

NUCLEAR ENERGY RESEARCH INITIATIVE

Selective Separation of Trivalent Actinides from Lanthanides by Aqueous Processing with Introduction of Soft Donor Atoms

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Collaborators: Pacific Northwest National Laboratory

Related Program: AFCI

Project Description

This project investigates new chemical methods for selective separation of actinide isotopes from lanthanides in mixed oxide (MOX) fuels by aqueous processing with soft donor atoms. Implementation of a closed loop nuclear fuel cycle requires the utilization of MOX fuels containing plutonium. This results in increased production of trans-plutonium actinides, most significantly isotopes of americium and curium. Because the presence of these isotopes significantly impacts the long-term radiotoxicity of high level waste, it is important to develop effective methods for their isolation and transmutation. Transmutation is most efficiently done in the absence of lanthanide fission products, making effective procedures to separate the actinides from the lanthanides important.

As the chemistries of these elements are nearly identical, differing only in the slightly stronger interaction of trivalent actinides with certain ligand donor atoms, separation is a complex task. Current research has led to the development of new reagents and processes with considerable potential for accomplishing separation. However, pilot scale testing indicates these reagents are susceptible to radiolytic and hydrolytic degradation.

The objective of this research project is to identify the most effective and economic means of controlling radiation damage in actinide/lanthanide extraction systems. Researchers will study the extraction and chemical stability properties of a class of soft-donor extractants adapted from water-soluble analogs, and the application of simple soft-donor anions like thiocyanate in tandem with conventional extractant molecules. The potential of radical scavenger molecules to protect soft-donor extractant molecules from radiolytic degradation will also be studied.

Work Scope

- Investigate selective extraction of trivalent americium and curium from ammonium thiocyanate solution.
- Adapt the TALSPEAK process to these extractant systems using water-soluble species
- Explore radiation protection methods based on removal of radiolytic degradation products from the extractant phase.
- Design ligands for selected new classes of reagents (lipophilic analogs of EDTA and thio polyamide derivatives).