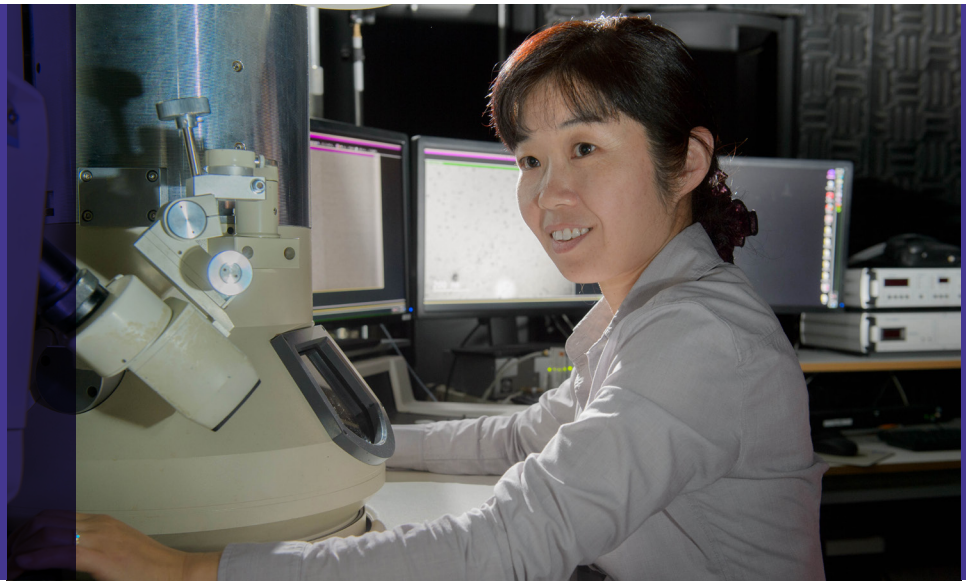
Argonne NATIONAL LABORATORY

NUCLEAR ENGINEERING

Advancing the state-of-the-art in next-generation nuclear systems



- Argonne National Laboratory was founded to develop technologies for civilian uses of nuclear energy
- The laboratory's expertise spans the entire nuclear spectrum

The IVEM-Tandem User Facility at Argonne National Laboratory features transmission electron microscopy with in situ ion irradiation for research on advanced materials for nuclear systems: structural alloys, fuels, and complex oxides. In this photo, nuclear engineer Meimei Li performs research at IVEM-Tandem.

Nearly every commercial reactor in existence today owes its development to seminal research conducted at Argonne National Laboratory.

Building on this heritage, the mission of Argonne's Nuclear Engineering (NE) division is to advance the safe and sustainable use of nuclear energy and to apply its nuclear technology-related expertise to current and emerging programs of national and international significance.

The NE division participates in key U.S. Department of Energy (DOE) nuclear energy initiatives, including leading the nation's program for development and demonstration of fast reactor and fuel recycle technologies that promise to improve the affordability of nuclear power, enhancing the assurance of safety and security and minimizing the discharge of radioactive waste.

The division has six primary focus areas, many of which leverage other sectors of Argonne's expertise.

ADVANCED SYSTEMS

Argonne hosts a team of leading scientists and engineers who are at the forefront of scientific research on advanced nuclear energy systems. Their expertise in reactor physics and engineering, separations science, materials science and actinide chemistry optimally position them to integrate innovations and discoveries in the design and operation of future nuclear systems. Argonne nuclear energy researchers also have access to the Advanced Photon Source, Center for Nanoscale Materials Electron Microscopy Center and the Argonne Leadership Computing Facility—major scientific research facilities that can significantly enhance discovery and provide an improved understanding of relevant phenomena.

MODELING AND SIMULATION

Argonne plays a leading role in the U.S. Department of Energy's Office of Nuclear Energy Advanced Modeling & Simulation program. The laboratory's computational scientists and nuclear engineers have created and refined a sophisticated set of internationally recognized integrated models and advanced simulation tools. These capabilities help increase understanding of the diverse physical phenomena underlying nuclear reactor and fuel cycle system behavior, and improve researchers' abilities to efficiently predict and validate the performance and safety of new nuclear energy systems.

SEPARATION TECHNOLOGIES

Argonne chemists and engineers have developed processes to reduce nuclear waste volumes and recover valuable elements from spent nuclear fuel. These techniques allow portions of the spent fuel to be reused. Separations technologies based on pyrochemical and aqueous approaches are being developed for existing spent nuclear fuel and specialized transmutation fuels. The major objectives are to reach sufficient throughputs at acceptable costs and low loss rates to the waste streams.

MATERIALS DEVELOPMENT

Future advanced nuclear reactor systems are likely to operate at conditions that expose nuclear fuels and materials to high-temperature and high-radiation conditions and thus, require new and more capable radiation tolerant materials for nuclear environments. Argonne has world-class nuclear fuels and materials expertise that supports life extension and improved operation of current and evolutionary plants. Argonne researchers apply their expertise and harness unique facilities such as the Intermediate Voltage Electron Microscopy-Tandem Facility and the proposed eXtreme MATerials beamline at the Advanced Photon Source to potentially achieve transformative advances in the understanding of materials.

NE researchers use thermal imaging to capture surface temperatures and improve insulation across the 26-m tall Natural Convection Shutdown Heat Removal Test Facility (NSTF).

NUCLEAR WASTE MANAGEMENT

Argonne's extensive capabilities in risk assessment, simulation, materials science and engineering and source term science can be applied to a broad range of needs for the geologic repository system, from transportation and storage of radioactive waste to its permanent disposal.

NONPROLIFERATION

Argonne has a distinguished history of advancing the nation's nonproliferation goals, including leading the effort to convert research and test reactors worldwide from high-enriched uranium fuel to low-enriched uranium. Argonne also leads the development of secure technologies for the recycling of spent reactor fuels and the incorporation of effective safeguards in the design of future nuclear energy systems.

All of this research is conducted in concert with science-based investigations to achieve potentially transformative advances in the understanding of fundamental chemistry and materials science related to nuclear energy phenomena and to develop high-performance materials, processes and design concepts based on Argonne's fundamental research.

CONTACT

Jordi Roglans-Ribas
Phone: 630.252.3283
E-mail: roglans@anl.gov
www.ne.anl.gov