U.S. DEPARTMENT OF ENERGY | Nuclear Energy

Nuclear Energy Enabling Technologies
Reactor Materials

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Overview

Vision

- The NEET-RM will enable the development of innovative and revolutionary materials and provide broad-based, modern materials science that will benefit DOE-NE's mission.

Goal

- Bring about revolutionary improvements in safety, performance, reliability, economics, and proliferation risk reduction and promote creative solutions to the broad array of nuclear energy challenges related to reactor and fuel cycle development through innovative materials development, promoting the use of modern materials science and establishing new, shared research partnerships.

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Research Awards

- NEET Reactor Materials began in FY2012
- Annual research competition among national laboratories, universities, and industry
- Duration: 3 years
- Value: up to $1M per proposal

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Ongoing Research

- **FY 2012**
  - Successful completion of awards will provide advanced materials that will show improvement in mechanical performance by a factor of 5-10 over traditional materials, increase in maximum operating temperature of greater than 200° C over an 80 year lifetime, and/or increased radiation tolerance to beyond 300 dpa
  - **Funded 9 proposals**

- **FY 2013**
  - Successful completion of awards will provide advanced methods for sample preparation and new tools and techniques for examining and understanding material microstructures in a variety of conditions ranging from as-received to treated or irradiated.
  - **Funded 7 proposals**

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Ongoing Research

- **FY 2014**
  - Successful completion of awards will provide advanced joining techniques for materials for nuclear fission reactor applications.
  - **Funded 3 proposals**

- **FY 2015**
  - Successful completion of awards will provide advanced materials that will show improvement in mechanical performance by a factor of 5-10 over traditional materials, increase in maximum operating temperature of greater than 200° C over an 80 year lifetime, and/or increased radiation tolerance to beyond 300 dpa.
  - **Funded 2 proposals**

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Descriptions of NEET-RM Funded Research

Publications section of Energy.gov/ne

- NEET-RM Annual Summaries
- NE Materials Newsletter

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Innovative idea development is intended to follow a SBIR approach

2012 2013 2014 2015 2016

Great idea 2012-1
Great idea 2012-2
Great idea 2012-3

Great idea 2012-1
Great idea 2012-3

Great idea 2013-1
Great idea 2013-2
Great idea 2013-3

Great idea 2013-2 transferred to SFR!

Great idea 2014-1
Great idea 2014-2

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Research Competition

- **Advanced reactor materials characterization techniques and tools.**
  - Successful completion of awards will provide advanced methods for sample preparation and new tools and techniques for examining and understanding material microstructures in a variety of conditions ranging from as-received to treated or irradiated.
- **Potential Benefits**
  - Understanding of the effects of irradiation, temperature, pressure and corrosive environments on material microstructures and mechanical behavior.
  - More efficient use of existing irradiated materials and enable fabrication of smaller specimens from previously examined materials.
- **High-risk/reward and transformational concepts are appropriate for NEET.**

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Infrastructure Competition

- **The key components to modern materials science include computational techniques, experience, and modern tools and research techniques.**

- **The objective is to provide resources that will expand capabilities for all programs and efforts.**
  - Strategic investments in new tools for modern materials science will be evaluated to benefit the entire NE portfolio.

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Contacts

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Joint Nuclear Scientific User Facility and Nuclear Energy Enabling Technologies Research Projects

NEET Materials Edition

August 12, 2015

Research Topics

- **NEET-NSUF 1.3a Separate Effects Irradiation Testing of Fission Product Behavior** (Federal POC: Sue Lesica & Technical POC: Rory Kennedy)

  - The objective of this workscope is to study behavior of fission products (gaseous, insoluble solid, soluble solid) and actinide species of relevance to fuel performance. Separate effects testing on transport mechanisms, thermomechanical or thermophysical property influence, and fuel cladding interaction that are strongly related or coupled to modeling efforts are encouraged. All fuel forms specifically relevant to the mission of DOE-NE can be proposed.

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Research Topics

- **NEET-NSUF 1.3b Irradiation Assisted Stress Corrosion Cracking (IASCC)** (Federal POC: Sue Lesica & Technical POC: Rory Kennedy)
  - Mechanistic studies, data for high fluence conditions, innovative experiment designs, and alternative irradiations. Correlations between irradiated microstructures with IASCC susceptibility, role of precipitates on hardening and cracking, influence of stress/loading history, void/ bubbles, fluence, and neutron spectrum on IASCC.

- **NEET-NSUF 1.3c Irradiation Testing of Materials Produced by Innovative Manufacturing Techniques** (Federal POC: Alison Hahn & Technical POC: Rory Kennedy)
  - Products from advanced and innovative manufacturing techniques that offer lower cost and higher performance can be proposed for irradiation testing to demonstrate performance. Coupling to modeling mechanisms predicting performance enhancements is encouraged.

Research Topics

- **NEET-NSUF 1.3d Experiments with Synchrotron Radiation at the Advanced Photon Source** (Federal POC: Sue Lesica & Technical POC: Rory Kennedy)

  - Proposed research includes the use of facilities at the Materials Research Collaborative Access Team (MRCAT) beamline located in the Advanced Photon Source Facility at Argonne National Laboratory. Proposals requesting the use of these facilities should focus on post-irradiation examination or concurrent use with ongoing irradiations at ATR NSUF. Experiments conducted at MRCAT will be facilitated by the Illinois Institute of Technology. Experiments that can currently be carried out at the MRCAT include x-ray diffraction (XRD), x-ray absorption (XAS), x-ray fluorescence (XRF), and 5 μm spot size fluorescence microscopy.