



MECHANICAL & MATERIAL COLLOQUIUM

Title: Predicting Evolving Material Performance: Multiphysics Modeling and Validation Approaches

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Material performance is dependent on the material microstructure. Resistance to operational loads—mechanical stress, heat, electric fields, and radiation exposure—depends on microstructural characteristics, including grain size and orientation, dislocation densities, and defect types. Elucidating how structural material microstructures evolve under both manufacturing processes and operational conditions requires coordinated simulation and experimental measurement approaches. The capabilities of the Multiphysics Object-Oriented Simulation Environment (MOOSE) and MOOSE-based codes are well-suited for these microstructure-sensitive simulations. In this talk, two examples of material property degradation simulations for nuclear applications will be discussed: 316 stainless steel as a structural material in a fission reactor and tungsten as a plasma-facing material for fusion. A final example of modeling the Electric Field Assisted Sintering (EFAS) advanced manufacturing process using the MOOSE Application Library for Advanced Manufacturing UTilityEs (MALAMUTE) code will be given. Challenges with and future plans for model validation will be discussed for each example.

Dr. Stephanie Pitts is a Senior Computational Scientist in the Irradiated Fuels and Materials Department at Idaho National Laboratory (INL). Her research interests include the modeling of materials under extreme conditions, with an emphasis on structural material response in nuclear environments—fission and fusion—and advanced manufacturing applications. Many of her projects integrate simulation work with experimental characterization and measurements to improve both model validation and experimental workflows. Stephanie joined INL in 2016 and earned



her PhD in Mechanical Engineering from Washington State University in 2019. She is a lead developer of INL's MOOSE-based crystal plasticity capabilities and of the open-source, advanced manufacturing process code, MALAMUTE. She was a member of the 2021 R&D100 Award code development team for the BISON code and has contributed to five INL software disclosure records.

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For questions, comments and suggestions, contact Colloquium Organizers Dr. Saja AL Rifai (salrifai@fiu.edu) or Dr. Jihua Chen (chenj@fiu.edu)