NUCLEAR ENERGY RESEARCH INITIATIVE

Powder Metallurgy of Uranium Alloy Fuels for TRU-Burning Fast Reactors

PI: Sean M. McDeavitt, Texas Engineering Experiment Station

Project Number: 07-060

Program Area: AFC R&D

Collaborators: None

Project Description

This project will develop a powder metallurgical fabrication technology to produce U-Zr-transuranic (TRU) alloys at relatively low processing temperatures (500℃ to 600℃) using either hot extrusion or "alpha-phase" sintering. Researchers will quantify the fundamental aspects of both processing methods using surrogate metals to simulate the TRU elements. If successful, this process will produce novel solutions to some of the issues related to metallic fuels, such as fuel-cladding chemical interactions, fuel swelling, volatility losses during casting, and casting mold material losses.

Fast reactors will be evaluated to enable the transmutation of transuranic isotopes generated by nuclear energy systems. The motivation for this is that TRU isotopes have high radiotoxicity and relatively long half-lives, making them unattractive for disposal in a long-term geologic repository. Fast reactors provide an efficient means to utilize the energy content of the TRUs while destroying them. An enabling technology that requires research and development is the fabrication metallic fuel containing TRU isotopes using powder metallurgy methods.

Workscope

There are two primary tasks associated with this project:

1. Hot working fabrication using mechanical alloying and extrusion
    - Design, fabricate, and assemble extrusion equipment
    - Extrusion database on DU metal
    - Extrusion database on U-10Zr alloys
    - Extrusion database on U-20xx-10Zr alloys
    - Evaluation and testing of tube sheath metals

2. Low-temperature sintering of U alloys
    - Design, fabricate, and assemble equipment
    - Sintering database on DU metal
    - Sintering database on U-10Zr alloys
    - Liquid phase sintering on U-20xx-10Zr alloys
    - Sintering development in tube sheath containers