U.S. DEPARTMENT OF ENERGY
INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE
DOE/France

ABSTRACT

Evaluation of Materials for Gas-Cooled Fast Reactors

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Both France and the United States (US) have a shared interest in the development of advanced reactor systems that employ inert gas as a coolant. Currently, insufficient physical property data exist to qualify candidate material for gas-cooled fast reactor (GFR) designs. The goal of this project is to establish candidate metallic and ceramic materials for GFR designs and to evaluate the mechanical properties, dimensional stability, and corrosion resistance.

The first goal of this project is to improve high temperature creep strength and resistance to environmental attack by optimizing grain boundary structural orientations and alloy compositions. Thermal-mechanical treatment will be performed on GFR candidate alloys to maximize the fraction of low-energy boundaries. Additionally, minor alloy modifications will be attempted. Following treatment, the changes to microstructure will be characterized. For optimized alloys, creep testing in controlled purity gas environments (e.g., He, He+O and simulated HTGR with complex impurities, eg. H_2, H_2O, CO, CO_2, CH_4, etc.) will be performed.

The second goal of the project is to characterize radiation resistance of candidate GFR metallic materials. Candidate metallic materials for the GFR have not typically been used for high dose core components. Therefore, radiation response of these alloys will be characterized by examining the changes in microstructure in samples irradiated with high-energy ions and when available, neutrons from a test reactor.

The third goal of the project is to start studies on the environmental compatibility of ceramic materials in controlled purity gas environments (e.g., He, He+O and simulated HTGR with complex impurities).