INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE

SiC/SiC Composites for Gen-IV Reactors

PI (U.S.): William E Windes, Idaho National Laboratory; Lance Snead, Oak Ridge National Laboratory

PI (France): Frederic Ravel, Commissariat à l'énergie atomique

Collaborators: University of Bordeaux, Snecma Propulsion Solide

Project Number: 2008-001-F

Program Area: Generation IV

Project Start Date: April 2008

Project End Date: April 2011

Project Abstract

Ceramic composites, both carbon-based and silicon carbide (SiC)-based, are considered advanced materials for use in Generation IV nuclear systems at temperatures beyond the operating temperature limits for metallic heat-resistant alloys. SiC fiber-reinforced SiC matrix (SiC/SiC) composites are very promising for high-neutron loading and fast flux in Gen-IV applications (some portions of very high-temperature reactor control rods and most gas-cooled fast reactor core internals). The overall project objective is to address some of the most critical design issues for SiC/SiC components.

A similar I-NERI collaboration with France was initiated in FY 2005. The program consisted of three task elements, but only Task 1 was completed before funding was temporarily discontinued. The current project will draw from the previous one, although the plan has evolved since the initial collaboration.

In the current project, Task 1 is evaluation with a U.S. emphasis on long-term environmental and synergistic effects. Through both theoretical modeling and experiments, researchers will attempt to establish a reliable scheme for life prediction of SiC/SiC under a combined environment of high-temperature, mechanical loading, radiation, and weakly oxidative atmosphere. In Task 2, the research team will analyze, both experimentally and theoretically, relations between mechanical behavior of tubes and planar tensile specimens of the SiC/SiC composite.

During the previous collaboration period, both the United States and France designed and fabricated their reference composite materials and test articles. The U. S. reference SiC/SiC is a Hi-Nicalon™ Type-S, multilayered interphase, chemically vapor-infiltrated SiC matrix composite, while the French reference is a monolayered pyrocarbon interphase composite (otherwise identical with the U.S. reference material). During the course of this project, both research teams plan to design the composite architecture and components based on requirements

and thermomechanical analyses. In this task, the teams will perform design and analysis independently and exchange information.