NUCLEAR ENERGY RESEARCH INITIATIVE

Cladding and Structural Materials for Advanced Nuclear Energy Systems

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Project Number: 08-055

Program Area: Generation IV

Collaborators:
Alabama A&M University
Pennsylvania State University
University of California, Berkeley
University of California, Santa Barbara
University of Wisconsin, Madison

Project Description

The goal of this consortium is to address key materials issues in the most promising advanced reactor concepts that are yet to be resolved, or that are beyond the existing experience base (dose/burnup). The research program consists of three major thrusts: 1) high-dose radiation stability of advanced fast reactor fuel cladding alloys, 2) irradiation creep at high temperature, and 3) innovative cladding concepts embodying functionally graded barrier materials.

The objectives of this research are to:

- Develop an understanding of the high-dose radiation stability of candidate sodium fast reactor (SFR) cladding and duct alloys under a range of temperatures and doses expected in the SFR, using a closely integrated program combining targeted charged particle and neutron irradiations, in-situ irradiation, and computer simulation of defect microstructure
- Determine the stability of oxide dispersion strengthened (ODS) steel and ultrafine, precipitation-strengthened (HT-UPS) austenitic steel
- Characterize and understand the mechanisms for irradiation creep in silicon carbide (SiC) in TRISO fuel, ferritic-martensitic (F-M) alloys, and ODS and UT-UPS steels
- Develop barrier layers for protection of F-M alloys from fuel-clad chemical interaction and of alloy 617 from attack by coolant impurities in the VHTR intermediate heat exchanger
- Develop modeling tools to explain the behavior of F-M steels under irradiation, and predictive tools to extend the reach of our understanding beyond the experimental database

Beyond scientific achievements, this consortium will provide substantial additional outcomes that are expected to provide long-term benefits to the advanced reactor program, including the education of about eight graduate students and several post-docs; inclusion of minority students into the radiation effects and reactor materials fields; creation of new working relationships among universities, laboratories, and industry; and establishment of a pathway to incorporate data generated by the research thrusts into the ASME codes and standards that will be crucial for success of the advanced reactor programs.