Coated Particle Fuel Development Laboratory

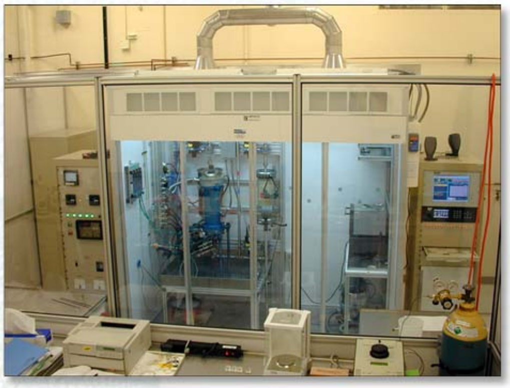
Description

The Coated Particle Fuel Development Laboratory is a modern, integrated facility certified for NQA-1 laboratory-scale fabrication and characterization of uranium-bearing coated particle fuel (CPF). Within this facility, tristructural isotropic (TRISO) coatings of carbon and silicon carbide are deposited on a variety of fuel kernels by chemical vapor deposition (CVD). Fuel elements are fabricated by packing the particles into graphite matrix forms, such as cylindrical compacts or spherical pebbles. State-of-the-art characterization is performed to determine fuel properties and defect populations prior to irradiation testing of the fuel performance.

Current work includes fabrication and characterization of coated particle fuels to support the Next Generation Nuclear Plant, the X-energy Xe-100 Reactor, Advanced Small Modular Reactors, Nuclear Thermal Propulsion, and Advanced Light Water Reactor concepts. In addition, the lab is used to prepare capsules containing uranium bearing test articles for irradiation in the High Flux Isotope Reactor. Previously fabricated fuel compacts are also undergoing post-irradiation examination and testing to further evaluate fuel performance and irradiation induced microstructural evolution.

Applications

- High Temperature Gas-Cooled Reactor fuel
- Liquid Fluoride Salt-Cooled Reactor fuel
- Enhanced accident tolerant fuel for Light Water Reactors
- Deep Burn of transuranic fuel for fuel cycle applications



Computer-controlled fluidized-bed CVD coating system

Fabrication	
TRISO Coating	50-mm-diameter fluidized-bed CVD coating furnace with computer-control of deposition temperature and gas composition
Particle Upgrading	Roller micrometer for size separation and tabling for shape separation
Particle Compacting	Graphite-resin blending, fluidized-bed and drum overcoatings, sieves, automated servo-electric linear and isostatic presses, process furnaces

Characterization

- Materialographic sample preparation (mounting, grinding, polishing, and etching)
- Computer-automated optical microscopy with dimensional analysis
- Electron microscopy for study of coating microstructure
- Liquid density-gradient columns and mercury porosimetry to accurately measure densities
- Determination of pyrocarbon structural anisotropy using the ORNL-designed Two-Modulator Generalized Ellipsometry Microscope (2-MGEM)
- X-ray tomography with 1–2 μm resolution for non-destructive imaging of internal particle structure
- Electrolytic compact deconsolidation, acid leaching, and carbon removal by oxidation to detect exposed uranium, defective coatings, and quantify impurity content

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