Tuesday Morning, November 1, 2011

Energy Frontiers Focus Topic
Room: 108 - Session EN-TuM

Industrial Physics Forum on Energy III
Moderator: D.G. Seiler, National Institute of Standards & Technology, J.S. Murday, University of Southern California

8:00am **EN-TuM1 Materials for Low Risk Nuclear Reactors**, ***T.R. Allen***, University of Wisconsin, Madison **INVITED**

Advanced reactor concepts have been proposed for many reasons that could be attributed to “risk reduction.” Risk reduction could mean improved safety margins, more certain economic performance, greater resistance to proliferation, or reduction of risk of exposure during the long-term storage of waste. For many of the envisioned advanced reactor concepts that have been proposed to reduce some form of risk, the ultimate deployment hinges on overcoming challenges in fuels and materials performance. The limits of performance unique to nuclear systems are typically associated with either radiation damage from high-energy particles or due to high-temperature corrosion or stress corrosion cracking. This presentation will provide an overview of the unique operating conditions in proposed reactor concepts and special challenges associated with structural materials operation. Then an overview of two approaches to improve material performance will be presented, specifically use of nanoparticles to improve high temperature strength in radiation fields and the use of tailored systems of grain boundaries to improve corrosion and stress corrosion cracking resistance.

8:40am **EN-TuM3 Battery 500 - the Li-Air Battery Opportunity**, ***S.A. Swanson***, IBM Almaden Research Center **INVITED**

In 2009, IBM started a project to develop rechargeable Li-air batteries for electric cars with a range of 500 miles per charge. This type of high density energy storage technology could become a game changer for the widespread adoption of electric vehicles but it also presents enormous technical challenges. Published work on Li-air batteries has only reported small fractions of the theoretical limit with limited rechargeability. Many aspects of the technology, including the lithium-oxygen electrochemistry, appear to have been poorly understood.

This presentation will give an overview of Li-air battery technology. We will describe our ongoing research including our investigation into the decomposition of carbonate based solvents during cell discharge using Differential Electrochemical Mass Spectrometry, the characterization and identification of the cathode electrodeposits, and enhanced cell capacities achieved using alternative aprotic solvents.

9:20am **EN-TuM5 Advanced Thermoelectric Technology for Waste Heat Recovery**, ***G.P. Meisner***, General Motors Research & Development **INVITED**

In today’s internal combustion engine based vehicles, more than two-thirds of the fuel energy is lost as waste heat. At General Motors Global Research & Development, we aim to demonstrate a viable thermoelectric (TE) generator system to recover that waste heat by converting it into useful electricity using advanced TE technology and thereby reduce vehicular fuel consumption. Essential to the long term success of TE technology in the automobile industry, and for waste heat recovery applications in general, is new materials research, specifically fundamental physics and materials research aimed at discovering and understanding new high performance TE materials, and the development of those materials into robust and high performance TE devices. Our work, which is generously supported by the U. S. Department of Energy's Vehicle Technologies Program, focuses on (1) bulk TE materials (e.g., filled skutterudites) and their temperature dependent physical, mechanical, and TE properties, and (2) TE device and module development, TE generator design, and prototype TE generator fabrication, assessment, and validation. We have made significant progress on constructing working prototype automotive TE generator and testing it on a GM production vehicle.

10:40am **EN-TuM9 Improving Solar Energy Conversion with Nanoscale Materials**, ***S.F. Bent***, Stanford University **INVITED**

With the intensifying global need for alternative energy, there is strong interest in new approaches to materials for sustainable energy devices. A variety of different energy technologies must work in concert to produce, store, and consume the 20 TW of energy that humans will soon demand. Underlying the diverse set of energy conversion devices are similar physical and chemical phenomena, many of which can be controlled with nanoscale materials. This talk will describe research on nanoscale materials for solar photovoltaics and solar fuel production. Synthetic strategies including atomic layer deposition are used to generate nanoscale materials with a high level of control over composition, structure, and thickness. The materials are then tested in energy conversion devices. The prospects and challenges for such materials to contribute to higher energy conversion efficiencies will be discussed.

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