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MSE 690 SEMINAR SERIES

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ARMS 1010



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“Multi-scale modeling of the evolution of structure and properties in materials for nuclear energy applications”

Abstract: Nuclear energy is an important component of an overall strategy to address climate change. Idaho National Laboratory (INL) is the U.S. Department of Energy’s primary facility for research and development in nuclear science and technology for energy generation, supporting the improvement and life extension of the existing reactor fleet and the development and licensing of new reactor designs. Computational modeling is an important component of these activities, particularly in the area of materials for nuclear applications, where experimental data can be very challenging and expensive to acquire, and where data is especially scarce for new reactor designs. INL has used multi-scale modeling – linking atomistic, mesoscale, and engineering scales – to improve the ability to predict the performance of materials for nuclear energy applications. These modeling efforts make extensive use of MOOSE (Multiphysics Object-Oriented Simulation Environment), a general-purpose open source finite element framework developed at INL. In this talk, I will give an overview of the approach and tools used, and several examples of application, including performance of nuclear fuels, understanding radiation-driven formation of nanoscale void and gas bubble superlattices, and powder densification through electric field assisted sintering.

Biography: Dr. Larry Aagesen is a Computational Scientist at Idaho National Laboratory (INL), and is the leader of the Computational Microstructure Science group there. He is a member of the development team for Marmot, INL’s application for simulating microstructural evolution in nuclear fuels and reactor structural materials, which is based on MOOSE, INL’s framework for solving partial differential equations using the finite element method. His primary area of expertise is in the phase-field method, having developed phase-field models for a variety of physical phenomena, including fission gas bubble evolution, solid-state precipitation, solidification and coarsening in metallic alloys and ceramics, and semiconductor growth. He received his undergraduate degree in Physics at the University of California, Berkeley in 1997, followed by service in the U. S. Navy’s nuclear propulsion program and work in industry. He then returned to graduate school, completing his Ph.D. in Materials Science and Engineering at Northwestern University in 2010. This was followed by appointment as a postdoctoral researcher and Assistant Research Scientist in the Department of Materials Science and Engineering at the University of Michigan from 2010 to 2015, after which he joined INL.



School of Materials Engineering