Project Title

Experimental Validation of UO2 Microstructural Evolutions for NEAMS Tool MARMOT

PI: Yong Yang & University of Florida

Program: NEAMS

Collaborators: Juan Nino – University of Florida, Michael R. Tonks – Idaho National Laboratory, and Xianming (David) Bai – Idaho National Laboratory

ABSTRACT:

The proposed project is aimed at experimentally validating the NEAMS tool MARMOT for predicting the GB migration and pore and GB interaction in UO_2 oxide fuel under the driving forces of high temperatures and large temperature gradient anticipated in a LWR fuels. By performing the well-aligned experiments and simulations simultaneously using precisely defined initial conditions, the high quality experiment data will provide a direct benchmarking of the MARMOT code by evaluating the fidelity of physics, materials science principles and models, and the coupling of multi-physics solutions. A bottom up approach will be used by studying each specific behavior while the code will be statistically validated again the overall structural evolution. The GB energy, specific GB mobility, grain growth kinetic, GB interaction with pores, and effects of large temperature gradients will be specifically studied using experiments. The isothermal grain growth, grain growth under large temperature gradient, and pore and GB interactions will be modeled using 2-D or 3-D simulations. Four questions will be answered at the conclusion of this project:

1. Is the anisotropic grain boundary energy model able to better represent a real view the grain property and would it have a significant impact on the grain growth behavior?
2. Is the classical Zener pinning model in MARMOT sufficient for representing the retarding effect on grain gain boundary migration from pores?
3. Does the temperature gradient have a minimum impact on the average grain growth behavior at varied average temperatures and temperature gradients?
4. Does the pore migrate towards the high temperature domain at the velocities predicted by MARMOT code?