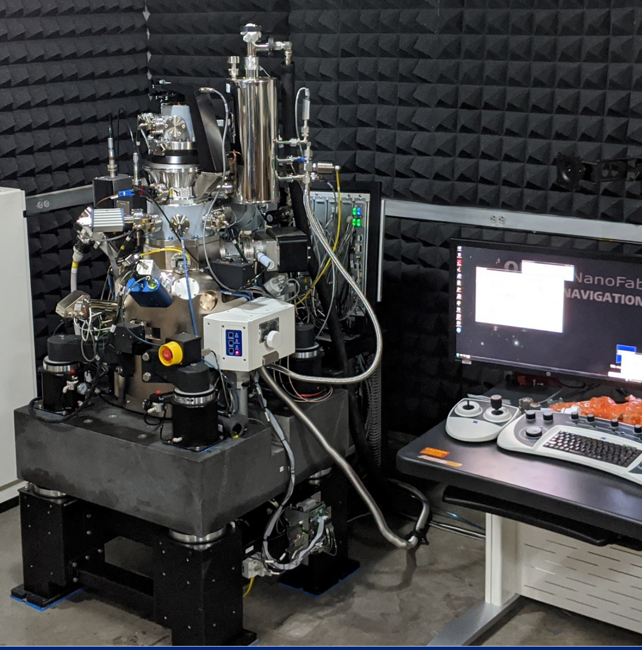
CENTER FOR NANOSCALE SCIENCE AND ENGINEERING-ION BEAM LAB

LABORATORY SPECIALIZING IN DEVICE FABRICATION AND CHARACTERIZATION UTILIZING FOCUSED AND BROAD BEAM ION SOURCES



Shane Cybart

Lab Director

ASSOCIATE PROFESSOR

- Department of Electrical and Computer Engineering

DIRECTOR

- Nanofabrication Facility
- Ion Beam Lab

EDUCATION

- Ph.D., University of California, San Diego, Materials Science

RESEARCH

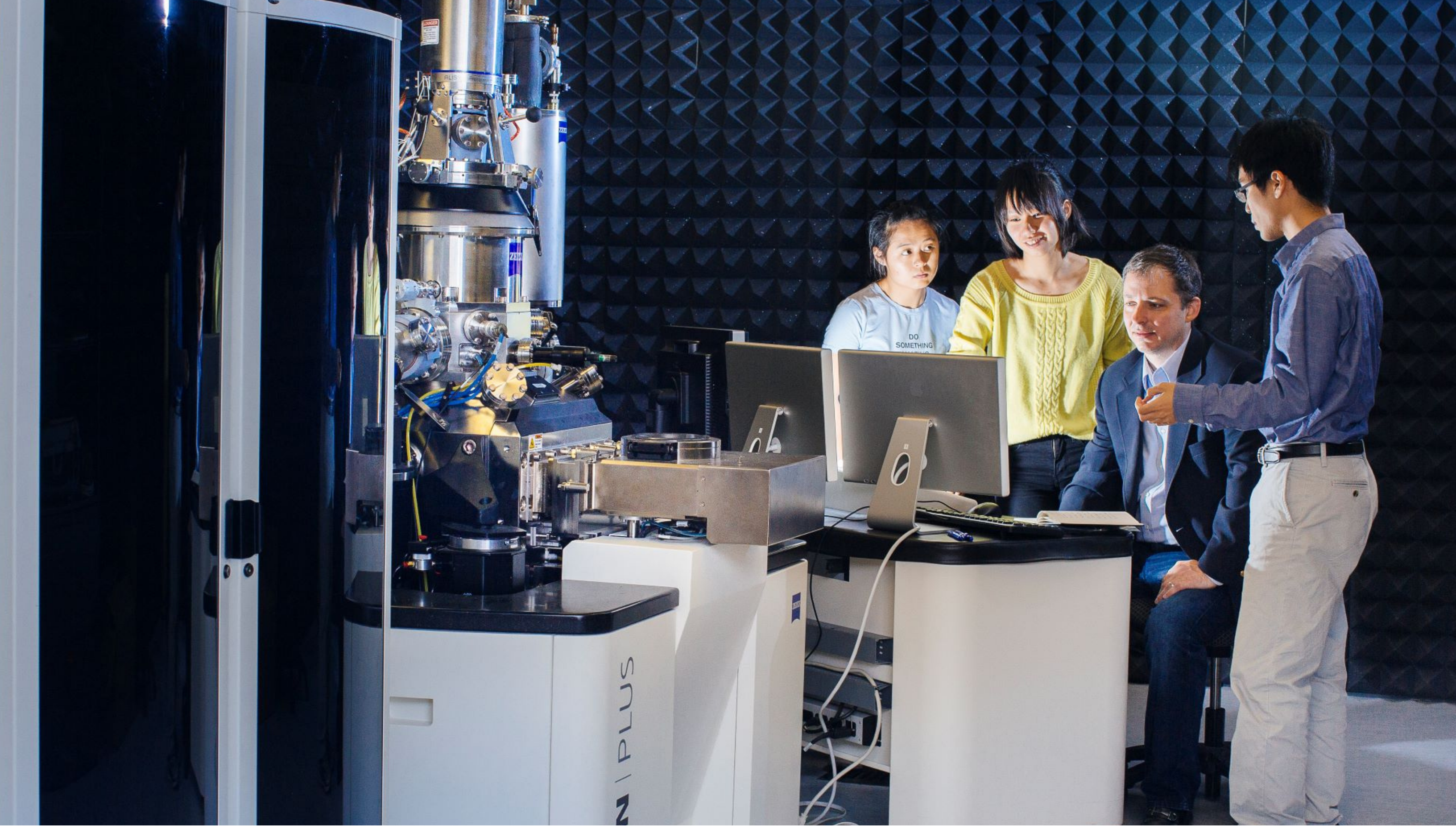
- Ion Beam Materials Modification
- Superconducting Quantum Electronics
- Radiation Effects in Electronic Materials
- Quantum Circuit Edit and Failure Analysis
- Electronics and Materials Forensics

BACKGROUND

Currently, electron beam lithography systems and gallium focused ion beams are ubiquitous in nanotechnology and can routinely be used to create structures of the order of tens of nanometers. However, the ability to scale to the sub-10 nm has been a technological challenge until the development of gas field ion sources (GFIS) over the past decade. The GFIS source, utilizes a single crystal tungsten wire sharpened to just 3 atoms. Helium gas is field ionized by one of these atoms, creating a helium ion beam with diameter of only 0.25nm! This instrument is emerging as an important tool for sub-10nm structuring of materials. Helium ion beams have significant advantages. Helium is small and chemically inert which allows it to be used for direct modification of materials properties without etching away material or employing resists. The Ion Beam Lab at UCR CNSE is a world leader in this emerging technology.

CAPABILITIES

- Zeiss Nanofab Helium Ion Microscope
  - Helium-Neon Gas Field Ion Source
  - Gallium Liquid Metal Ion Source
  - Gas Injection Ion Beam Assisted Materials Deposition
  - Raith Ion Nanolithography System
  - Nano-Prober System for Insitu Electrical Measurement
- Zeiss Orion Plus Helium Ion Micrscope
- 21 cm broad beam Kaufmann Argon Ion Source
- 16 cm broad beam RF Argon Ion Source
- 5cm Argon/Oxygen Hollow Cathode Ion Source



APPROACH

My research group has been utilizing GFIS for direct patterning of ceramic high-temperature superconducting materials for quantum electronics. The helium ion beam induces nanoscale disorder from irradiation into the crystalline structure which converts the electrical properties of the material from superconductor to insulator. Insulating feature sizes of less than 2nm have been successfully demonstrated and many unique novel devices have been realized. Much of this success is due to the irradiation sensitivity of electrical transport in high temperature superconductors. This sensitivity results from loosely bound oxygen atoms (~1-8ev) in the crystal lattice that are easily displaced into interstitial or anti-site defects. With this form of GFIS materials modification we fabricate and study electronics for high performance computing, quantum sensing, and high frequency radiation detection.

SUPPORTED BY

Army Research Office

Air Force Office of Scientific Research

Office of Naval Research

Department of Energy National Nuclear Security Agency