

Synthesis of Actinide Fluorides for Advanced Nuclear Fuels and National Security

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Development of new protocols for the synthesis of high-purity, anhydrous actinide fluoride materials is driven by increasing ramp-up of advanced nuclear reactor systems including Molten Salt Reactors (MSRs), which in parallel require the development of safeguards and nonproliferation strategies. Furthermore, these compounds are essential building blocks in fundamental chemistry. Synthetic routes towards isolated actinide fluorides are dominated by the use of hydrofluoric acid (HF) using pressure or flow reactors at high temperatures, with significant infrastructure investments required to mitigate hazards these conditions pose to workers and the environment. We demonstrate the capability to generate anhydrous actinide fluorides at low temperatures, with minimal investment, using easy-to-handle main group fluoride reagents in reaction with actinide chloride coordination compounds. Described in this presentation are new synthetic routes to ThF₄, UF₄, and UF₃ materials bypassing the use of HF, with progress towards the synthesis of analogous Pu materials discussed. Efforts towards utilizing common oxide starting materials in the generation of actinide halides will also be discussed.