Track 2:
Role of Experimental Mechanics on Emerging Energy Systems and Materials

Organized by:
Bill Y.J. Chao, *University of South Carolina;* Yu-Ling Lo, *National Cheng-Kung University;* Ashok K. Ghosh, *New Mexico Technology University;* Ron Y. Li, *General Motors Corporation;* David Dillard, *Virginia Polytechnic Institute and State University*

Welcome to Indianapolis and the 2010 SEM conference track on "Role of Experimental Mechanics on Emerging Energy Systems and Materials." In recent years, energy has become a hot topic in all walks of life. SEM community is no exception. Steered by the Research Committee, this track intends to bring together researchers and engineers interested in mechanics aspects of energy systems and materials, and provide a forum to facilitate technical interaction and exchange. A wide range of topics are solicited and organized. Papers in the following general technical research areas are included:

- Composite Materials for power generation such as wind power generators
- Fuel cells technology, materials and durability
- Solar energy – Solar cell materials and technology
- Alternative forms of energy
- New energy phenomena from nature

In addition to the contributed papers, a Keynote presentation will be given by Dr. Kenneth Reifsnider, University of South Carolina. We thank the SEM staff and all session organizers for their persistent, devoted efforts as well as the authors, session chairs and presenters in this track who make the ultimate success of the track and the conference.

Keynote Presentation:

Dr. Kenneth Reifsnider, *University of South Carolina*
Experimental Mechanics for Prognosis of Material State Changes in Heterogeneous Materials for Energy Systems
Tuesday, June 8, 1:30 PM, Session 21

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Keynote Presentation:

Kenneth Reifsnider
University of South Carolina

Experimental Mechanics for Prognosis of Material State Changes in Heterogeneous Materials for Energy Systems

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The performance of energy devices and structures is typically discussed in terms of concepts such as structural integrity, durability, damage tolerance, fracture toughness, etc These familiar concepts are usually addressed by considering balance equations, crack growth relationships, and constitutive equations with constant material properties, and constant or cyclically applied load conditions. Loading histories are represented by changing stress (or strain) states, only. But for many situations, especially associated with energy conversion devices, the local state of the material may also change during service, so that the properties used in those equations (e.g. stiffness, strength, and conductivity) are functions of time and history of applied conditions. Changes in material state are defined by these physical variables.

The present paper will discuss prognosis in the context of such changes. The present paper departs from classical approaches to consider the use of impedance spectroscopy under the AC excitation of material elements to follow the specific nature of defect development in composite material structures, under cyclic loading. For this purpose, we have selected out-of-plane bending of thin structural composites as a method of introducing non-uniform distributions of damage. In this paper we discuss some multi-physics foundations for this approach. Specifically, we examine some of the mechanics and physics that makes this concept work.

Dr. Kenneth Reifsnider is the only faculty who is a member of the National Academy of Engineering in South Carolina. He is one of the world's leading scientists in the field of heterogeneous materials, the stuff used to make solid oxide fuel cells. He earned a bachelor's degree in mathematics from Western Maryland College and a bachelor's degree in engineering science from Johns Hopkins University, where he also earned a master's degree in mechanics and a doctoral degree in metallurgy and solids mechanics. He joined the faculty at Virginia Tech in 1968 and was promoted to associate provost for interdisciplinary studies, overseeing 104 centers. He was a deputy director of the National Science Foundation's Center for High Performance Polymeric Adhesives and Composites from 1992-2000. In 2002, he joined the University of Connecticut as holder of the Pratt & Whitney Chair of Design and Durability.

Dr. Reifsnider was named Director of the Connecticut Global Fuel Cell Center in 2004. A fellow of the American Society of Testing and Materials and the American Society for Mechanical Engineers, Reifsnider holds three patents and has published more than 200 articles in leading journals in his field. He has served as Editor-in-Chief of the International Journal of Fatigue and associate editor of the International Journal of Fuel Cell Science and Technology, published by ASME, for which he is founding Editor. Reifsnider has a history of building successful programs and groups. He has founded two journals, one of which is the only fuel cell journal published by the American Society for Mechanical Engineers. He co-founded the Global Fuel Cell Center in Connecticut. He was the first faculty member ever elected to the National Academy of Engineering at the University of Connecticut. And he has founded the South Carolina Center of Excellence in solid oxide fuel cells at USC. Reifsnider serves on countless panels and national committees for the National Research Council, NATO, and National Academy of Engineering.