Development of Corrosion Resistant Coatings and Liners for Structural Materials for Liquid Fueled Molten Salts Reactors

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Program: RC-1.1 Down Selection of Cladding Materials for Structural Components in Liquid-Fueled Molten Salt Reactors

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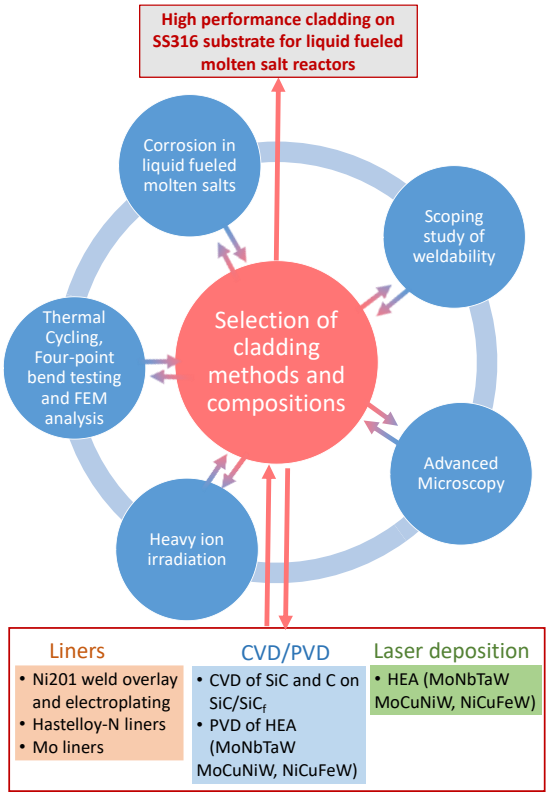
ABSTRACT:

The goal of the proposed research is to develop corrosion-resistant coatings and liners (collectively referred to as 'cladding' in this proposal) for structural materials for use in fuel dissolved molten salt environment for future Molten Salt Reactors (MSRs). Corrosion and electrochemical testing will be performed in molten FLiBe salt (with and without uranium-fluoride additions). The substrate for this study will be 316 stainless steel, which is ASME Sec III Div 5 codified and therefore already being considered as the leading metallic material for MSR components by the reactor designers. The claddings will be subjected to rigorous mechanical testing, including thermal cycling and flexural four-point bend tests to ensure mechanical integrity of the interface, in order to provide data to ASME Sec III Div 5 codification. The claddings will also be evaluated for radiation damage resistance given that structural materials will be subjected to a significant neutron flux in thermal and fast liquid fueled MSRs. A scoping study for weldability will be performed on down-selected coatings and liners. Innovative, but industrially scalable surface cladding approaches are proposed yielding promising surface and interfacial compositions however the processes themselves are commercial and have high Technology Readiness Levels (TRL), and consequently would greatly facilitate the accelerated development of MSRs (see Figure).Simultaneously, innovative scoping approaches such as high throughput characterization, laser cladding, and combinatorial synthesis are proposed that will pave the way for development of new cladding systems for MSR components. Feedback from mechanical testing, and microstructural and compositional uniformity analyses will inform optimization of the cladding fabrication methods with the end goal of achieving highly durable.



Logical path to down select high performance cladding options for structural materials for liquid fueled molten salt reactors