Wisconsin Energy Institute
UNIVERSITY OF WISCONSIN–MADISON

Hotter, Safer, Stronger, Cheaper: Using Corrosion Science to Address Challenges in the Nuclear Industry

Wednesday, December 5th, Noon – 1 pm
Wisconsin Energy Institute Room 1115

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Abstract:

Everything corrodes, including current and advanced nuclear reactors. As reactor designers challenge the limits of material performance, corrosion scientists work on controlling material and environmental properties to meet these challenges and ensure long economic service times. This 2-part talk will discuss current research aimed at improving accident tolerance of light water reactors, and at enabling molten salt reactors.

Since the Fukushima incident in 2011, the nuclear industry has sought to replace Zircaloy fuel cladding with a material which that better withstand a beyond-design-basis incident. A suitable material must possess superior oxidation resistance in high temperature steam to withstand a loss of coolant accident, while maintaining good hydrothermal corrosion properties. In addition to corrosion issues, a suitable material must also demonstrate sufficient mechanical strength, creep resistance, radiation tolerance, and favorable neutronics. Part 1 of this talk will present results and analysis of experiments investigating corrosion of coated SiC materials for use as accident tolerant fuel cladding.

Molten chloride salts possess many attractive properties for use as a coolant and storage medium in advanced nuclear reactors and in concentrated solar power systems. Among the many challenges is the corrosion of salt-facing structural components. Part 2 of this talk will discuss efforts aimed at fundamentally understanding degradation of alloys in molten salts. Results of a combined experimental and computational strategy in which traditional experimentation is coupled with x-ray spectroscopy and thermodynamic modeling are used to identify relevant reactions and to develop a thermodynamic description of the alloy-salt system.

Dr. Stephen Raiman is an R&D Associate in the Corrosion Science and Technology Group in the Materials Science and Technology Division at Oak Ridge National Laboratory. He is interested in understanding corrosion and degradation of materials in nuclear power plants and other extreme environments. His recent work has focused on evaluating materials for accident tolerant fuel cladding in light water reactors, and on materials compatibility in molten salts for use in molten salt reactors and concentrated solar power. Prior to joining ORNL, he graduated from The University of Michigan in 2016 with a Ph.D. in Nuclear Engineering and Radiological Sciences. He also holds a B.S. in Physics from the University at Buffalo.