**Special Materials Seminar**

Department of Materials Science & Engineering

# Friday May 4, 2018

1:30 – 2:30 ~ Ferris 405

"Understanding Degradation of Structural Alloys in Molten Chloride Salts"

**Speaker: Dr. Stephen Raiman**



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Abstract:

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. In molten halide salts, the passive films that typically form on the surface of corrosion resistant alloys either do not form, or are unstable due to the very low oxygen activities. Therefore, corrosion of materials is dependent largely on interfacial dissolution reactions between the molten salt and the bare metal surface in which alloy constituents with the most stable chlorides tend to be the most likely to dissolve.

For most common structural alloys, chromium has the most stable chloride, and thus selective dissolution of chromium from the alloy into the salt is the dominant form of material degradation in molten halides. While this fact is well known and backed-up by experimental data, the mechanism of chromium depletion from alloys is not yet known. To truly understand corrosion in molten salts, the mechanism of chromium depletion from alloys must be understood and quantified.

This talk will discuss results of a combined experimental and computational strategy aimed at fundamentally understanding corrosion of alloys in molten chloride salts. Controlled capsule tests are conducted in which model Ni-Cr alloys are exposed to molten KCl-MgCl2 at temperatures in excess of 600°C to measure degradation in molten salt. In an effort to maintain greater control of the molten salt environment, new processes to sufficiently purify salts are discussed. Quantification of salt impurities is matched to corrosion results in an effort to quantify the effect of salt impurity concentrations on corrosion rates. Traditional experimentation is coupled with x-ray spectroscopy and thermodynamic modeling to identify relevant reactions and to develop a thermodynamic description of the alloy-salt system. This work is funded by the Laboratory Directed Research and Development Fund at Oak Ridge National Laboratory.

Biography:

Dr. Stephen Raiman is an R&D Associate in the Corrosion Science and Technology Group at Oak Ridge National Laboratory. He is interested in understanding corrosion and degradation of materials in nuclear power plants and other extreme environments. He is currently studying corrosion of structural materials in molten salts, for use in molten salt reactors and concentrated solar power systems. His other primary area of focus is hydrothermal corrosion of structural materials in light water reactor environments. His recent work is centered around corrosion of silicon carbide materials for accident tolerant fuel cladding. He is also involved with projects ranging from supercritical steam corrosion to oxidation of phase-change materials for energy storage. Prior to joining ORNL, he graduated from The University of Michigan in 2016 with a Ph.D. in Nuclear Engineering and Radiological Sciences, where his thesis topic was “Irradiation Accelerated Corrosion of 316L Stainless Steel in Simulated Primary Water”. He also holds a B.S. in Physics from The University at Buffalo.