



Nanoscale
Science



Nano-Bio
Interface



Sustainable
Energy



Renewable
Materials



Sustainable
Water



Cognition and
Communication



National
Security



Emerging
Technologies

Technology is at a unique point in history. Engineering systems are now the same size as basic units of life. Sensors and probes operate at the cellular level, and materials are manipulated at even smaller dimensions – down to individual atoms.

The ICTAS Corporate Research Center location opened in 2007. The facility houses the Nanoscale Characterization and Fabrication Laboratory on the first floor. The second floor hosts research

laboratories, student offices, collaborative space, and conference and meeting rooms. Equipped with more than \$10 million in highly specialized equipment, more than half of which was made possible through funding provided by the Commonwealth Research Initiative, this facility helps researchers investigate novel phenomena and build transforming technologies that solve critical challenges.

The Nanoscale Characterization and Fabrication Laboratory (NCFL) contains approximately 16,000 square feet of laboratory space with dedicated instrumentation for bio- and nano-characterization and fabrication of nanoscale structures. The NCFL consolidates characterization equipment that provide researchers with the tools to work in converging disciplines at the nanometer dimension.

The NCFL building is designed to minimize interference to instruments from environmental factors such as building vibrations, stray electromagnetic fields, and temperature fluctuations.

The facility is staffed with instrument specialists who train

users and assist with the operation of the equipment.

Equipment in the NCFL is available on a cost basis to members of the academic research community and to industry.

NCFL PROVIDES:

- **access to advanced equipment for electron microscopy, optical microscopy, and several spectroscopic techniques**
- **training for students and researchers in the use of the lab's instrumentation**
- **short courses and characterization services for industry**



www.ictas.vt.edu/ncfl

For detailed information about: Operating Policies; Instrument Rates, Capabilities, Availability, and Training; Access to the Building and Hours of Operation; and Training Policies.

▪ SURFACE ANALYSIS



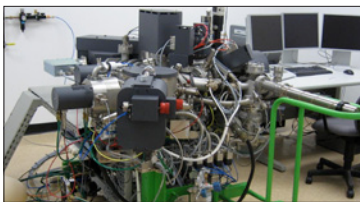
X-RAY PHOTOELECTRON SPECTROMETER

(Phi Quantera SXM) Used for quantitative characterization of chemical elements and chemical states of the top few nanometers of the surface of solids. It features a focused, monochromated X-ray source for small-spot analysis and is automated for high sample throughput. Depth profiling can be accomplished with automated ion milling.



FIELD EMISSION AUGER ELECTRON SPECTROMETER

(VG 350) Provides chemical analysis of surfaces with lateral resolution on the nanometer scale. Sample preparation is relatively simple, and the technique has excellent surface sensitivity (less than 5 nanometers).



MAGNETIC SECTOR SECONDARY ION MASS SPECTROMETER (SIMS)

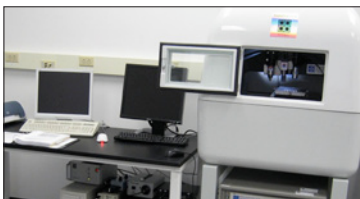
(Cameca IMS 7f GEO) Used for surface molecular or elemental analysis, trace element depth profiling, and secondary ion microscopy. Instrument provides true elemental and stable isotopic analysis with high mass resolution and high sensitivity and may be used to provide a 3-dimensional chemical analysis profile from a surface into the bulk of a solid with submicron spatial resolution.



QUADRUPOLE SECONDARY ION MASS SPECTROMETER

(Atomika 4100) Provides high chemical sensitivity and very high-depth resolution for analysis of thin layers or shallow ion implants. Measurements on insulators are simplified relative to those made with the magnetic sector SIMS.

▪ SCANNING PROBE MICROSCOPY



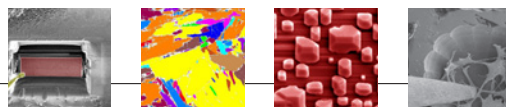
NANOMECHANICAL TEST INSTRUMENT

(Hysitron TribolIndenter) Provides 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.



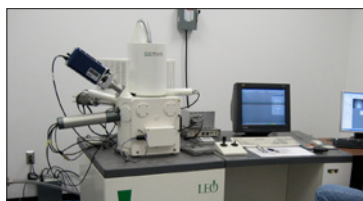
DUAL-BEAM FOCUSED ION BEAM

(FEI Helios 600 NanoLab) For dissecting or depositing material at a micro- to nano-meter scale, this is a nano-machining platform built into a high-performance scanning electron microscope; it is capable of nanoscale lithography, deposition, and tomography.



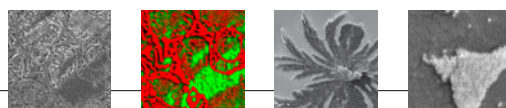
ENVIRONMENTAL SCANNING ELECTRON MICROSCOPE

(FEI Quanta 600 FEG) An environmental SEM also capable of operating in low- and high-vacuum modes. It is used to observe non-conducting materials and samples containing moisture. It is equipped with an energy dispersive spectrometer for chemical analysis, a tensile stage for making in-situ observations during mechanical tests, a hot-stage capable of reaching 1000 degrees C, and a Peltier cold stage.



FIELD EMISSION SCANNING ELECTRON MICROSCOPE

(LEO (Zeiss) 1550) A scanning electron microscope that provides images of solid surfaces with a resolution approaching 1 nanometer, and uses an energy dispersive spectrometer to provide semi-quantitative information about the distribution of chemical elements. It is used for high-resolution imaging of surfaces, qualitative assessment of the distribution of elements (with atomic numbers between boron and uranium), submicron structure analysis, and determination of crystal orientation and crystalline texture.



FIELD EMISSION SCANNING TRANSMISSION ELECTRON MICROSCOPE

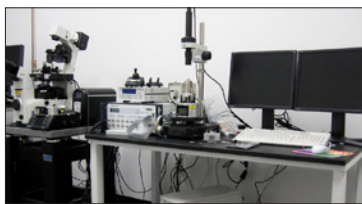
(FEI Titan 300) A scanning transmission electron microscope with the capability to reveal the atomic structure and chemistry of sub-micron regions in materials. The instrument can image the arrangement of atoms within solids with sub-angstrom resolution – the highest resolution available with any microscopy technique. It is used to study the nature of internal defects and interfaces that influence the mechanical, chemical, electrical, magnetic, and optical properties of solids.



TRANSMISSION ELECTRON MICROSCOPE

(Philips EM420) The Philips EM420 is a conventional TEM, mainly focuses on BF/DF imaging and electron diffraction. The microscope is capable low acceleration voltage operation (from 60 up to 120kV), thus it is ideal for polymer, bio and other electron beam sensitive materials. This TEM is also ideal for routine TEM investigations, sample survey and large tilting diffraction/imaging experiments. The TEM is used for training, teaching and research/research education.

OPTICAL AND HYBRID INSTRUMENTS



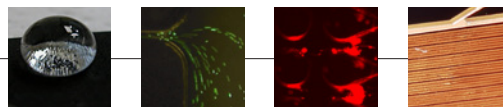
BIO ATOMIC FORCE MICROSCOPE (AFM)

(Veeco BioScope II) Integrated with a Nikon confocal microscope and nanolithography package for biological or molecular patterning, this microscope is capable of imaging in dry or fluid environments with temperature control and can be used for spatial identification and mapping of protein molecules and cellular structures, studies of lipid membrane composition and reorganization events, investigations of cell response to mechanical stimulation, and real-time observation of cell signaling events.



DIGITAL VIDEO MICROSCOPE

(HIROX KH-7700 3D Digital Video Microscope) This optical inspection microscope is used to image objects with rough surfaces or irregular topology, do optical comparisons, measure feature sizes in 2 or 3 dimensions, generate 3D profiles, and view objects from multiple perspectives. The microscope has optics optimized for digital imaging and a significantly larger depth of field than conventional optical microscopes. It also has a motor-driven prism system that makes it possible to record streaming video movies of objects viewed from a rotating perspective.



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