



College of Engineering  
Department of  
Mechanical & Industrial Engineering

## The Sidney E. Fuchs Seminar Series

3:30-4:30pm, Friday, March 22, 2013

Frank Walk Room



### Materials Under Extreme Environments: Fission and Fusion Energy

by **Steven J. Zinkle, Ph.D.\***

**Chief Scientist, Nuclear Science and Engineering Directorate  
Oak Ridge National Laboratory**

Development and deployment of a diverse mixture of economic and environmentally sustainable energy sources is important for international energy security. Nuclear (fission) power currently provides 20% of the US electricity, and a variety of fission and fusion energy concepts are under consideration for meeting future energy needs. After a brief review of current and proposed fission and fusion energy systems, the crucial role of high performance materials on possible future pathways for fission and fusion energy systems will be discussed. Key materials science aspects associated with operation in these extreme temperature, mechanical stress and radiation environments will be summarized. Radiation-induced nanoscale complexes that evolve over multiple length and time scales (with the potential for dramatic accompanying property changes) are a recurring feature in many materials systems for nuclear energy. Several strategies to design new high-performance self-healing structural materials will be discussed. Recent exploratory research on potentially improved accident-tolerant fuel systems for fission reactors (motivated by the 2011 accident at the Fukushima Dai-ichi power plants in Japan following the devastating earthquake and tsunami) will be presented.

\* Steve is currently the Chief Scientist of the Nuclear Science and Engineering Directorate and a Corporate Fellow at Oak Ridge National Laboratory. He previously served as the director of the ORNL Materials Science and Technology Division from 2006 - 2010, and in a variety of research scientist and program management roles since he joined ORNL in 1985. He received a PhD in Nuclear Engineering and an MS in Materials Science from the University of Wisconsin-Madison in 1985. His research interests include deformation and fracture mechanisms in structural materials and investigation of radiation effects in ceramics, fuel systems, and metallic alloys for fusion and fission energy systems. He has written over 240 peer-reviewed publications and is a member of the National Academy of Engineering. Steve is a recipient of the 2006 U.S. Department of Energy E.O. Lawrence Award, and is a fellow of the American Ceramic Society, ASM International, The Minerals, Metals and Materials Society (TMS), the Materials Research Society, the American Nuclear Society (ANS), and the American Association for the Advancement of Science. He received the 2007 Mishima Award from ANS for outstanding R&D on nuclear fuels and materials and received the inaugural Robert Cahn Award from Elsevier Ltd. in 2010.

  
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