

Development of In-Situ Corrosion Kinetics and Salt Property Measurements 08380

Salt Properties and Corrosion Kinetics on Metal Films

1. Impact

Chloride ternary salts are key candidates for CSP. Higher salt temperatures aggravate the corrosion of metallic container alloy demanding a thorough experimental understanding of microstructural and chemical evolution at salt-alloy interfaces under these temperatures.

2. Project Goal

The main goal of the project is to understand the corrosion and chemical properties of molten salts and then to provide fundamental data for material selection including the molten salt for Gen3 CSP. The correlations between corrosion kinetics and salt structure/dynamics will be developed.

3. Method(s)

Four innovative approaches are developed to achieve the objectives: Micro-Environmental Cell (MEC) in-situ to Transmission Electron Microscope (TEM), Molten-Salt Cell (MSC) in Neutron Reflectometry (NR), Electrochemical Studies, and Ab initio molecular dynamics (AIMD) analysis based on neutron and X-ray experiments.

4. Outcome(s)

We set up the electrochemical cell and operational procedure for the electrochemical tests; we commissioned, installed, and operated the new MEC apparatus, and it is now in routine use; we designed and made two different types of MSC for NR; and we built AIMD model of ternary salts based on various neutron and X-ray measurements.

5. Conclusion/Risks

These outcomes lead to realization and initial application of in-situ techniques for measuring molten salt fundamental properties including molten salt structure, dynamics, and salt density, etc. and the micro-structural and -chemical response of containment alloys to corrosive molten salt environments. Throughout the experiments, moisture and oxygen levels have to be controlled very carefully. In liquids structure, diffusion and phonon are inseparable. We will carry Van Hove function analysis from neutron scattering for molten salts in addition to diffraction for solids.

6. Team

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Visuals

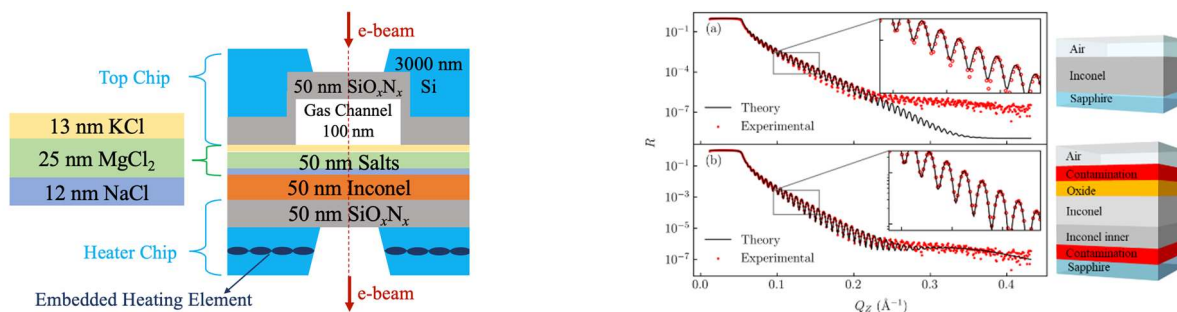


Figure 1. (Left) Ability to deposit, characterize and corrode Inconel / salt mixture under controlled environment (vacuum or controlled gas partial pressure); (Right) Seven-slab model vs. three-slab model for Inconel film on sapphire (exposed to air)