



VILLANOVA UNIVERSITY
**MECHANICAL ENGINEERING
DEPARTMENT**

Fall 2019 SEMINAR SERIES

Seminar Date: December 6th, 2019

Lecture: Engineering Thermal Transport in Nanoparticle-in-Alloy Semiconductor Composites

Speaker: Dr. Joseph Feser

Associate Professor, Department of Mechanical Engineering, University of Delaware

Abstract:

Introducing nanoscale inhomogeneities into semiconductor alloys is a known route to enhance the scattering of long wavelength phonons and to subsequently reduce thermal conductivity. For key applications such as thermoelectric energy conversion materials, this must be done efficiently to avoid harming electronic functionality. Key questions arise such as what type (i.e. contrast mechanisms), shape, size, and number density of particles should be used. This talk presents two theoretical developments in this area from our group: (1) The use of continuum mechanics to analytically calculate exact phonon scattering cross sections of cylindrical and spherical shaped elastic discontinuities across a wide range of wavelengths, and their subsequent use in Boltzmann transport models of thermal transport and (2) the development of a frequency-domain atomistic numerical approach to simulate scattering from nanoparticles of arbitrary complexity in a mode-resolved manner across the entire Brillouin zone. The efficiency and scalability of the approach allow for extremely large system sizes to be studied. The applications to phonon localization will be discussed along with complimentary experiments.

Biography:



Joseph P. Feser is an Associate Professor in the Department of Mechanical Engineering at the University of Delaware with an expertise in theoretical and experimental microscale heat transfer. He received his Ph.D in Mechanical Engineering in 2010 from the University of California, Berkeley and completed a post-doctoral position in the Materials Science and Engineering Department at the University of Illinois, Urbana-Champaign with David G. Cahill. Feser is a current recipient of the NSF Career Development award.

Host: Prof. Aaron Wemhoff