Fundamental Studies of Irradiation-Induced Modifications in Microstructural Evolution and Mechanical Properties of Advanced Alloys

PI: James Stubbins, University of Illinois

Collaborators: Brent Heuser, UIUC; Peter Hosemann , UC Berkeley; Meimei Li, ANL

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ABSTRACT:

This program is designed to provide a basis for designing a neutron irradiation campaign for two advanced, irradiation tolerant alloys. The approach is to develop substantive correlations between neutron and ion irradiation effects in microstructural evolution, and to assess the influence of these microstructural modifications on degradation of mechanical properties. The two advanced alloys are optimized Grade 92 and Alloy 709, both developed for improved resistance to irradiation effects. This research program will: (1) establish ion-to-neutron irradiation correlations between available neutron-irradiated reference alloys (Grade 91, Grade 92 and NF709) and the ion irradiations on these materials to be performed in this program, and (2) to use these correlations to provide a basis for estimating neutron performance of the optimized Grade 92 and Alloy 709 materials. Neutron irradiation results for the reference alloys (Grade 91, Grade 92 and NF709, as well as the base materials, are available from a current, on-going DOE program. **The new insights developed here will both provide a firm basis for the prediction of neutron irradiation response based on ion irradiation results and a methodology to design a neutron irradiation campaign for the optimized Grade 92 and Alloy 709 materials.**

The alloys for study in this program, optimized Grade 92 and Alloy 709, are promising candidates for future application in advanced sodium-cooled fast reactors. The proposed research will focus on a unique set of ion-irradiation conditions of these alloys that directly compare with available neutron-irradiation data. Appropriate models will be established to accurately estimate the microstructural modifications and the mechanical property degradation in neutron-irradiated advanced alloys based on ion irradiation data. The effects of irradiation-induced microstructural evolution on mechanical properties will also be quantitatively analyzed to better predict the performance of the optimized alloys for prospective advanced fast reactor applications, and to establish the parameters of a neutron irradiation campaign to verify their performance.