



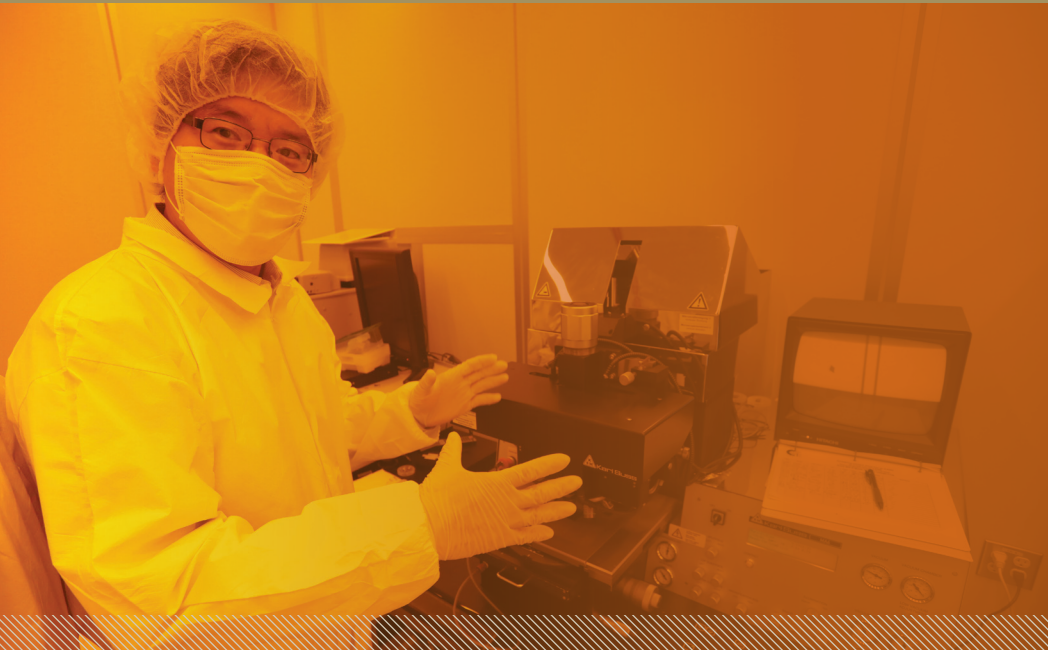
UCR

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Nanofabrication Cleanroom

Overview

The UCR Center for Nanoscale Science & Engineering (CNSE) operates two nanofabrication cleanroom facilities designed and built to enhance the research capabilities of a diverse set of researchers engaged in multidisciplinary nanotechnology research.



Bourns Hall B Wing Cleanroom

The Bourns Hall B Wing nanofabrication research facility is a 2,000-square-foot controlled and monitored space that is fully operational and certified at Class 100 in the Photolithography Bay and Class 1,000 in the Thin/Film Etch Bay.

The facility is open 24 hours a day to qualified personnel and has a staff of three full-time engineers available to users at no charge during normal business hours.

Materials Science and Engineering Cleanroom

The Materials Science and Engineering cleanroom is a class 100/1,000 space that occupies 8,000 square feet and two bays that are functional with the initial few tools installed. CNSE personnel also operate users' facilities, outside of the cleanroom spaces, which are used for material characterization and device testing.

Facilities

UC Riverside has one fully operational research cleanroom and one research cleanroom under development, totaling 10,000 square feet of class 100/1,000 cleanroom space.

The facilities feature Electron Beam Lithography (EBL) and Focused Ion Beam (FIB) instruments that provide state-of-the-art nanofabrication capabilities. In addition, users have access to the following fabrication and metrology instruments:

Fabrication Processes

- Surface preparation
- Thermal gate oxidation
- Low Pressure and Plasma Enhanced Chemical Vapor Deposition
- Photolithography and associated wet chemical processing
- Electron-beam Pattern Generation
- Reactive Ion Etching
- Plasma Etching
- Atomic Layer Deposition
- Thermal and Electron-beam Evaporation of various metals and materials
- Metal and Dielectric Sputtering
- Rapid Thermal Annealing

Metrology Capabilities

- Oxide metrology for oxide/nitride measurements
- Atomic Force Microscopy (AFM)
- Energy dispersive Spectroscopy (EDS)
- Electron Backscatter Diffraction (EBSD)
- Scanning Transmission Electron Microscopy (STEM)
- Thin-film profiling for photo resist and metal layer thickness
- C/V Stress measurement to ensure gate oxide process integrity
- I/V Probe for electrical parametric control
- Digital camera display optical microscopy
- Optical Profilometry for surface inspection and 3D surface analysis

Interdisciplinary Research

The nanofabrication cleanroom provides the infrastructure, equipment and staff support necessary to enable faculty, students, academic and corporate partners to conduct competitive research in the growing number of fields that rely on nanofabrication.

The UCR CNSE nanofabrication cleanroom facilities enable cutting-edge interdisciplinary research. They have been instrumental for numerous cooperative multi-PI research projects funded by the Federal Government, the State of California and industry.

Availability of CNSE cleanroom facilities has made it possible for UCR faculty to be leaders in several research areas, including graphene, two-dimensional (2D) materials and devices, and spintronic devices.

Successful Research Collaborations

Spins and Heat in Nanoscale Electronic Systems (SHINES)

- Energy Frontier Research Center (EFRC)
- Funded by a \$12 million U.S. Department of Energy grant
- Collaborators: 14 principal investigators (PIs) from seven institutions: UC Riverside (lead organization), UCLA, UC Irvine, Johns Hopkins University, Colorado State University, Arizona State University, and University of Texas at Austin

Two-Dimensional Atomic-layer Research and Engineering (2-DARE)

- Funded by the National Science Foundation (NSF) under the Emerging Frontiers in Research and Innovation (EFRI) program
- Led by UC Riverside and includes collaborators from the University of Georgia
- Cutting-edge research in 2D materials and devices

NSF Nanoelectronics for 2020 and Beyond (NEB) Program

- Funded by National Science Foundation (NSF) together with the semiconductor industry's Nanoelectronics Research Initiative (NRI)
- Research focused on innovative computational paradigms

NSF Research Experience for Undergraduates (REU) Site Undergraduate students engage in nanofabrication research by taking on-campus courses that cover various nanofabrication techniques.

Education

The CNSE nanofabrication facility is dedicated to providing graduate and undergraduate students an opportunity to experience hands-on research in a cleanroom setting. Graduate students can receive individual instructions and become trained users of the facilities, who are allowed to work independently or in small teams.

Undergraduate students are provided guided tours of the facilities as part of their engineering courses. They can also obtain individual training and be engaged in research together with graduate students working on research projects offered as part of special programs.



For more information on cleanroom training and relevant educational opportunities for students, faculty and academic and corporate partners, please visit Center for Nanoscale Science and Engineering website at www.cnse.ucr.edu.

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