PHYSICAL SCIENCES DIVISION

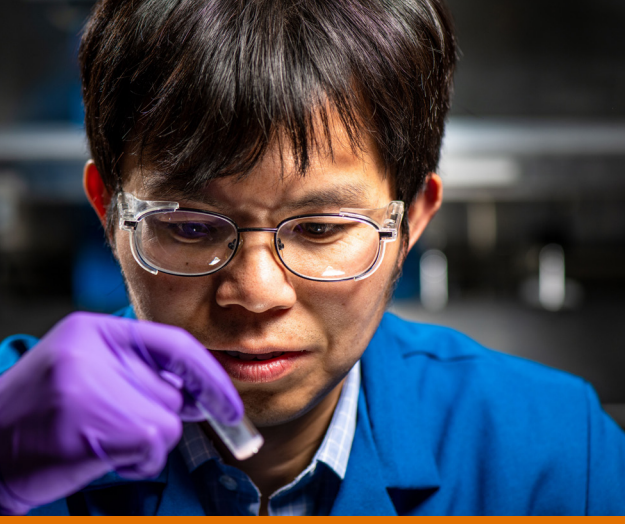
Pacific Northwest NATIONAL LABORATORY

Representing a broad research portfolio encompassing basic and applied chemistry, analytical chemistry, catalysis, materials sciences, geochemistry, and chemical physics

CAPABILITIES

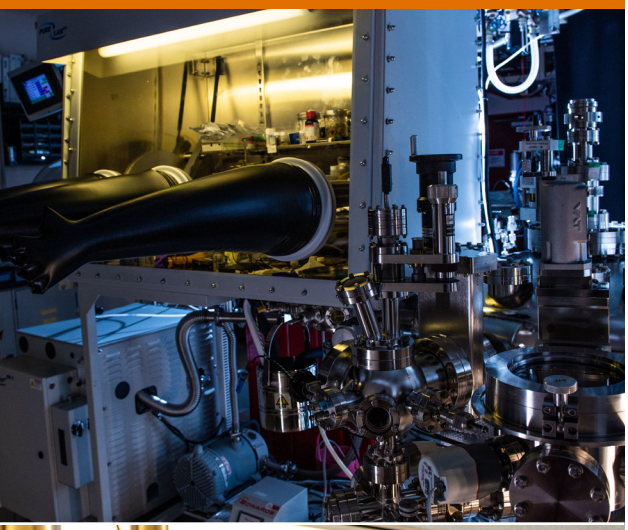
- Chemical and molecular science
- Condensed phase and interfacial chemical physics
- Theoretical and computational chemistry and data science
- Spectroscopic techniques for remote sensing and trace detection
- Physical metallurgy
- Earth and environmental geochemistry
- Materials science and condensed matter physics
- Bioinspired science

COLLABORATION • CREATIVITY • COURAGE • INTEGRITY • IMPACT



MISSION OBJECTIVE

We discover and apply new knowledge from chemistry, physics, and materials sciences to address basic science questions in energy conversion and storage, catalysis, environmental remediation, and quantum information science.



WHO WE ARE

The Physical Sciences Division at Pacific Northwest National Laboratory (PNNL) stewards a broad research portfolio encompassing basic and applied chemistry, catalysis, materials sciences, bioinspired science, geochemistry, and chemical physics. Our research strives to develop new atomic- and molecular-level understanding of complex, multiphase systems and phenomena.

Our scientists work in close partnership with the U.S. Department of Energy's (DOE) Basic Energy Sciences programs, as well as applied programs from the Office of Fossil Energy and Carbon Management, Office of Energy Efficiency and Renewable Energy, and National Nuclear Security Administration, advancing DOE mission priorities.

WE CREATE SCIENCE IMPACT & BUILD ENDURING CAREERS

Exceptional People

Attract, invest in, and enable exceptional people to excel and foster collaborative high-performing research teams.

Scientific Solutions

Deepen our understanding of molecular-level processes to address the world's most complex problems, ranging from energy production and storage to quantum information science.

Trusted Experts

Apply expertise in fundamental chemistry, catalysis, materials sciences, geochemistry, and chemical physics delivering scientific insight across disciplines.

FACILITIES, EQUIPMENT, AND METHODS

Energy Sciences Center	Environmental Molecular Sciences Laboratory	Magnetic resonance, including *in situ*
Transmission electron microscopy, including *in situ*	Scanning probe microscopies	X-ray photoelectron spectroscopy imaging system
X-ray tomography, and *in situ* X-ray diffraction		Molecular beam epitaxy deposition system
Calorimetry	Ion soft-landing mass spectrometry	Benchtop X-ray absorption spectrometers
Ultra-sensitive infrared spectroscopy	Atom probe tomography	Molecular beam surface-scattering instrumentation

TECHNICAL GROUPS

CATALYSIS SCIENCE

- Chemistry and chemical engineering
- Homogeneous, heterogeneous, and biocatalyst synthesis
- Characterization and surface science
- Theory, modeling, and simulation
- *In situ* reaction monitoring

CHEMICAL PHYSICS & ANALYSIS

- Chemical physics of complex processes
- Spectroscopy for applications in trace detection and remote sensing
- Separations
- Theory, modeling, and simulation

GEOCHEMISTRY

- Reactions at mineral-fluid interfaces
- Molecular structure and reactivity
- Multi-modal characterization
- Theory, modeling, and simulation

MATERIALS SCIENCES

- Nucleation and growth
- Charge and mass transfer
- Hierarchical and bioinspired materials
- Atomically precise materials
- Theory and simulation
- *In situ* and *ex situ* microscopy

Catalysis is a particular strength of PNNL. The Catalysis group covers the full suite of catalysis, from heterogeneous catalysis and homogeneous catalysis, to biocatalysis and surface science. Our researchers explore and develop the chemistry and technology of catalyzed processes that are key to securing energy independence, including storing energy in chemical bonds, reducing emissions, and increasing the efficiency of chemical conversions. Our catalysis programs have concentrations in catalysis synthesis, characterization, mechanistic understanding, and theory and simulation.

Our **Chemical Physics and Analysis** group seeks to understand the underlying chemical physics of complex processes relevant to energy production and use, environmental remediation, waste management, and national security. Our approach is to develop advanced experimental and theoretical tools to make highly quantitative experimental measurements of molecular-level processes that lend themselves to rigorous and accurate theoretical modeling and simulation. The goal is to provide a detailed understanding that leads to a mechanistic description of complex processes using a combined experimental and theoretical approach.

Our **Geochemistry** group seeks to understand reactions at complex mineral and fluid interfaces in geochemical and environmental systems at the Earth's crust. Our approaches span molecular to mesoscale regimes, often by integrating experiments with theory and computational modeling. Impacts from new knowledge about key reaction mechanisms and rates include improved models for predicting water quality and sustainability, safe and efficient energy and mineral resource extraction, nutrient availability, contaminant fate and transport, and storage of carbon and energy wastes in the subsurface.

Our **Materials Sciences** group aims to develop predictive understanding and establish control of synthesis pathways and degradation phenomena for materials relevant to energy sustainability, including energy capture, conversion, and storage, as well as lightweight materials, bioinspired materials, and materials for quantum information sciences. Our approach combines a broad range of synthesis techniques, *in situ* and *ex situ* microscopic and spectroscopic characterization, tomography, computational modeling, and data analytics. The research provides insight into complex relationships between materials building blocks, synthesis conditions, and the resulting structure, properties, and functions, underpinning the development of novel energy technologies.

ABOUT PNNL

Pacific Northwest National Laboratory advances the frontiers of knowledge, taking on some of the world's greatest science and technology challenges. Distinctive strengths in chemistry, Earth sciences, biology and data science are central to our scientific discovery mission, laying a foundation for innovations that advance sustainable energy through decarbonization and energy storage, and enhancing national security through nuclear materials and threat analyses. PNNL collaborates with academia in its fundamental research and with industry to transition technologies to market.

CAREERS

The Physical Sciences Division actively seeks candidates with expertise in disciplines including basic and applied chemistry, materials sciences, condensed matter physics, geochemistry and environmental science, catalysis, separations, spectroscopies and microscopies, chemical physics, theory and computational modeling.

View PNNL job listings at:
https://www.pnnl.gov/careers

CONTACT

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