NUCLEAR ENERGY UNIVERSITY PROGRAMS

Corrosion and Creep of Candidate Alloys in High Temperature Helium and Steam Environments for the NGNP

PI: Was, Gary - University of Michigan

Collaborators:
Jones, J. Wayne - University of Michigan
Pollock, Tresa - University of Michigan

Project Number: 09-354

Initiative: Gen IV

Abstract

This project will investigate the processes by which candidate materials degrade in helium (He) and supercritical water/steam environments characteristic of very-high temperature reactor (VHTR) designs. The current focus is on lower outlet He temperatures of 750-850°C. These temperatures are below the critical temperature for decarburization, so chromium (Cr)-bearing alloys used for the intermediate heat exchanger will likely form protective oxides and undergo carburization. While the oxide layer is expected to be generally protective, localized oxidation attack along grain boundaries may be life-limiting, as selective internal oxidation occurs in Ni-Cr alloys in this temperature range.

This research will focus on understanding the roles of temperature in the 750-850°C range, and carbon and oxygen potential, on both uniform oxidation and selective internal oxidation along grain boundaries in Alloys 617 and 800H. Because mechanical loading will likely accelerate damage in high-temperature helium, the team will examine the application of static and cyclic stresses in combination with impure He environments. They will conduct both creep and creep/fatigue experiments on Alloys 617 and 800H over a range of oxygen and carbon potentials. Combined, these studies will elucidate the potential high damage rate processes in environments and alloys relevant to the Next-Generation Nuclear Plant (NGNP) program.