Institute for Materials Science

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Institute for Materials Science Lecture Series

Dr. David Parker
Staff Scientist
Oak Ridge National Laboratory

Einstein Revisited: Thermal Transport in Tl_3VSe_4 and Related Materials

Thursday, August 16th, 2018
2-3pm
Sig Hecker Conference Room (TA03-0032-134)

Abstract: Thermal transport has long been a topic of great scientific interest. Indeed, an early attempt at a theoretical description was given by Einstein, in terms of a random "hopping" of heat from uncorrelated harmonic oscillators. While this attempt failed spectacularly, largely since the concept of a "phonon", or quantized sound wave, did not yet exist, the concept has persisted and found increasing utility in attempts to define a "minimum thermal conductivity" – the lowest thermal conductivity a crystalline solid can exhibit. In this regime, the thermal conductivity κ shows a very different temperature dependence from that of typical materials, which exhibit boundary-scattering related T^3 behavior at low temperatures, and *Umklapp*-related 1/T behavior at high temperatures. For this reason, crystalline semiconductors with very low κ provide a precision test of these two disparate mechanisms for thermal transport. In our recent theoretical and experimental work on Tl_3VSe_4, we find evidence for this additional transport "channel" theorized by Einstein, despite our independent confirmation of well-defined phonons. An analysis of existing data and theory on other low-κ materials also finds evidence for this channel, which may well be present in all crystalline materials.

Biography: Dr. David Parker has been a Staff Scientist at Oak Ridge National Laboratory for 8 years, beginning in 2010, following postdoctoral work at the Naval Research Laboratory and a Ph.D. in Physics from the Univ. of Southern California in 2006. He applies first principles methods to some of the most difficult challenges in materials science, including magnetic materials, thermoelectrics, ferroelectrics and superconductors.

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For general information Please contact: Kelly Shea* kshea@lanl.gov * 667-9244

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