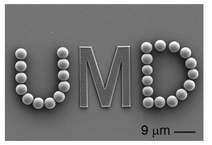
Maryland NanoCenter - ISR Partnership
Equipment and Expertise

Gary W. Rubloff, Jim O'Connor and Wen-An Chiou



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 **30** THIRTY YEARS OF SYSTEMS RESEARCH EXCELLENCE

INSTITUTE FOR SYSTEMS RESEARCH
A. JAMES CLARK SCHOOL OF ENGINEERING

History

The Maryland NanoCenter was created in 2005 as the University campus consolidated its experimental facilities.

Infrastructure goal: to organize and manage a portfolio of experimental facilities shared among internal & external users.

Research development goal: to leverage these capabilities for leading-edge nano research, driven by a collaborative community on campus and beyond.

Now more than **100 research groups** use the NanoCenter's shared **microscopy** and **fabrication** labs. It has enabled UMD faculty to generate **hundreds of millions of research dollars.**

Research threads weave future pattern of advancement

The NanoCenter is poised to enable new visions in nano research, providing support from state-of-art equipment & training in our laboratories; access to research expertise from UMD faculty experts; and administrative guidance and support to implement programs.

Designer nanomaterials
Nie Group: Bottom-up Design of Functional Nano- and Micro-scale Materials

Nano for energy
Rubloff group: Electrochemical nanostructures for enhanced electrode materials and solid state battery

Nano-bio science and tech
Fisher Group: Engineering and vascularizing tissues via 3D printing

Nanoelectronics & Nanophotonics
Appelbaum Group: Spin-polarized Electron Transport in Semiconductors

Understand and preserve signs of our history
UMD Geology: Probing the earth's early oceans

Fundamental science at the nanoscale

Micro and nano systems
ISR research in the NanoCenter

Nanomanufacturing
Mesoporous Paper & Textiles for Energy, Flexible Electronics

The NanoCenter's Core Strength: Shared Equipment and Facilities

FabLab: Micro & Nano Fabrication Lab

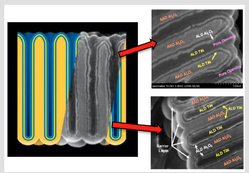
The NanoCenter's FabLab is a **10,000 sq. ft. clean room** micro and nano fabrication complex. It features bays for deposition, thin films/CVD, etching, and lithography, a spacious teaching lab and an exploratory materials laboratory. Key tools for **nanofabrication**, including a Raith eLine 150 electron beam lithography system, an Atomate nanowire growth system, and a Beneq atomic layer deposition system.

Microfabrication tools include: PVD (evaporation & sputtering), CVD, thermal oxide growth, PECVD, dry etching, deep RIE, wet etching, photolithography, wafer alignment and bonding, and rapid thermal annealing.

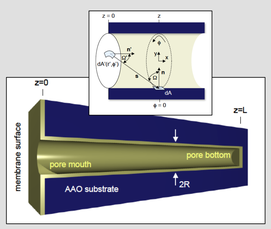
Inspection and metrology tools include: an SEM, surface profiling, electrical test, Hall measurement, thin film stress measurement, porosimetry, battery fabrication and testing, selected optical characterization, and more.

Systems Research Advances

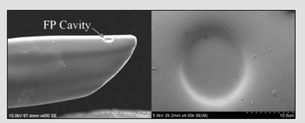
Microsystems and nanosystems play a major role in the NanoCenter. Arising from the merger of microelectronics fabrication and its application to arenas well beyond electronics (chemical sensing, mechanical sensing and actuation, fluidics, and others) applications. The NanoCenter boasts a broad cadre of microsystems researchers with interests including biomedicine, combustion, energy, unmanned aerial vehicles, robotics and security. They seek to exploit microsystems as components in these systems and as powerful platforms for fundamental experimental research.



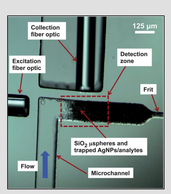
Self-assembly of nanopores in anodic aluminum oxide, Rubloff & Lee



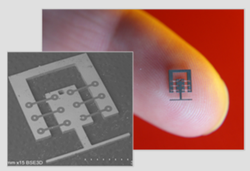
Coupling ballistic transport & surface reaction models, R. A. Adomaitis



Miniature surface-mountable Fabry-Perot pressure sensor, M. Yu, Ghodssi



Optofluidic SERS Microsystem for aquaculture fungicides detection, I. White



Silicon/PDMS Micromechanisms for Jumping Microrobots, S. Bergbreiter

Joint ISR / NanoCenter Members

Pamela Abshire
Ray Adomaitis
Sarah Bergbreiter
Chris Davis
Alison Flatau
Reza Ghodssi
S.K. Gupta
Gary Rubloff
Ben Shapiro
Elisabeth Smela
Ian White
Miao Yu

AIMLab: Advanced Imaging & Microscopy Lab

The NanoCenter's AIMLab is home **to electron and ion microscopy** instruments, for state-of-the-art analytical and high resolution characterization techniques for research and education in the nano- and bio-sciences. Instruments include two JEOL 200kV transmission electron microscopes (with EDS, EELS, EFTEM and holography), a Hitachi FE-SEM with EDS, and a JEOL WDS and EDS microprobe. **In-situ TEM studies** are the highlight of research for these instruments.

Two dual beam (focus ion beam (**FIB)/SEM**) **systems** with gallium and plasma beams enable **sample prep, 3D characterization, micromachining, microfabrication and even microrepair**.

An NT-MDT electrochemical scanning probe microscopy system provides a wide variety of **scanning nanoprobe modes** plus coupling to microRaman, tip-enhanced Raman, and near-field scanning optical microscopy. UV-Vis and FTIR systems and other Raman systems complement the optical capability.

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