





International facility access: NSUF

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POWERING THE NEW ENGINEER TO TRANSFORM THE FUTURE

- ✓ Neutron Irradiation
- ✓ Post Irradiation Examination
- ✓ Gamma Irradiation

- ✓ Ion Beam Irradiation
- Characterization Beamline (Neutron, Positron, or X-ray)

Nuclear Science User Facilities

Partner Institution	Facilities							
Argonne National Laboratory	Intermediate Voltage Electron Microscopy (IVEM) Tandem Facility		√		√			
Brookhaven National Laboratory	National Synchrotron Light Source II					√		
Center for Advanced Energy Studies	Microscopy and Characterization Suite (MaCS)		√					
Lawrence Livermore National Laboratory	Center for Accelerator Mass Spectrometry				√			
Los Alamos National Laboratory	Lost Alamos Neutron Scattering Center - Lujan Center Beamlines, Plutonium Surface Science Laboratory					√		
Massachusetts Institute of Technology	Massachusetts Institute of Technology Nuclear Reactor, Massachusetts Institute of Technology Reactor	√	√					
North Carolina State University	PULSTAR Reactor	√				√		
Oak Ridge National Laboratory	High-Flux Isotope Reactor, Irradiated Fuels Examination Laboratory, Irradiated Materials Examination and Testing Facility, Low Activation Materials Design and Analysis Laboratory	√	√	√				
The Ohio State University	The Ohio State University Research Reactor	√		√				
Pacific Northwest National Laboratory	Materials Science and Technology Laboratory, Radiochemical Processing Laboratory		✓					

Partner Institution	Facilities					
The Pennsylvania State University	Radiation Science and Engineering Center	√		√		√
Purdue University	Interaction of Materials with Particles and Components		√		√	
Sandia National Laboratories	Annular Core Research Reactor, SNL Ion Beam Laboratory, Sandia Pulse Reactor Facility Critical Experiment, Gamma Irradiation Facility	√	√	√		
Texas A&M University	Accelerator Laboratory				√	
University of California, Berkely	Nuclear Materials Laboratory		√			
University of Florida	Nuclear Fuels and Materials Characterization		√			
University of Michigan	Irradiated Materials Testing Laboratory, Michigan Ion Beam Laboratory, Michigan Center for Materials Characterization		√		√	
The University of Texas at Austin	Nuclear Engineering Teaching Laboratory					√
University of Wisconsin	Characterization Laboratory for Irradiated Materials, University of Wisconsin Ion Beam		√		√	
Westinghouse	Churchill Laboratory Services		√			

Accessing equipment through NSUF

- Rapid Turnaround Experiments (RTEs):
 - Quick analysis of irradiated samples (9 months), ~\$50K
 - 3 calls per year, 2-pg. narrative
- ➤ Super RTE
 - Broader scope (12 months), ~\$100K
 - 1 call per year, 3-pg. narrative
- ✓ PIs have to be affiliated with a US institution or a foreign entity based in the US.
- ✓ PIs from foreign institutions can lead if they have a collaborator from the US.
- Consolidated Innovative Nuclear Research (CINR)
 - 3–7-year projects, ~\$5M
 - 1 call per year, 5-pg. pre-proposal, 15-page full proposal narrative

UF NSUF capabilities





FEI HELIOS NANOLAB 600 Dual Beam FIB/SEM



FEI TECNAI F20 TEM

- Accepts specimens with dose rates up to 300 mR/hr at contact.
- Approved for α , β , and γ samples.



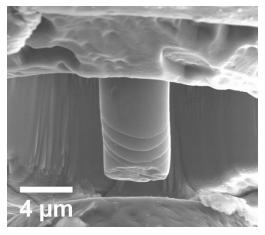


- Bruker PI88 PicoIndenter
 - Low-load and high-load transducers
 - Berkovich/cube corner, flat punch tips for RT and HT
 - HT tests up to 800C
 - Irradiated samples can be characterized



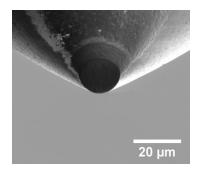


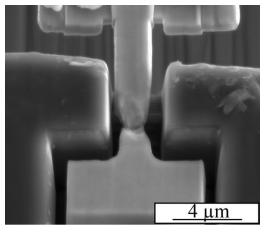




Micro compression

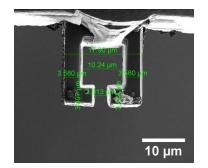
- Easy to fabricate
- Pillar tapering at bottom
- Stress transferred to base
- Fracture highly unlikely
- No special tip required

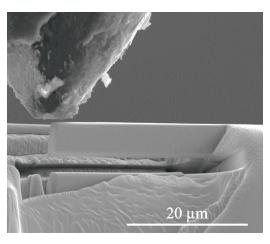




Micro tensile

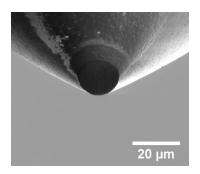
- Hard to fabricate
- Ease of data analysis
- Can be tested to fracture
- Special tips is needed





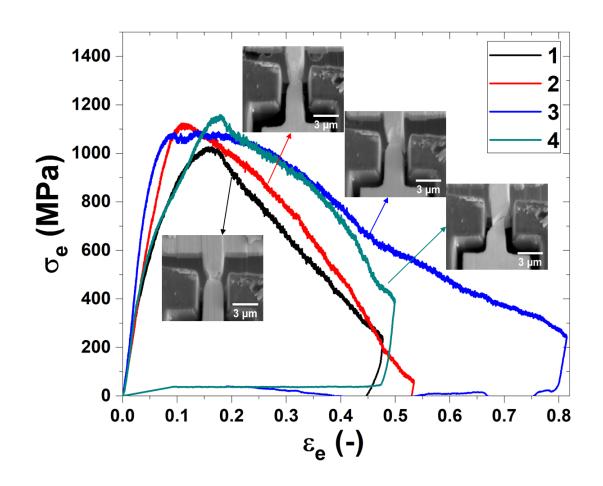
Micro cantilever

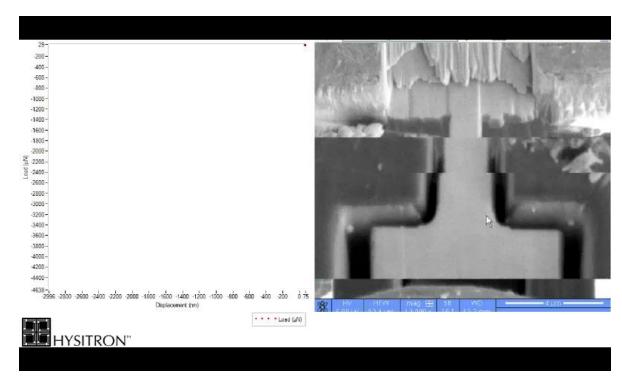
- Fabrication relatively easy
- Complex data analysis
- May/may not lead to fracture
- No special tip required





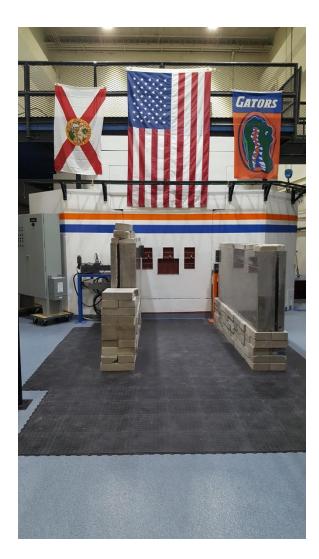
UF micro mechanical testing capabilities





UF capabilities (cont.)





GENERAL FEATURES

Reactor type
Licensed rated power level
Maximum thermal flux level in center vertical port
at 100 kW
Excess reactivity (at 72 °F)
Effective prompt neutron lifetime
Temperature coefficient
Start-up source
•

Heterogeneous, thermal 100 kW thermal

1.5 x 10^{12} n/cm²sec ~600 pcm 2.0 x 10^{-4} sec -1.8 pcm/°C SbBe ≤ 25 curies or PuBe ≈ 1.0 curies Graphite (1.6 g/cm³) H₂0 and graphite



Moderator





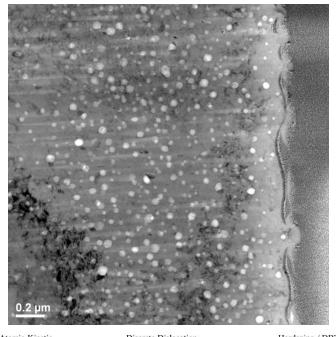


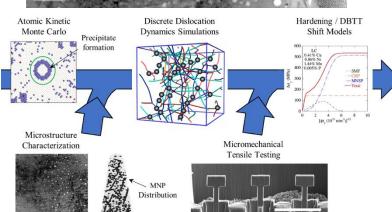




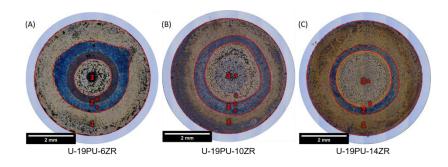
Example of the research conducted through NSUF

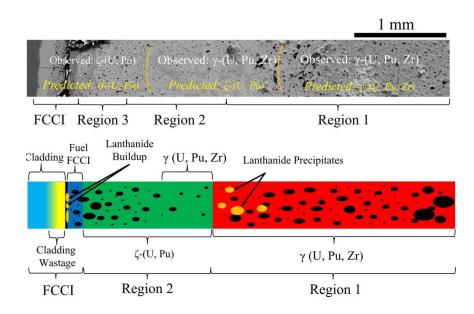
Structural Materials



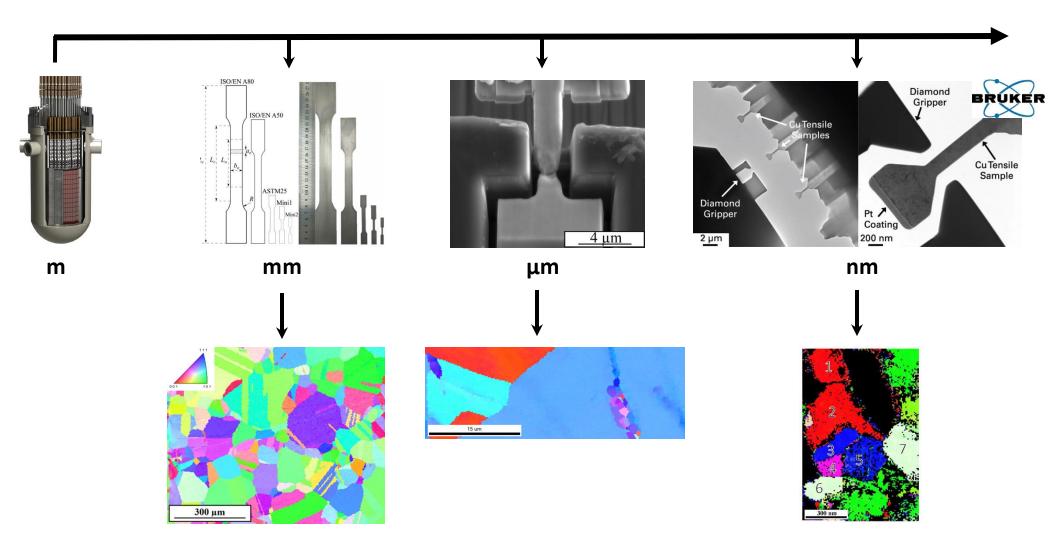


Nuclear Fuels



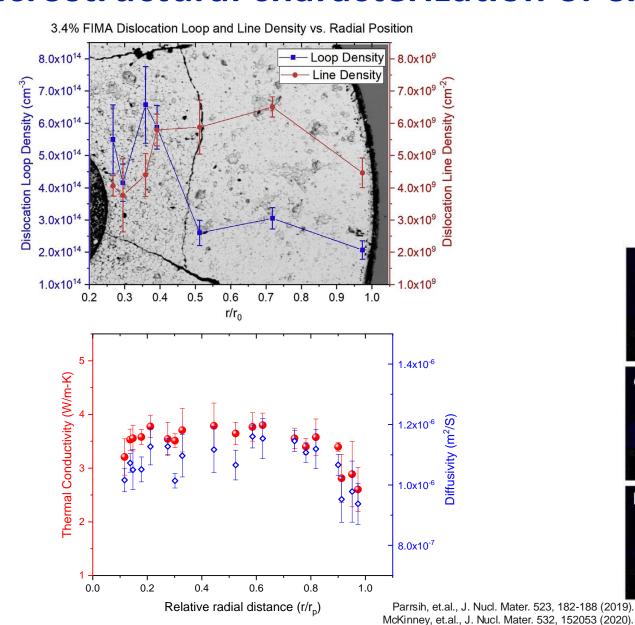


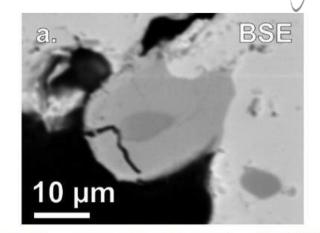
Bridging length scales for mechanical tests

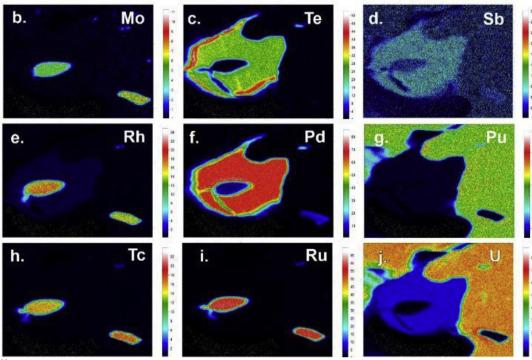


Microstructural characterization of oxide fuels



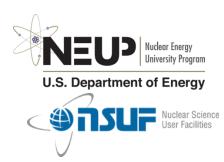


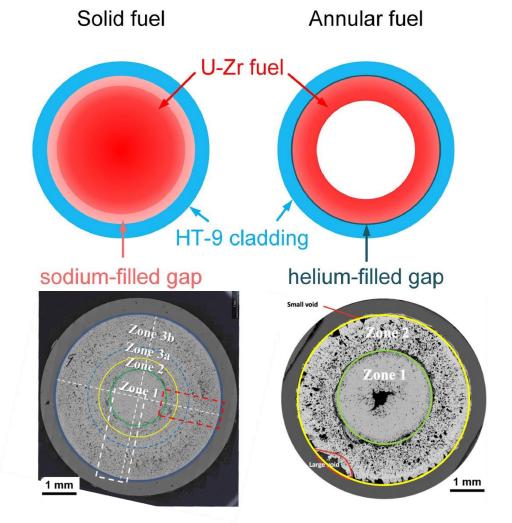


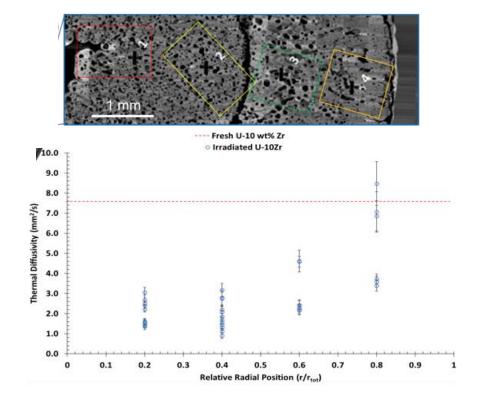


Parrsih, et.al., J. Nucl. Mater. 524, 67-79 (2019).

Understanding Constituent Redistribution, Thermal Transport, and Fission Gas Behavior in U-Zr Annular Fuel Without a Sodium Bond







Xu, et.al., Scientific Reports 13, 10616 (2023). Sevart, et.al., under review, J. Nucl. Mater (2024).

