NUCLEAR ENERGY RESEARCH INITIATIVE

Microwave Processing of Simulated Advanced Nuclear Fuel Pellets

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Project Description

In this proposal, microwave processing is being proposed as an alternative method for manufacturing advanced nuclear fuel pellets. The primary goal of this work is to sinter simulated nitride fuel pellets using microwave energy. The sintered pellets, consisting of non-radioactive materials with properties similar to actual pellets, will be characterized with respect to density and grain morphology. The research team will employ two different heating methods: a combination of microwave and conventional heating (microwave hybrid heating) and direct microwave sintering.

Work performed to date suggests that the overall sintering schedule for advanced nuclear fuel pellets could be modified to achieve the desired density (80 percent ± 10 percent theoretical density) without losing highly volatile critical components such as americium and dysprosium oxides and nitrides. The following assessment metrics have been established:

- Demonstrate the ability to sinter simulated oxide and nitride fuel pellets to 85–95 percent theoretical density using microwave energy.
- Demonstrate that sintered pellets lose less than 10 weight-percent dysprosium during the sintering process.

The research team will propose a model to account for the degree of sintering observed in the samples, given the processing and characterization data collected, and will provide a path forward for developing a prototype-scale model of the most successful laboratory microwave sintering process.

Workscope

The primary goal will be accomplished through achievement of the following milestones:

- Preparation of “green” simulated fuel pellets
- Measurement of pellet dielectric property
- Direct Microwave Heating (DMH) to achieve sintering
- Microwave Hybrid Heating (MHH) to achieve sintering
- Pellet characterization before and after microwave processing
- Microwave process evaluation
- Development of a model for the microwave sintering processes