

The Nanoscale Characterization and Fabrication Laboratory at the Virginia Tech Corporate Research Center

<http://www.ICTAS.vt.edu/NCFL/>

The Nanoscale Characterization and Fabrication Laboratory (NCFL) is approximately 16,000 square feet of laboratory space with instrumentation for bio- and nano- characterization. Located in the Corporate Research Center adjacent to Virginia Tech's campus in Blacksburg VA, it is operated by the University's Institute for Critical Technology and Applied Science (ICTAS). The state-of-the-art facility is housed in a dedicated building designed to shield sensitive instruments from environmental factors such as building vibrations, stray electromagnetic fields, and temperature fluctuations. It operates as a service center with a cost structure tailored to serve the needs of researchers from Virginia Tech and from the surrounding industrial community. The facility is staffed with instrument specialists to train users and assist in the operation of the equipment. Available instrumentation includes:

Field Emission STEM (FEI Titan) A Scanning Transmission Electron Microscope capable of revealing the atomic structure and chemistry of sub-micron regions in materials. The microscope is capable of atomic-resolution imaging in transmission and scanning transmission modes, and it is equipped with an Energy Dispersive Spectrometer, an Electron Energy Loss Spectrometer (a Gatan Image Filter), a High-Angle Annular Dark Field detector, a 3D electron tomography package, and a Lorenz lens imaging magnetic domains.

Field Emission SEM (LEO 1550) This Scanning Electron Microscope provides images of solid surfaces with a resolution approaching 1 nm, and uses an Energy Dispersive Spectrometer to provide semi-quantitative information about the distribution of chemical elements.

Focussed Ion Beam / FE-SEM Workstation (FEI Helios 600 Nanolab) This dual-beam FIB can be used to dissect or deposit material at a micro- to nano-meter size scale. The instrument is a nano-machining platform built into a high-performance scanning electron microscope; it is capable of nanoscale lithography, deposition, and tomography. It is equipped with an integrated EDS and EBSD package for gathering chemical and spatial orientation information in 3-dimensions.

Environmental Scanning Electron Microscope (FEI Quanta 600 FEG) for investigating samples that are difficult or impossible to image in conventional high vacuum systems — for example, organic materials, fully hydrated materials, biomaterials, and in-situ observations of materials heated as high as 1000 C. This instrument is equipped with a high-speed Li-drifted Si Energy Dispersive Spectrometer and a STEM detector.

SIMS (Cameca IMS 7f) A magnetic sector Secondary Ion Mass Spectrometer for surface molecular or elemental analysis, trace element depth profiling, and secondary ion microscopy. This instrument provides true elemental and stable isotopic analysis with high mass resolution and high sensitivity (parts per billion detection limits). It can be used to provide a 3-dimensional chemical analysis profile from a surface into the bulk of a solid with sub-micron spatial resolution.

Scanning X-ray Photoelectron Spectrometer Microprobe (PHI Quantera SXM) An automated small-spot XPS for quantitative characterization of chemical elements and chemical states of the top few nanometers of a surface. Depth profiling can be accomplished with automated ion milling.

Multiphoton Excitation Microscope (Zeiss LSM 510 NLO) Point scanning laser confocal microscope with nonlinear optics extension for multi-photon fluorescence of cell and tissue samples. Can generate 3D stacks of sharply defined optical sections from thick biological samples with high spatial resolution, and can spectrally discriminate multiple fluorophores.

Bio-Atomic Force Microscope (Veeco BioScope II) An AFM integrated with a Nikon confocal microscope and nanolithography package for biological or molecular patterning; capable of imaging in dry or fluid environments with temperature control.

Nanomechanical Test Instrument (Hysitron TriboIndenter) a nanoindenter for measuring mechanical properties such as hardness, elastic modulus, fracture toughness, wear resistance, coefficient of friction, and viscoelastic properties of thin films, coatings, and particles with nanometer spatial resolution.

Nanomanipulator The Dimension 3100 Nanoman AFM provides a variety of high resolution surface imaging techniques and the ability to manipulate or create nanoscale structures. Imaging techniques include contact mode AFM, tapping mode AFM, Scanning Tunnelling AFM, Conductive AFM, and Scanning Capacitance Microscopy. The X and Y position of the tip can be independently controlled to allow precise placement of the tip. Direct manipulation of particles and localized charge placement or oxidation of a substrate is possible.

Sample Preparation Cryo-Ultra Microtome for preparing polymeric electron microscopy samples. Dimple grinding, polishing equipment, precision ion-mills, and electro-polishing equipment for inorganic electron microscopy samples.

400 and 600 MHz NMR Spectrometers (Bruker Avance II) Nuclear Magnetic Resonance spectrometers with Triple Resonance Probe, Cryo-probe, Gradient Spectroscopy probe, and micro-imaging unit. For investigating the structure of macromolecules and research in structural biology; the micro-imaging attachment accessory can be used to image soft materials and small animals (NMRs available through the Chemistry Department NMR Service Center).

For more information, please visit the NCFL website: <http://www.ICTAS.vt.edu/NCFL/>
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