Chemistry/T_CSUH Joint Special Seminar

Department of Chemistry

Texas Center for Superconductivity at the University of Houston

Dr. Jeff Snyder

Jet Propulsion Laboratory,

California Institute of Technology

"Zintl Phases as High Efficiency Thermoelectric Materials"

Monday, April 10, 2006

Room 634, Science and Research 1

11:00 am to 12:00 noon

Abstract

An efficient thermoelectric material requires the combination of high electronic density of states with high electrical conductivity in combination with low thermal conductivity. Simple semiconductors can have electronic properties suitable for a thermoelectric material but often have high thermal conductivity. Amorphous conductors can have complex crystal structures for low thermal conductivity but also have broad electronic bands unsuitable for thermoelectrics. The ideal thermoelectric material has a complex, even disordered, structure at multiple Angstrom and nanometer length scales to scatter phonons, but also a covalently bonded network that provides high mobility, and heavy mass charge carriers. In addition, like high temperature superconductors, thermoelectrics require precise doping of electronic concentration without disrupting charge carrier pathways. Zintl phases are ideally suited for thermoelectrics because they can provide complex structures within a semiconducting framework that include ionic regions for doping. Examples of this principle in action are evident in the high thermoelectric figure of merit materials, Zn_4Sb_3, $Yb_{14}MnSb_{11}$ and the Skutterudites.

Brief Bio

Dr. Jeff Snyder received his B.S. in physics, chemistry and mathematics at Cornell University and his Ph.D. in applied physics from Stanford University (1997) where he was a Hertz Fellow. His research interests include Solid State Chemistry, Physics and Engineering of electronic, magnetic and energy materials. His current research focuses on Thermoelectric Materials and Devices.

Since joining JPL/Caltech in 1997, Dr. Snyder has been investigating novel thermoelectric materials including antimonide Zintl phases, and nanometer scale structures. He has developed the concept of thermoelectric compatibility for design and optimization of segmented generators. He has developed JPL capabilities in both low and high temperature transport properties measurements of both bulk and thin film materials. Using electrochemistry and low-cost microfabrication techniques, he has developed the fabrication process and testing of thermoelectric microdevices. For novel thermoelectric device engineering, he has developed empirical and analytical models for efficient power generation and transient cooling. He has also designed and tested portable power sources for terrestrial and space applications.

Dr. Snyder's previous areas of research include Colossal Magnetoresistance materials and Metallic Ferromagnets (Stanford University) which involved materials synthesis, thin film deposition, and design, automation and analysis of electronic and magnetic measurements. At the Max Planck Institut für Festkörperforschung, (Stuttgart, Germany) where he studied Intermetallic, Sub-nitride, and C60 intercalation solid state chemistry. At Cornell he studied chalcogenides.

Persons with disabilities who require special accommodations in attending this lecture should call (713) 743-8210 as soon as possible.