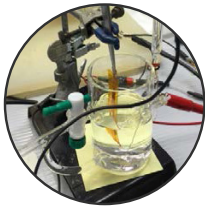


# Nuclear Energy

## NUCLEAR REACTOR MATERIALS

The National Synchrotron Light Source II (NSLS-II) at Brookhaven National Laboratory provides state-of-the-art material characterization tools that can be used to gain an understanding of both the structural and functional characteristics of nuclear reactor components. This understanding will improve the reliability and performance of materials- including additively manufactured materials developed for nuclear applications.

### THE CHALLENGE:

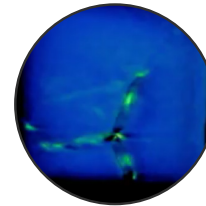


#### STRESS CORROSION CRACKING

Understanding the role of grain boundaries in steel is critical to ensuring material integrity and preventing stress corrosion cracking in nuclear reactor components.



### BROOKHAVEN LAB SOLUTION:



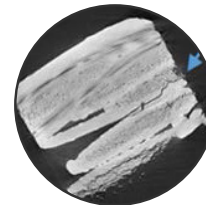
#### X-RAY SPECTROSCOPY

The x-ray spectroscopy capabilities at NSLS-II can be used to map the separation of alloy elements to grain boundaries. Understanding the role of grain boundaries to prevent material failures.



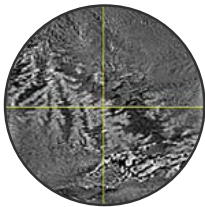
#### COMPOSITE TOUGHNESS

Silicon carbide (SiC)-SiC composite materials are of prime interest for fusion and advanced fission energy applications — however cracking and failure remains a problem.



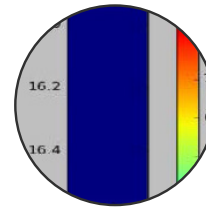
#### FAILURE IMAGING

The *in situ* x-ray tomography capabilities at NSLS-II can be used to image the structural failures of complex SiC-SiC composites under compressive loads — resulting data can be used to improve the fracture toughness of the materials.



#### JOINING COMPOSITES

SiC-SiC composites have vulnerabilities in how they are bonded which can lead to structural weaknesses in nuclear reactor components.



#### STRUCTURE-FUNCTION ANALYSIS

Multiple x-ray techniques at NSLS-II (tomography, fluorescence, and absorption) can be used to determine the location and failure morphology of interfaces and joints.

The x-ray analysis capabilities at Brookhaven Lab have been utilized by industry to test materials critical to nuclear reactors:

- General Atomics performed in situ mechanical testing of silicon carbide ceramic matrix composites
- General Electric characterized corrosion films from advanced cladding for accident tolerant nuclear fuels
  - The Navy studied the aging of nickel chrome alloys at high temperatures
  - Westinghouse studied radiation damage in silicon carbide components



## WORK WITH US

The Nuclear Science and Technology Department at Brookhaven National Laboratory is a leader in nuclear technology research and development, materials characterization, reactor reliability and risk assessment, and advanced nuclear modeling and simulation.

[www.bnl.gov/partner](http://www.bnl.gov/partner)



## DIVERSE EXPERTISE

Brookhaven Lab provides scientific expertise to support nuclear industry initiatives including

Safety Guidance on Radioactive Material Sample Handling

Experiment Planning/ Design

Materials Characterization

*In situ and Operando* Experiments

Data Analysis

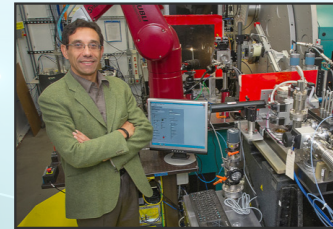
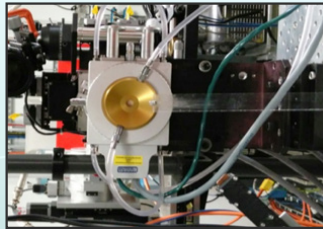
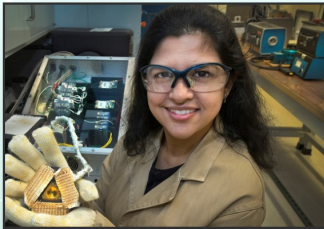


## RESEARCH FACILITIES

Research facilities are open to researchers — a range of access modes are available:

National Synchrotron Light Source

[www.bnl.gov/guv/facilities.php](http://www.bnl.gov/guv/facilities.php)



**BROOKHAVEN**  
NATIONAL LABORATORY



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