NUCLEAR ENERGY UNIVERSITY PROGRAMS

Thermal Properties of LiCl-KCl Molten Salt for Nuclear Waste Separation

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Abstract

This project addresses both practical and fundamental scientific issues of direct relevance to operational challenges of the molten LiCl-KCl salt pyrochemical process, while providing avenues for improvements in the process. In order to understand the effects of the continually changing composition of the molten salt bath during the process, the project team will systematically vary the concentrations of rare earth surrogate elements—lanthanum, cerium, praseodymium, and neodymium—which will be added to the molten LiCl-KCl salt. They will also perform a limited number of focused experiments by the dissolution of depleted uranium. All experiments will be performed at 500°C.

The project consists of the following tasks. Researchers will measure density of the molten salts using an instrument specifically designed for this purpose, and will determine the melting points with a differential scanning calorimeter. Knowledge of these properties is essential for salt mass accounting and taking the necessary steps to prevent melt freezing. The team will use cyclic voltammetry studies to determine redox potentials of the rare earth cations, as well as their diffusion coefficients and activities in the molten LiCl-KCl salt. In addition, the team will perform anodic stripping voltammetry to determine the concentration of the rare earth elements and their solubilities, and to develop the scientific basis for an on-line diagnostic system for *in situ* monitoring of the cation species' concentration (rare earths in this case). Solubility and activity of the cation species are critically important for the prediction of the salt's useful lifetime and disposal.