaged showing that different grain boundaries can have very different thermal resistances with high energy grain boundaries having more resistance and low energy boundaries having lower thermal resistance. Interfaces and grain boundaries are 2-dimensional thermodynamic phases (complexions) that have distinct energy, composition and properties that can be rigorously described using the Gibbs excess formalism. The common thermodynamic quantities of temperature and chemical potential connects the complexions to the 3-D phases allowing a phase boundary mapping of grain boundary and interface properties similar to that for point defects.

Biography:

G. Jeffrey Snyder is a Professor of Materials Science and Engineering at Northwestern University. His interests are focused on engineering of electronic and thermal properties and he is well known for his work on thermoelectric materials. He has developed new methods of electron band structure engineering and microstructure engineering of thermal and electrical properties of complex materials. His interdisciplinary approach stems from his background in Solid State Chemistry at Cornell University and the Max Planck Institute for solid state research, Applied Physics at Stanford University and thermoelectric materials & device engineering at NASA/Jet Propulsion Laboratory and California Institute of Technology (Caltech).

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