NUCLEAR ENERGY RESEARCH INITIATIVE

Ambient Laboratory Coater for Advanced Gas Reactor Fuel Development

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Project Number: 05-118

Collaborators: None

Related Program: AFCI

Project Description

The behavior of fluidized bed technology for applying coatings to nuclear fuel particles for the Advanced Gas Reactor will be explored. Researchers will evaluate the effects of particle characteristics (size, density, surface, sphericity), bed size, inlet nozzle diameter, distributor shape, and gas flow rates on the hydrodynamics of fuel coating. Experimental measurements will be provided to the ORNL fluidization reactor modeling team to validate numerical models for use in parametric design simulations. The modeling team can then utilize the simulation code to design improved beds that will be constructed and characterize in the laboratory.

This project will also develop online feedback control strategies, study ozone reaction to access mass transfer in limiting regimes with simple reaction kinetics, study step changes in gas inlet temperature to evaluate heat transfer, and evaluate the effect of particle size distribution and segregation on operation. A major challenge will be to account for the effects of hydrodynamics on the chemical vapor deposition rate and to characterize the controlling factors and final product quality of the turbulent gas-solid particle interface in the fluidized bed reactor.

Four and six-inch ambient laboratory mockup coaters are to be fabricated that are designed to accommodate various nozzles and distributors. The bed will be instrumented with appropriate sensors and the resulting measurements synchronized with digital images to develop correlations of bed characteristics as a function of pressure, gas and particle velocity, void fraction, spout height, and spout diameter. Ultimately, this project will establish a flexible laboratory coater, collect high-quality measurements for a range of operating regimes, and develop correlations from the experimental data. The measurements and correlations will be used to enhance simulations, improve operations techniques and provide for online feedback control.

Work Scope

- Design and fabricate fluidized beds with changeable nozzles, distributors, and other components.
- Develop LabVIEW software for operation, control, data collection/synchronization, and feedback control.
- Develop new measurement techniques and implement maturing technology, as the ability to use fiber optic probes for void fraction measurement and particle velocity.
- Integrate ozone generator/analyzer, determine catalytic properties of surrogate particles, and their reaction to ozone.