

Special Interest Articles

The UF Nanofabrication Facility: A Unique Resource for UF Nano-Research

Meet the UFNF staff.

How do I use the UFNF?

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For additional information, go to the UFNF website at www.phys.ufl.edu/nanofab/

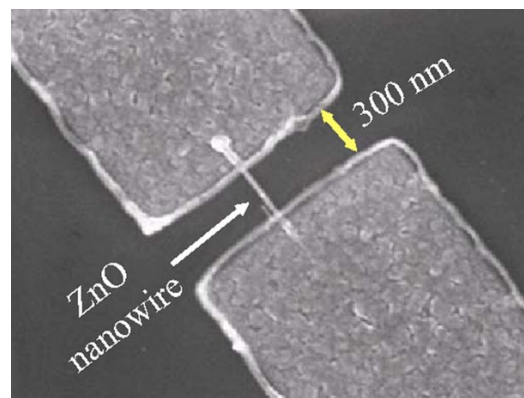
The UF Nanofabrication Facility: A Unique Resource for UF Nano-Research

Nanoscience and nanoengineering, building structures down to the molecular level, – are leading to an unprecedented understanding and control of the fundamental building blocks that comprise our physical world. In some cases, working at the nanoscale is a simple progression in making devices smaller, enabling integration of systems at remarkably small length scales, thus facilitating the creation of functional “packages”. In other instances, materials and devices with dimensions ranging from 1 to 100 nanometers – equivalent to only a few atoms in width at the smallest scale – result in physical properties that differ significantly from conventional devices. Research in nanoscale science and engineering is changing the way many things are designed, fabricated, and performed, from disease treatments to vaccines to computer chips. Grand Challenges for nanoscience research include detecting cancer in the human body at the earliest stages, improving computing speed and efficiency by factors of 100 to 10,000, building Mb memory chips that are smaller than the width of a hair, and developing autonomous micro-probe sensors that can transmit, sense, and interpret local chemistry and environments. Clearly, these types of breakthroughs would have an enormous economic impact. They would also bring significant societal benefit if realized.

In support of nano-research activities here at the University of Florida, the UF Office of Research and Graduate Programs, back in the spring of 2002, initiated the formation of the University of Florida NanoFabrication Facility (UFNF). The initial investment of \$2.5M was allocated for the creation of this laboratory, designed to nucleate a multi-disciplinary UF user facility that would

facilitate the synthesis of nanoscale structures for fundamental studies and applications in electronics, chemistry, sensors, physics, bioscience, and medicine. This investment was leveraged with additional support from the Colleges of Engineering and Liberal Arts and Sciences, providing for three full-time engineers to oversee the construction and day-to-day operations of the facility.

The UF Nanofabrication Facility is now fully operational, providing the capability of designing, fabricating and processing device constructs for applied and fundamental research with feature size as small as 10 nm. The UFNF consists of two laboratories, the multi-disciplinary NanoFab Lab, located on the ground floor of the New Physics Building, and the Silicon MicroFabrication Laboratory located in Benton Hall. The latter is undergoing renovation with an additional investment of \$1.1M by the College of Engineering and the Provost’s office. Key capabilities within the UFNF include electron-beam and UV optical lithography for



Scanning electron microscope image of the of a ZnO nanowire device structure fabricated using the UFNF e-beam lithography facilities. (SEM image courtesy of the UF MAIC facility)

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The UFNF is a multi-disciplinary user facility designed to facilitate the synthesis of micro- to nanoscale structures for fundamental studies and applications in electronics, chemistry, sensors, physics, bioscience, and medicine

micro-to-nanoscale pattern definition, reactive ion etching for selective material removal, sputter and plasma-assisted deposition for metal and insulating film formation. All of this is housed in class-100 cleanrooms, giving the University of Florida a capability not before available for investigating dimensional-dependent phenomenon and nanoscale synthesis for electronic, mechanical, biomedical, and chemical systems.

The UFNF organizational structure includes technical and administrative staff, and an Advisory Committee representing the various areas of research that utilize the facility. The NanoFab Lab, together with the Si MicroFabrication Laboratory, possesses a number of tools for the fabrication and study of nanostructured devices and materials. This capability is enabling for research opportunities where creating micrometer to nanometer length-scale structures are needed. Examples include creating nanoscale catalysts patterns for biofunctional nanosensors, fabricating nanoscale transistors based on novel correlated electronic materials, and studying the electron spin properties of single quantum states in

semiconductor quantum dot arrays.

Within the UFNF, we are fortunate to have three full-time technical staff who oversee the day-to-day operation of the facilities. Al Ogden has been with the College of Engineering for 13 years, and is the principal technical staff in the Benton Facility operation. Al's immediate duties focus on the renovation of the Benton facilities, scheduled for completion in 2006. Ivan Kravchenko is located in the New Physics Building facility, having worked within the Physics Department for the past 9 years. Ivan's interests include nanoscale patterning using e-beam lithography. Bill Lewis joined UF in 2003 from Lucent Technologies in Orlando. Bill's specialties include process development.

The administrative duties for UFNF are carried out by Paula Mathis, who has held numerous positions within the Department of Materials Science and Engineering since 1992.

Major facilities currently available

E-beam lithography

Raith 150 E-Beam Writer
e-beam resist spinners, ovens, accessories

UV photolithography

Karl Suss Deep UV mask aligner
Resist spin coaters, developer ovens,
yellow light clean room

Metallization and dielectric deposition

Kurt J. Lesker Multi-Target
Sputter Deposition System

Modular clean room

Inspection microscopes
Class 100 work space

Plasma-enhanced CVD

Surface Tech System plasma-enhanced
chemical vapor deposition system

Reactive Ion Etching

Unaxis Inductively-Coupled
Plasma Etcher

Deep Reactive Ion Etching (Si only)

Surface Tech Systems Deep Reactive
Ion Etcher/ Bosch Process System

Hard mask removal

Plasma asher

How to use the UFNF?

Access to the UFNF facilities can easily be achieved through a simple 3-step process.

1. Contact UFNF staff to discuss project needs
2. Submit UFNF Lab Use Request Form at www.phys.ufl.edu/nanofab/user.html to establish user account.
3. Schedule UFNF equipment use and safety training with UFNF technical staff.