Presents:
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Making Americium Hexavalent Again

Abstract: Advanced nuclear fuel cycles aim to improve uranium fuel efficiency and decrease the amount of high-level waste (HLW) through burnup of long-lived minor actinides. The average fuel efficiency of uranium in commercial nuclear fuel rods is approximately five percent, due to a buildup of fission products (predominantly lanthanides) reducing the neutron consumption efficiency of uranium. The lanthanides, due to their inherently high neutron cross sections, compete with uranium, and progressively slow the fission process. One strategy to increase uranium fuel efficiency and decrease HLW is to selectively recover uranium, neptunium, plutonium, and americium from used nuclear fuel and reuse the uranium and plutonium in mixed oxide fuels (MOX) in conventional reactors. Neptunium and americium could be transmuted in fast spectrum reactors to reduce the storage timelines and heat load strain, respectively, on the long term storage facilities used for radionuclide disposal.

Separation of americium from trivalent lanthanides and trivalent actinides is one of the most difficult elemental separation steps in closing the nuclear fuel cycle. One separation method under consideration is to oxidize americium to the hexavalent state, forming a linear dioxo cation. Forcing americium to the hexavalent state provides a path for achieving group actinide (U, Np, Pu, and Am) separation from lanthanides, trivalent actinides, and remaining fission products. Thus far only sodium bismuthate, an insoluble oxidizer, has demonstrated the ability to oxidize and maintain Am in the hexavalent state in molar nitric acid for recovery by solvent extraction. The insolubility of sodium bismuthate in aqueous and organic phases could be a limitation in further process development. This work evaluates aqueous soluble Cu\textsuperscript{3+} periodate (shown on the right) as an oxidant to be used to accomplish a group actinide separation with the extractant diamyl amylphosphonate (DAAP) dissolved in n-dodecane.

Biography: Professor Braley joined the faculty at Colorado School of Mines in the fall of 2012 after a two-year employment at Pacific Northwest National Laboratory. During her undergraduate research, she studied the solid-state synthesis of f-block elements at Colorado State University with Professor Peter Dorhout. In 2006 she joined the group of Professor Ken Nash at Washington State University (WSU). Here she examined the fundamental solution chemistry of the f-elements relevant to solid-liquid and liquid-liquid separations chemistry. While in graduate school, she was able complete an intership at Eichrom Technologies with Dr. Phil Horwitz and bolstered her understanding of extraction chromatographic (solid-liquid) separations. She has joined the faculty at Colorado School of Mines to educate students on the fundamental and applied concerns of nuclear chemistry and radiochemistry (including the nuclear fuel cycle, nuclear forensics, and fundamental actinide chemistry). As a member of the Nuclear Engineering Program at Mines, she actively engages the U.S. Geological Survey 1 MW TRIGA Nuclear Reactor on the Denver Federal Center to accomplish research and educational goals.

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