Laboratory for Development of Advanced Nuclear Fuels and Materials

Department of Nuclear and Radiological Engineering
Department of Materials Science and Engineering
University of Florida
Gainesville FL 32611

The **Laboratory for Development of Advanced Nuclear Fuels and Materials** at the University of Florida brings together the multidisciplinary expertise of eleven members of the Departments of Nuclear and Radiological Engineering (NRE) and Materials Science and Engineering (MSE) to address some of the most important technological issues for the development of improved nuclear fuel and structural materials and to develop the capability to model and simulate the performance of materials under temperature, pressure and irradiation. The areas of major interest are the improved processing of nuclear fuel materials, the development of innovative combinations of materials to improve the overall performance of the subject materials and the development of materials for specialized purposes. The laboratory is already exploring the benefits of exploiting the superior thermal-transfer properties of nanofluids in nuclear reactors, the development of high conducting fuel materials and the improvement of processing of uranium and thorium oxide, nitrides, and carbides fuels.

Current Projects

Professor Juan C. Nino is leading a UNERI project on **Optimization of Oxide Compounds for Advanced Inert Matrix Materials**. As part of Advanced Nuclear Fuel Development element of DOE's Advanced Fuel Cycle Initiative (AFCI) program, this project models, designs, synthesizes and characterizes oxide ceramics with optimized thermophysical properties for inert matrix fuel (IMF) use. Potential benefits of the optimized IMF materials developed include: higher thermal conductivity, leading to reduction of the centerline temperature; minimized damage against fission fragments will allow higher burnups; and better corrosion resistance will make the IMF compatible with coolant under cladding breach accidents.

Professor Simon R. Phillpot is leading a UNERI project on the **Development of Models to Optimize Selection of Nuclear Fuel Materials through Atomic-Level Simulation.** This project is developing an advanced fuel performance platform, based on the "FRAPCON" code, with detailed materials input from databases of nuclear materials behavior determined from thermodynamic, atomic-level and electronic-level calculations and simulations. Since fuel performance codes cannot be used for materials for which no experimental correlations exist, a key aim of this proposal is to develop new materials databases developed from the thermodynamic, atomistic and first principles calculations.

Dr. Ronald H. Baney is leading the UF part of a UNERI with Boise State University on **Synthesis and Optimization of the Sintering Kinetics of Actinide Nitrides** for the Advanced Fuel Cycle Initiative (AFCI), a fuel generation program for the Generation IV Nuclear Energy Systems Initiative. This program is synthesizing actinide and surrogate powders of varying morphologies and grain sizes, performing detailed analyses of their sintering kinetics, with the objective of identifying fast, economical, lower-temperature fuel processing strategies. Dr. Baney is also leading a project funded by AREVA to explore the potential of **nanofluids for enhanced heat-transfer** performance in reactors. Current work is focused in assessing the stability of nanoparticles in the sub-critical water operation conditions typical of a PWR.

Professor James S. Tulenko is leading three fuel research projects. He has a DOE NERI with AREVA, Sandia National Laboratory and Oak Ridge National Laboratory to i**nvestigate the case for increasing fuel enrichment from 5% to 10 and 20%**. A complete review of the processing, storage and manufacturing of nuclear fuel is a key part of this contract. Critical experiments validating analytical methods are also part of this research project. He has a DOE NEER project with the University of South Carolina **to investigate the effectiveness of SiC** as a fuel coating to greatly improve the thermal conductivity of UO_2 fuel. He has a DOE Space Fuels Working Group contract to gather and document into a database **the physical properties of Uranium Zirconium Hydride under irradiation conditions**.

Laboratory for Development of Advanced Nuclear Fuels and Materials

Faculty

James Tulenko
Director
Professor
President, American Nuclear Society (2004 -2005)
tulenko@ufl.edu
Nuclear fuel cycle, radioactive wastes, reactor analysis, engineering application of radioisotopes, robotics, intelligent databases, system analysis.

Ronald Baney
Associate Director
Research Scientist
rbane@mse.ufl.edu

Remediation of HTO and RDDs, clad corrosion protection, burnable poison rod assemblies, leach-stable fuel forms, enhanced thermal conducting UO_2 fuels, nanofluids.

Kevin Powers
Associate Director for the R&D Facility
kpowers@erc.ufl.edu

Sol Gel derived powders and glasses, surface chemistry of high silica glasses, synthesis of nanoscale particles with unique optical characteristics.

.

Samim Anghaie
Professor
Director, Innovative Nuclear Space Power and Propulsion Institute (INSPI)
anghaie@ufl.edu
Reactor design, thermal hydraulics, nuclear materials, Monte Carlo simulation.

Charles Beatty
Professor
Director, Polymer Processing and Properties Center
cbeat@mse.ufl.edu
Super-critical CO_2 processing of net-shape nano and micro ceramic and metal shapes and rods to control the thermal conductivity of fuel systems.

Gerhard Fuchs
Assistant Professor
gfuch@mse.ufl.edu
Physical and mechanical metallurgy of high-temperature materials. Microstructure/ property relations in high temperature materials.

Juan C. Nino
Assistant Professor
jnino@mse.ufl.edu
Investigation of fundamental structure-property-processing-performance relationships of ceramic materials for nuclear applications.

Simon Phillpot
Professor
sphil@mse.ufl.edu
Atomic-level simulation of nuclear materials. Simulation of thermal transport in nuclear fuels and nanofluids. Ferroelectricity, ceramics, mechanical properties.

Hans Seifert
Associate Professor
hseif@mse.ufl.edu
Computational materials thermodynamics, materials chemistry and thermal analysis, microstructure-property relationships in nuclear and high temperature

Susan Sinnott
Associate Professor
ssinn@mse.ufl.edu
Development of new potentials for atomic-scale molecular dynamics simulations, first principles, density functional theory calculations of nuclear fuel materials.

E. Dow Whitney
Professor Emeritus
ewhit@mse.ufl.edu
Phase transformations at high temperatures and pressures, physical chemistry of hard materials. Nuclear fuels materials.

Contact Information:

Department of Nuclear and Radiological Engineering
202 Nuclear Science Building
(Tulenko, Anghaie)

Department of Materials Science and Engineering
100 Rhines Hall
(all others)

University of Florida
Gainesville FL 32611

materials and their interfaces.			