NUCLEAR ENERGY RESEARCH INITIATIVE

Real-Time Corrosion Monitoring in Lead and Lead-Bismuth Systems

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Project Number: 05-114

Collaborators: None

Related Program: Gen IV

Project Description

This project addresses major corrosion issues associated with using lead and lead-bismuth liquid metals as working fluids in advanced nuclear systems, such as the Generation IV lead-cooled fast reactor concept or accelerator-based applications. The project's key approach to mitigating corrosion is to develop a persistent oxide film on the surface of internal structural components. The researchers will use Impedance Spectroscopy (IS) corrosion monitoring techniques to measure the kinetics and thermodynamics of the formation of oxides films on reactor structural materials. If properly formed and maintained, these films can provide a useful barrier to inhibit the corrosive attack of liquid metal. The researchers will study material alloying and surface treatment approaches that will form these protective films. The IS technology can measure the oxide film formation in real time, and is sufficiently compact that it can be deployed at numerous locations in an operating system to monitor local corrosion processes directly.

The goals of this project are to develop advanced real-time corrosion monitoring methods, study the thermodynamics and kinetics of scale formation on selected alloys, and apply this understanding to develop new corrosion-resistant alloy compositions or surface treatment techniques. A central objective is to further develop impedance spectroscopy for characterizing and monitoring corrosion in liquid metal systems.

Work Scope

The research test plan is formulated to accomplish the three major goals:

- Develop the IS technique for lead and lead-bismuths systems, which requires significantly extending the scanning frequency range.
- Use the enhanced IS techniques to measure the thermodynamics and kinetics of oxide scale formation for a variety of materials and oxygen pressures at temperatures ranging from 400 – 700 °C.
- Develop improved surface treatments and alloy compositions for enhanced corrosion resistance.