
Ni-based ODS alloys for Molten Salt Reactors

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ABSTRACT:

Developing Ni-ODS alloys can alleviate the problems related to swelling and irradiation damage which limit the currently available Ni-alloys for use in an MSR environment, while improving the mechanical properties.

Thus, the objective of this team work is to

- (i) develop a new Ni-based ODS alloy that can be used for structural applications in Molten Salt Reactors as the primary material facing the fuel
- (ii) demonstrate that its high temperature mechanical properties are adequate for MSR operating temperatures
- (iii) demonstrate its enhanced resistance to radiation damage compared to regular nickel alloys as a result of its inherent multi-interface character through “rapid” ion irradiation testing
- (iv) demonstrate its improved corrosion resistance in MSR environment through appropriate experiments.

Computational thermodynamics (Thermo-Calc), phenomenological diffusion modeling (DICTRA) precipitation simulations (PRISMA) and DFT calculations will be conducted to inform and guide the alloy development and processing of the new alloy. Powder metallurgy will be used to process batches of the new alloy and a comprehensive suite of characterization techniques will be employed to ensure the desired micro/nanostructure is achieved (including, electron microscopy techniques and Atom Probe Tomography). The radiation resistance of the new alloy will be probed through “rapid” ion irradiation characterization. The mechanical properties will be probed through a series of ex-situ and in-situ mechanical tests. C-V, polarization curve, and EIS techniques will be applied to investigate and demonstrate the hot corrosion resistance of the alloy in Molten Salt environment.