

Competition of Young Scientists at IIC 2026

Title:

Microstructure Engineering of Hastelloy N/Incoloy 800HT Dissimilar Joints for Corrosion Resistance in Molten FLiNaK: A Data-Driven Approach

Author: MSc. Alireza Karimi

Institute: Institute of Inorganic Chemistry, Slovak Academy of Sciences

Supervisor: doc. Ing. Miroslav Boča, DrSc.

Research start date at IIC: February 2026

Molten fluoride salts such as FLiNaK (LiF-NaF-KF) are promising heat-transfer and coolant media for advanced high-temperature energy systems. However, aggressive corrosion of structural materials remains a major challenge limiting their long-term application. This work focuses on developing dissimilar joints between Hastelloy N, a Ni-based alloy designed for molten-fluoride environments, and Incoloy 800HT, a comparatively lower-cost Fe-Ni-Cr alloy with good high-temperature performance.

The proposed joints will be fabricated by spark plasma sintering (SPS) using compositionally engineered powder-compact interlayers. We will investigate Ni-, Ni-Cr-, Ni-Mo-, and Ni-Cr-Mo-based powder mixtures, applying ball milling where appropriate to modify particle characteristics and improve compositional homogeneity. A literature-derived dataset, supported by statistical and machine-learning-assisted analysis, will guide the selection and interpretation of suitable interlayer compositions.

The resulting Hastelloy N/interlayer/Incoloy 800HT systems will be characterized using X-ray diffraction, SEM/EDS, EBSD, and microhardness measurements. Particular attention will be given to interlayer densification, residual porosity, elemental redistribution, phase formation, grain structure, grain-boundary characteristics, and interface morphology. The joints and parent materials will subsequently be exposed to molten FLiNaK, followed by analysis of preferential dissolution, elemental depletion, corrosion penetration, salt penetration, and interfacial degradation.

The overall aim is to establish the relationship between **interlayer composition, powder processing and SPS parameters, interfacial microstructure, and corrosion behavior in molten FLiNaK**. The study is expected to provide a basis for designing dissimilar joints with controlled composition and microstructure that combine the corrosion resistance of Hastelloy N with the lower material cost of Incoloy 800HT for molten-salt energy applications.