



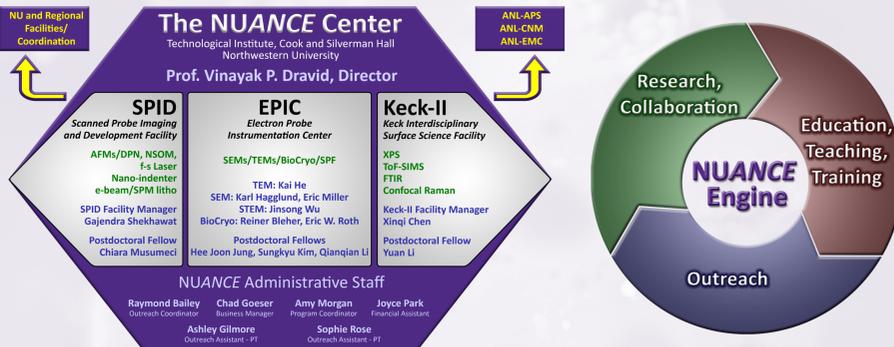
NUANCE

Atomic and Nanoscale Characterization Experimental Center

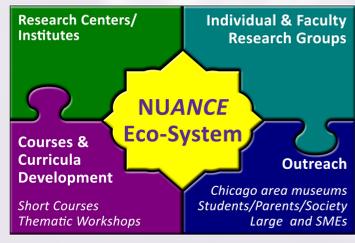
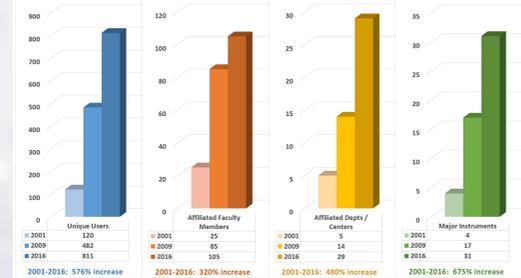
About NUANCE



Conceived by founding director Professor Vinayak P. Dravid, the Northwestern University Atomic and Nanoscale Characterization Experimental (NUANCE) Center was established in 2001 to integrate complementary analytical instruments and characterization capabilities with world-class research at Northwestern University. NUANCE serves the broader scientific and engineering community and provides invaluable resources to the private sector and public institution in and around the Midwest. An operationally and fiscally efficient solution to the increasing need for advanced analytical and characterization instrumentation, NUANCE leverages staff technical expertise to assist and collaborate with researchers in the physical sciences, engineering and interdisciplinary fields.



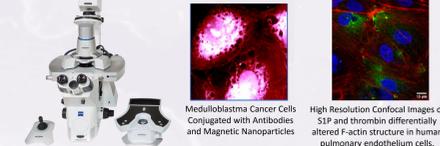
The NUANCE Center: 2001 - Present



Scanned Probe Imaging and Development (SPID) Facility

High Performance Scanning Probe Microscopy & Nanopatterning Systems

The Bruker BioScope Catalyst offers uncompromised performance through innovative design, the most complete integration of AFM and Light Microscopy, easiest to use and most productive life science AFM, simple and effective solutions for biological samples.



Photoconductive and Kelvin Probe Microscopy

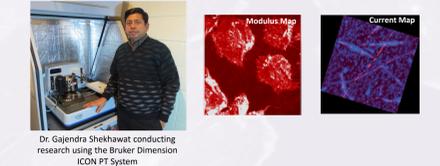
Scanning Kelvin Probe Microscope

- FM-KPFM and AM-KPFM modes available
- It leverages Peak Force QNM to give simultaneous mechanical and electrical information
- High repeatability through tight parameter control and probe design

Bruker Photoconductive AFM System

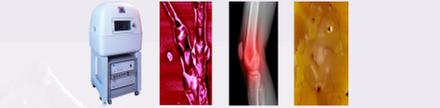
- Quantitative, High Resolution OPV, OLED's and photoelectric materials characterization

The Bruker High Performance Dimension ICON System integrates Scan Asyst (Exclusive Self-Optimizing AFM Scan Technology) with Peak Force Quantitative Nanomechanical Mapping (QNM).



Nanoscale Mechanical Testing

The Hysteron Tribo-Indenter is a high resolution nano-mechanical system integrated with quasi and dynamic indentation capabilities.

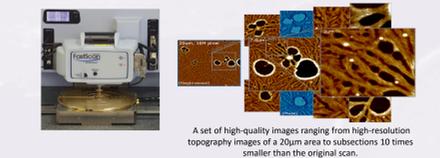


The AFM Integrated Confocal Raman System

Features

- AFM integration for TERS and Co-localized Imaging
- Multi-laser capability from UV to IR
- Multiple detectors for extended spectral range and specialized applications
- Ultra-fast Raman Imaging with SWIFT and DuoScan Technologies
- High performance Raman Spectrometer
- Chemical and PL mapping capabilities
- Liquid measurements capabilities

The Bruker Dimension FastScan AFM delivers extreme imaging speed with atomic resolution and Atomic PeakForce Capture™.



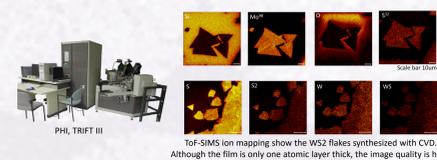
Keck Interdisciplinary Surface Science Facility (Keck-II)

Quantitative Chemical Analysis

X-ray Photoelectron Spectroscopy is a quantitative spectroscopic technique that measures the elemental composition, empirical formula, chemical state and electronic state of the elements that exist within a material.

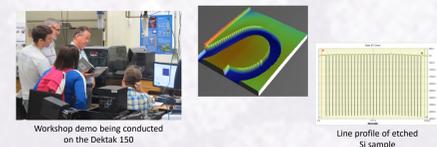


Time-of-Flight Secondary Ion Mass Spectrometry is a technique used to analyze the composition of solid surfaces and thin films in order to determine the elemental, isotopic, or molecular composition of the surface. SIMS is the most sensitive surface analysis technique, being able to detect elements present in the parts per billion range.

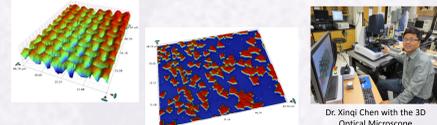


Surface Profiling

The Dektak 150 Surface Profiler (profilometer) is used to obtain surface profile and quantify its roughness. Vertical resolution at sub-nm level, and lateral resolution is at sub-µm level.



The 3D Optical Microscope (Bruker ContourGT Optical Profiler) provides the ability to obtain surface profile and quantify its roughness. Vertical resolution at sub-nm level, and lateral resolution is at sub-µm level.

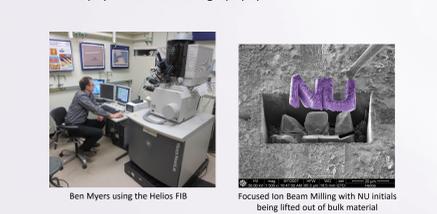


Sample Preparation and Helios FIB

FEI Helios Nanolab

The Helios FIB/SEM is used for high precision micro/nano machining, prototyping, lithography, and sample preparation.

- Five gas injection systems for deposition and enhanced etching
- OmniProbe Auto 200 micromanipulator
- Retractable STEM detector for bright-field, dark-field, and high angle annular dark-field imaging
- Bruker SDD EDS system and Oxford-HKL EBSD
- KleinDieck nanomanipulation and probing system
- Automated slice-and-view for 3D FIB tomography
- Raith Elphy Multibeam lithography system

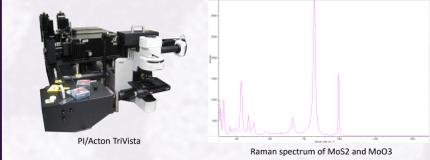


Vibrational Spectroscopy

Fourier Transform Infrared Spectroscopy produces a spectrum representing the molecular absorption and transmission of infrared radiation. The spectrum produced serves as a molecular fingerprint of the sample.

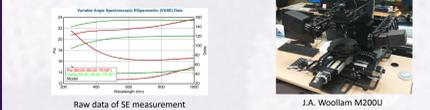


The Confocal Raman Microscope (PI/Acton TriVista) measures the wavelength and intensity of inelastically scattered light from molecules. The mechanism of Raman scattering is different from that of infrared absorption. IR spectra provide complementary information to Raman spectra.



Other Instruments

The Spectroscopic Ellipsometer (J.A. Woollam M2000U) Enhanced UV coverage down to 245nm. Ideal for many thin films: dielectrics, organics, semiconductors, metals, and more. Use it to measure optical constants and thickness for coatings from sub-nanometer to tens of microns.



The Zetasizer (Malvern Instruments Ltd, Nano ZS) Provides the ability to measure three characteristics of particles or molecules in a liquid medium. These three fundamental parameters are particle size, zeta potential and molecular weight.



Other Available Instruments

- Denton Desk IV Sputter coater
- Filgen Osmium Coater
- Fischione IBT systems for consistent ion milling
- Fischione Model 1040 Nanomill
- Gatan dry pumping station for cryo TEM holders
- Gatan ultrasonic disc cutter
- High performance 3D workstation and Amira software
- Laurell Technologies Spin Coater
- Lesker Nano38 Thermal Evaporator
- Nikon Eclipse ME600L Metallurgical Microscope with CCD camera
- Precision ion polishing systems
- SBT Plasma Cleaner
- Tousimis Critical Point Dryer



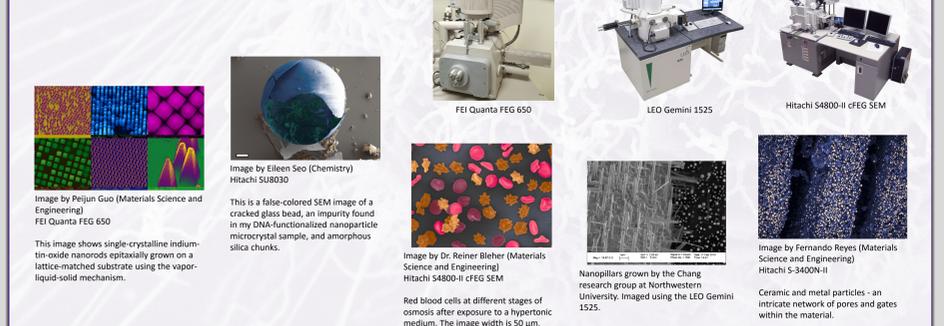
Electron Probe Instrumentation Center (EPIC)

Scanning Electron Microscopy (SEM) and Related Capabilities

The Electron Probe Imaging Center of NUANCE is home to five Scanning Electron Microscopes.

Available capabilities involving SEM include

- Energy Dispersive X-ray Spectroscopy (EDS)
- Low Vacuum or Environmental SEM for imaging of wet, oily, or non-conductive samples in their natural state.
- Electron Backscatter Diffraction (EBSD)
- Wavelength Dispersive X-Ray Spectroscopy (WDS)
- STEM Imaging
- Electron and Ion Beam Lithography
- Cryo-SEM

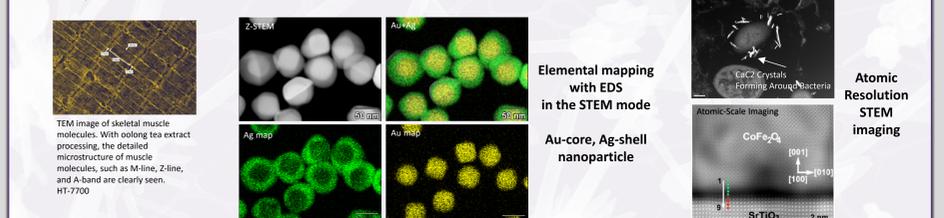


Transmission Electron Microscopy (TEM) and Related Capabilities

The Electron Probe Imaging Center of NUANCE houses six Transmission Electron Microscopes as well as a Scanning Transmission Electron Microscope, all capable of atomic resolution.

Available capabilities involving TEM include

- Electron Energy Loss Spectrum (EELS)
- Energy Filtered TEM (EFTEM)
- Bright-field and Dark-field imaging
- Electron diffraction with large specimen tilt
- Cryo-TEM capability for organic and biological samples
- X-ray energy dispersive spectroscopy (EDS) analysis
- Protochips Poseidon 500 electrochemical liquid cell holder
- Nanofactory electrical probing holder
- Gatan heating holder
- Tomography holder
- Imaging in a fluidic environment by Protochips Poseidon 500 electrochemical liquid cell holder
- In-situ Transport measurement by Nanofactory electrical probing holder
- In-situ heating observations by Gatan double-tilt heating holder
- 3D imaging by electron tomography by Hummingbird and Hitachi full-space tilting holders



BioCryo Capabilities

The BioCryo Facility offers expertise and assistance for cryo/Electron Microscopy and Microanalysis of biological and soft samples. We handle specimens from different fields of research, including life sciences, materials science, and other disciplines.

Electron Microscopy & Microanalysis systems we use: TEM, STEM, cryo TEM, cryo STEM, cryo SEM, EDS, EELS

