Glenn T. Seaborg Center Seminar

Modeling Nuclear Fuel Performance from Atoms to Assemblies: Current Status, Challenges and Opportunities

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4:00 - 5:00 pm
Building 70A, Room 3377

Radiation damage, and its consequence to material properties, is a central issue in many advanced technologies, from nuclear fuel performance to lifetime extension in currently operating nuclear light water reactors to the future development of advanced fission and fusion power plants. In particular, the nuclear fuel operating environment is among the most extreme encountered by any functioning materials system. Fission processes generate high temperatures and high fluxes of energetic particles. The zirconium alloy cladding is exposed to a highly corrosive environment, in addition to numerous mechanical and chemical interaction forces as it serves as the first engineered barrier against the release of radioactive fission products. This presentation will first introduce the inherently multiscale nature of irradiation effects in nuclear fuels and cladding materials, with several examples of how atomic-scale interactions impact fuel performance; and then describe an engineering-scale, 3D framework for modeling nuclear fuel performance, with an emphasis on pellet clad interaction. Following a description of the important materials degradation phenomena and the current best effort models to describe them, the presentation will focus on an example demonstrating the capability to the model stress state in a Zirconium alloy fuel clad surrounding a fuel pellet with a missing pellet surface during an operational transient.

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Brief Bio:

Brian Wirth is Professor and Governor's Chair of Computational Nuclear in the Department of Nuclear Engineering at the University of Tennessee, Knoxville, which he joined in July 2010. Brian received a BS in nuclear engineering from the Georgia Institute of Technology in 1992 and a PhD in mechanical engineering from the University of California, Santa Barbara in 1998, where he was a Department of Energy Nuclear Engineering Graduate Fellow. In 2002 he joined the faculty at the University of California, Berkeley as an Assistant Professor of Nuclear Engineering, following several years in the High Performance Computational Materials Science Group at Lawrence Livermore National Laboratory, and was promoted to Associate Professor in 2006. His research interests involve using multiscale modeling and advanced microstructural characterization techniques to develop improved understanding and models of microstructure - property relationships and microstructural evolution during processing and service in hostile environments, with an emphasis on irradiation effects; and to use this knowledge as a basis for developing advanced materials. He has received a number of awards, including the 2007 Fusion Power Associates David J. Rose Excellence in Fusion Engineering Award, the 2003 Presidential Early Career Award for Scientists and Engineers (PECASE), a Graduate Student Gold Medal award from the Materials Research Society, and the Outstanding Scholastic Achievement Award as the top graduate of the Nuclear Engineering and Health Physics Program in 1992 at the Georgia Institute of Technology.