

The microscopy assets of the Joint School of Nanoscience and Nanoengineering are summarized below:

### **Helium Ion Microscopy Facility**

The Joint School of Nanoscience and Nanoengineering Helium Ion Microscopy (HIM) Facility houses a Zeiss Orion Helium Ion microscope, one of only twenty dedicated HIM microscope facilities in the world, and the only HIM facility in the southeastern USA. HIM is a relatively new scanning particle beam microscopy technique that offers several advantages over standard scanning particle beam imaging techniques that include increased absolute resolution (~0.3nm resolution), extremely high depth of field, and enhanced imaging of uncoated soft materials such as polymers and biological materials. HIM data collection and imaging formation is performed through two separate detectors, a secondary electron detector that is similar to standard Scanning Electron Microscopy, and a Helium ion backscatter detector, which provides semi-qualitative elemental analysis of a sample. In addition to imaging, the HIM is also capable of nanoscale He ion beam milling, used in our facility to generate nanopores and other nanoscale features < 5nm.

### **Scanning/Transmission Electron Microscopes (SEM and TEM) Facilities**

JSNN houses three scanning electron microscopes: A Zeiss Auriga Dual Beam (Focused Ion beam milling/SEM), a Zeiss Evo Environmental SEM, and a Hitachi 4800 SEM. Each SEM is equipped with Energy-dispersive X-ray spectroscopy detectors to facilitate simultaneous elemental analysis during image capture. The Dual Beam Auriga SEM enables standard SEM imaging and focused ion beam milling via a gallium ion source in a broad range of materials including biological, polymers, metallic, and semiconductor materials. The dual beam nature of the Auriga allows for sequential FIB milling and SEM imaging, enabling the virtual 3D nanoscale reconstruction of a sample. The Auriga SEM is equipped with two secondary electron detectors, a backscatter electron detector, and allows for scanning transmission electron microscopy (STEM) functionality as well. JSNN's Zeiss Evo LS ESEM allows imaging of 'wet' hydrated samples and samples in different gaseous environments. In addition to imaging, the EVO LS ESEM is also equipped with a beam patterning system permitting e-beam lithography. The JSNN Hitachi 4800 is a fully function SEM with detectors for secondary electron, backscatter electrons, and elemental analysis via EDX. The JSNN Transmission Electron Microscope facility is equipped with a Carl Zeiss Libra 120 Plus TEM Microscope with full electron energy loss spectroscopy (EELS) capability for elemental analysis.

### **JSNN Confocal and Optical Microscope Facility.**

The JSNN optical microscope facilities houses three optical microscopes: a Zeiss Axio Observer Spinning Disc Confocal microscope, a Zeiss Axio Observer A1 Fluorescent and Polarized light microscope, and a Horiba XploRA One Raman Confocal Microscope System. The Spinning Disc system is fully outfitted with objectives ranging from 10X-100X and four channel laser excitation from the near UV into the near infrared range. Additional features include a stage

mounted temperature controlled CO<sub>2</sub> chamber for long term live cell imaging. The Zeiss Axio Observer A1 is an upright compound microscope that is fully equipped four channel wide-field fluorescence, bright-field, dark-field and polarized light microscopy. The Horiba XploRA One Raman Confocal Microscope System allows for simultaneous chemical analysis via RAMAN spectroscopy during the imaging of materials including live cells.

### **JSNN AFM facility**

The JSNN AFM facility houses an Agilent Technologies 5600 LS Series Atomic Force Microscope. This instrument is equipped for various scanning probe techniques, including standard topography mapping of various materials including soft polymeric materials and biological samples, force spectroscopy and the determination of mechanical properties of a variety of materials including living cells, the mapping of surface functionalities, and the physicochemistry of surfaces and nanostructured materials.

### **JSNN sample prep room**

In addition to the microscopes, the JSNN sample prep room is equipped to serve all electron, atomic force, and optical sample preparation needs. The room includes a fully functional vented hood, refrigerators, full stock of stains and chemical fixatives, a South Bay Technologies PC2000 Plasma Cleaner, critical point dryer and critical CO<sub>2</sub> preparation tool, and a Leica EM ACE600 High Vacuum Coater.