CINR Webinar

FC-1.1 – FC-1.6: Material Recovery and Waste Form Development

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U.S. DEPARTMENT OF ENERGY

MRWFD Major RD&D Thrust Areas

Aqueous Fuel Cycle Chemistry and Technology	Support R&D in chemical speciation, complexation, radiation, and process chemistry to predict and improve actinide separation efficiencies.
Molten Salt Chemistry & Processing	Support transformative salt chemistry R&D to enable tailoring and optimizing of salt properties and behaviors for salt technology applications.
Cross-Cutting for Aqueous & Salt Processing	Develop advanced waste forms & off-gas capture and immobilization technologies to enhance waste loading, durability, and cost reduction.
Joint Fuel Cycle Study	Jointly with South Korea to assess the technical feasibility of electro-chemical recycling technology for managing used LWR fuels.
Hybrid ZIRCEX RD&D	Evaluate the feasibility of HALEU production from high-value excess federally-owned nuclear fuels.
EBR-II Acceleration	Support the accelerated production of HALEU material to meet near-term advanced reactor HALEU fuel R&D needs.

Material Recovery and Waste Form Development Program
FY 2022 Solicitation Topics Overview

PROGRAM SUPPORTING: FUEL CYCLE TECHNOLOGIES (FC)

ELIGIBLE TO LEAD: UNIVERSITIES ONLY

FC-1.1: INNOVATIVE GAS-PHASE SEPARATIONS CHEMISTRY FOR HIGH-VALUE USED FUELS

FC-1.2: NUCLEAR FUEL CYCLE AQUEOUS SEPARATIONS CHEMISTRY

FC-1.3: UNDERSTANDING, PREDICTING, AND OPTIMIZING THE PHYSICAL PROPERTIES, STRUCTURE, AND DYNAMICS OF MOLTEN SALTS

FC-1.4: UNDERSTANDING THE STRUCTURE AND SPECIATION OF MOLTEN SALTS AT THE ATOMIC AND MOLECULAR SCALE

FC-1.5: IRON PHOSPHATE PROCESS: EVALUATION OF PROCESSING PARAMETERS ON THE PRODUCT PROPERTIES (Kim Gray)

FC-1.6: OFF GAS CAPTURE: IDENTIFICATION OF PROMISING KR STORAGE MATERIALS (Kim Gray)

FC-1.5 WASTE FORM DEVELOPMENT: IRON PHOSPHATE PROCESS - EVALUATION OF PROCESSING PRODUCT PROPERTIES

UP TO 3 YEARS AND $600,000

Phosphate-based process will generate a chemically durable iron phosphate glass wastes to immobilize salt wastes from the electrochemical reprocessing of used nuclear fuel. It may also enable recycling of chlorine. To better understand the chemical processing including materials development will further enhance the throughput of waste form production.

(A) Dehalogenated the salt via phosphates

- $NH_4H_2PO_4$ + salt ⟶ NH_4Cl, H_2O
- $(NH_4)_2HPO_4$ + salt ⟶ NH_4Cl, H_2O
- H_3PO_4 + salt ⟶ HCl, H_2O

(B) Vitrification with salt cations + P_2O_5 w/ Fe_2O_3

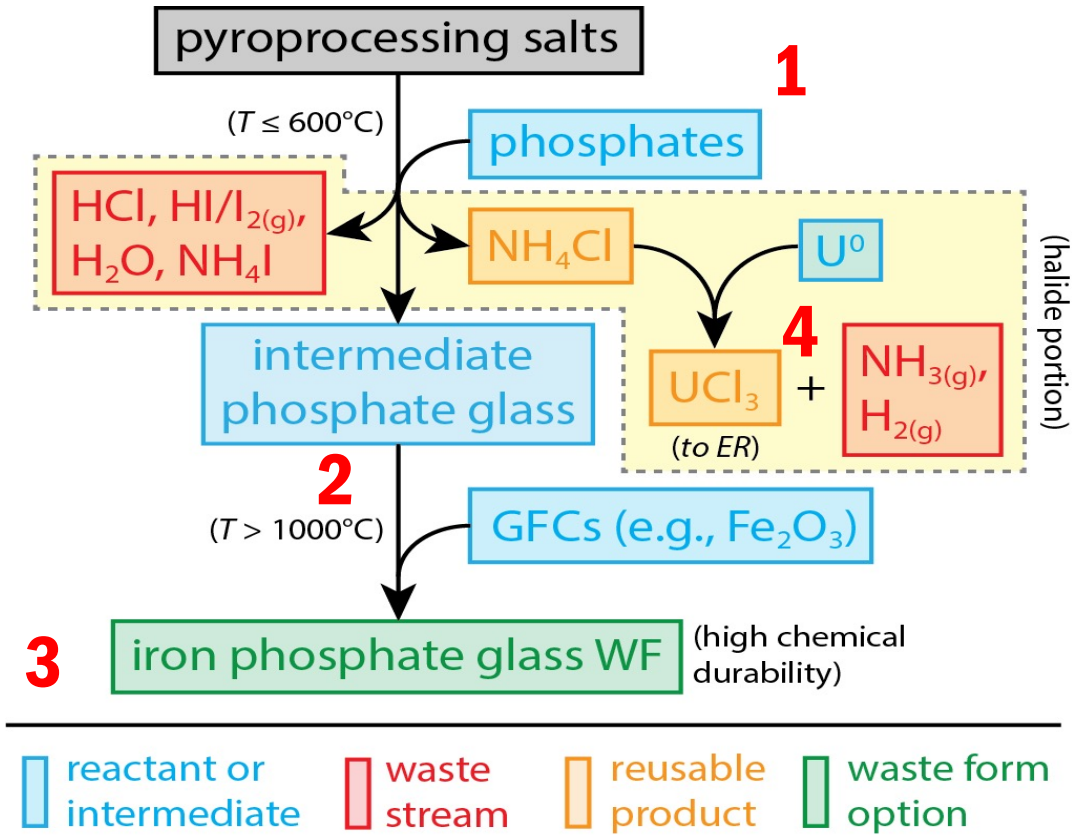
(C) Recycle NH_4Cl to make UCl_3

$$NH_4Cl + U \longrightarrow UCl_3 + NH_3 + H_2$$

We seek to further enhance the throughput of waste form productions. Innovative methods to better understand the chemical processes are especially encouraged.

FC-1.5 WASTE FORM DEVELOPMENT: IRON PHOSPHATE PROCESS - EVALUATION OF PROCESSING PRODUCT PROPERTIES

UP TO 3 YEARS AND $600,000



GFC = glass-forming chemicals

Proposals with innovative approaches are requested to:

1. Characterize and verify phosphate additives and precursor
2. Identify advanced crucible material that is compatible with the chemical process;
3. Characterize and evaluate the waste products properties;
4. Advanced process to enable efficient recovering of recycled chlorine

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FC-1.6 OFF-GAS CAPTURE: IDENTIFICATION OF PROMISING Kr STORAGE MATERIALS

UP TO 2 YEARS AND $400,000

Kr-85 is released from multiple sources within the nuclear fuel cycle. Current capture and separation methods include cryogenic distillation, engineered zeolite sorbents, and metal organic frameworks. Potential storage approaches include Kr-loaded molecular sieves, ion implantation, and storage as a compressed gas.

The objective of this call is to develop innovative Kr-85 capture and storage materials and technologies. Proposals are requested that:

- The novel materials and advanced technology may derive from existing capture and storage methods or innovative approaches that may integrate with the existing methods;
- Proposed new materials should be able to tolerate beta decay energy and should not degrade in the presence of Kr products;
- Demonstrate that the candidate materials have high capacity and retention, integrate with capture and separations methods, and that at least one of the criteria of corrosion or radiation tolerance is demonstrated.

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