



PHYSICS COLLOQUIUM 293

Understanding and Optimizing Energy and Mass Transport in Porous Materials for Energy, Water, and Thermal Management Applications

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ABSTRACT

Porous materials are ubiquitous and vital in a wide range of applications. Transport of energy, mass, and charge to the large fluid/solid interfacial area provided by these materials often controls their behavior in implementations of interest. In this presentation, we'll examine the engineering of transport phenomena in porous media, as well as the functionalization of the surfaces themselves, to enhance performance in several applications including energy storage in electrochemical systems, toxin removal from water, and dissipation of extreme heat fluxes. The interplay of electronic and ionic transport in porous structures, as considered here, provides opportunities for improving performance in electrochemical energy storage systems by tailoring the electrical resistance of porous matrices to reduce local depletion of ionic species. We'll also look at recent work on the combination of chemical affinity and electrostatic interactions in porous electrodes to produce electrically tunable adsorbents and allow selective removal of species from solution using capacitive deionization techniques. Finally, we'll discuss highly efficient two phase convective thermal transport in porous metallic matrices with tailored, template defined microstructures produced by electrodeposition and in systems combining these materials with high conductivity substrates such as diamond.

BIO:

James Palko is an assistant professor of Mechanical Engineering at the University of California, Merced. His group focuses on a range of transport phenomena including phase-change heat transfer and electrokinetics, with applications spanning from thermal management and additive manufacturing to energy storage and water purification. He received his Ph.D. and M.S. in Materials Science and Engineering from the University of Illinois, Urbana-Champaign where he was a Hertz Fellow, and his B.S. in Mechanical Engineering from Arkansas Tech University. Prior to joining UC Merced, he served on the research staff at Stanford University and has also worked in the aerospace and alternative energy industries.

