UNIVERSITY OF MINNESOTA
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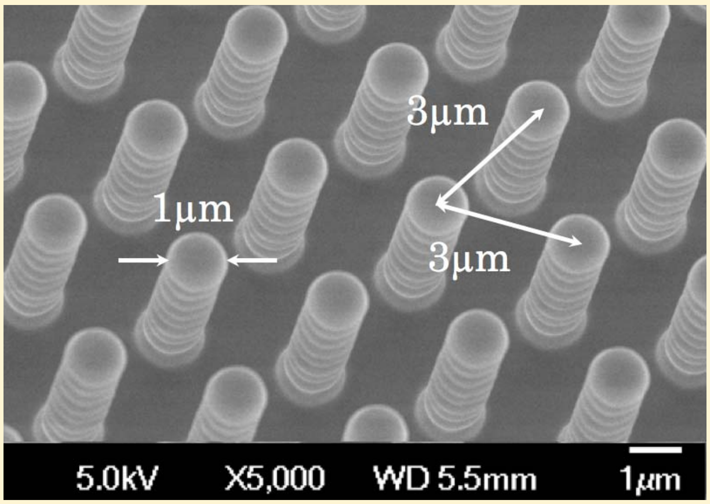
NANOTECHNOLOGY NEWS FROM THE UNIVERSITY OF MINNESOTA

SUMMER 2010

NNIN FEATURED RESEARCH



Agarose gels are the standard medium for separating DNA by size, but the separations are slow, require large amounts of DNA, and do not give quantitative results. Microfabricated post arrays, such as the one in this figure, reduce the separation time from hours to minutes while using only microliters of sample. Kevin Dorfman (Chemical Engineering and Materials Science) and his group are investigating the physics underlying DNA separations in these arrays and other microfabricated media. Photo courtesy of Kevin Dorfman and Jia Ou.

6th ANNUAL MINNESOTA NANOTECHNOLOGY CONFERENCE AND ELECTRICAL & COMPUTER ENGINEERING OPEN HOUSE

Save the date! The annual Nanotechnology Conference is coming this fall, October 7-8, 2010. We are busy planning and finalizing this year's topics and speakers, but you may review the past two conferences online at http://www.nano.umn.edu/conference2009/ and http://www.nano.umn.edu/conference2008/. This conference typically attracts 150 – 200 attendees from academia and industry throughout the region. As always, we will host a Reception and Poster Session on the evening of October 7 which is a great opportunity to network and talk to researchers one on one.

The University of Minnesota's Department of Electrical and Computer Engineering is hosting their annual Open House on Friday, October 8 from 12pm – 4:30pm in the main level atrium area of the Electrical Engineering & Computer Science Building. Come hear brief faculty updates and network with your friends and colleagues as the department opens the doors in your ECE home via poster sessions and open labs. For more information, visit www.ece.umn.edu or call 612-624-2284.

PHYSICS AND NANOTECHNOLOGY BUILDING UPDATE

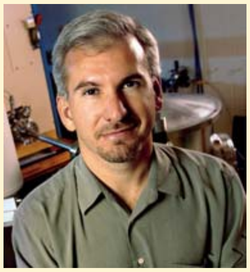
In a difficult economic environment, the Minnesota State legislature provided four million dollars in planning funds for the new Physics and Nanotechnology Building. I would like to express my sincere gratitude to the project's supporters, especially those from the private sector community, who championed this project at the legislature. NFC has been working with the architects. We expect 5000 square feet of clean room, more than doubling our current area. This is needed for our increasing user base and to accommodate new research areas such as nano bio and nano energy. The architects are placing the new clean room in a very prominent location near the building entrance, making it a point of pride for the entire community. The facility will also provide a small amount of temporary office space for our nearly 100 external users, many of whom visit the facility to get their work done.

Reminder: If your work uses the Nanofabrication Center please add the following in the acknowledgements section of any publication: "Parts of this work were carried out in the University of Minnesota Nanofabrication Center which receives partial support from NSF through the NNIN program."

Nanotechnology News from the University of Minnesota is published by the University of Minnesota's Center for Nanostructure Applications and made possible by:

Characterization Facility News

CharFac Director's Message



CharFac Director, Greg Haugstad

Equipment infusions once again dominate news in the CharFac. Successful grant-in-aid proposals have produced (1) a cryo attachment for our newest and most advanced microtome, the UC6 in our Hasselmo Hall EM facility; (2) a microcontact angle meter now positioned in our Shepherd Labs facility. Users began to receive training on the new cryomicrotome (for slicing thin samples) in March. The microcontact angle meter has been available for training since mid-May. Contact angle is the angle at which a liquid/vapor interface meets the solid surface. Measuring the contact angle of a water droplet on a given surface is a quick and easy way to evaluate the state of a solid surface. Research applications include wettability, surface affinity, adhesion, and repellency. The new instrument is capable of making droplets 20µm in size and 10 picoliter in volume, allowing contact angle measurement on microfabricated devices such as MEMS, as well as micro-regions on small objects such as biomedical stents.

The MRSEC has funded a new Agilent MACIII add-on electronics for our most advanced environmental AFM, located in Hasselmo Hall. This next-generation electronics, received in early May, enables several new imaging and measurement modes, plus improvements in resolution and speed for electrostatic and magnetic modes compared to the Veeco systems in Shepherd labs. These latter, traditional methods probe long-range interactions between tip and sample via a two-pass imaging scheme. The new electronics instead utilizes extra lock-in amplifiers tuned to frequencies higher than the fundamental cantilever resonance frequency to extract force information in parallel with surface topography, in a single pass. Higher cantilever eigenmodes also can provide materials contrast where lacking under conventional modes like phase imaging. For example the cantilever can be driven at both its fundamental resonance frequency and that of its second vibrational eigenmode. In one of our first tests, the amplitude signal of this eigenmode successfully contrasted phase-segregated domains of two similar glassy polymers, polymethyl methacrylate and polyethyl methacrylate, at room temperature where conventional modes had failed. At elevated temperature, upon the onset of conventional phase contrast as the glass-to-rubber transition of PEMA was approached, the second eigenmode generated contrast an order of magnitude stronger than conventional phase imaging.

(continued, top right)

Several investigators have been awarded a National Institutes of Health Major Research Instrumentation grant for a new 120-kV FEI transmission electron microscope, to be maintained and operated by the CharFac. CharFac staff scientist Dr. Wei Zhang served as the lead author of the proposal. Wei's research program in virology, within her role as Research Assistant Professor, resides in the Department of Diagnostic and Biological Sciences within the Academic Health Center, as do several of the coauthors' programs. Other coauthors represent additional AHC departments and research thrusts. The instrument will be equipped for cryogenic imaging as well as conventional room temperature TEM, and thus will be of interest to soft materials investigators (i.e., synthetic polymers) as well as the above bio-investigators. The TEM will be installed later this year.

A UV-Vis-NIR spectroscopy workshop was held in mid March and well attended. The CharFac continues to assess the level of interest in acquiring this capability. Please contact staff scientist Dr. Jinping Dong for more information.

CharFac at the University of Minnesota

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Greg Haugstad, Director

NANOFABRICATION CENTER NEWS

NFC DIRECTOR'S MESSAGE

NFC Director,
Steve Campbell

In this issue I would like to call your attention to two major upgrades to our nanofabrication infrastructure. In the last issue I mentioned three new tools that were funded through the support of NNIN and the American Recovery and Reinvestment Act. The first of these, a very easy to use electron microscope, is now up. User training will begin shortly. The system has EDS and can handle soft samples in a low vacuum mode. In June we expect delivery of an Advanced Vacuum model 320 batch reactive ion etcher configured for dielectric etching. This system is similar to the existing STS etcher which is heavily used, but is no longer supported by the vendor. Finally, we expect delivery of a new five-gun AJA sputtering system at the end of the summer.

Last fall NFC, working with co-PIs Professors Jim Leger and Paul Crowell, submitted a National Science Foundation Major Research Instrumentation (MRI) proposal. The MRI is a very competitive process that provides funding for large pieces of equipment that will have a significant impact on the country's research infrastructure. I am pleased to announce that, in an unusual outcome, our proposal was fully funded. With the mandatory University match, this will provide two million dollars for a state of the art direct write electron beam

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lithography system. In virtually every measure this system will be an order of magnitude better than our current Raith system, with a guaranteed resolution of 8 nanometer lines. Write times should also be much faster due to much higher beam currents and faster beam control. This is critical for projects that involve the fabrication of large arrays of structures. The existence of such a tool not only significantly bolsters academic research, it enables a broad range of nano-related R+D in the region.

IN PROCESS CHARACTERIZATION TOOLS

An important aspect of micro- and nanofabrication is the characterization of important details of a device and its constituent layers. This includes measurements of physical dimensions as well as thin film physical, optical and electrical properties. The Nanofabrication Center has a number of different tools available for these measurements. For physical dimensions, our state-of-the-art Tencor P16 surface profiler uses a contact stylus method for high accuracy measurements in x, y and z directions, with z resolution down to the nm level. The P16 can also be used to measure in-plane stress in deposited thin films. Higher accuracy dimensional information is available using the Digital Instruments 3000 atomic force microscope. The Hyphenated Systems confocal microscope uses a white light source and can measure in x, y and z directions to form 3D representations. This microscope, like the P16, can be programmed to make automated measurements at programmed site locations. For optical properties, NFC has standard ellipsometry for film thickness and index of refraction measurements, as well as a spectroscopic ellipsometer for more complex films. Thin film stress can also be measured at different temperatures with the FSM 900TC, a non-contact laser-based tool. All of these tools are available inside our cleanroom for your use.

SAFETY TRAINING

NFC is offering safety training for new users twice each month. On the first Thursday of every month, the training sessions begin at 1:00PM, and on the third Thursday of the month sessions begin at 10:00AM. The training includes watching our safety video and taking a brief quiz. Also, a NFC staff member provides a tour showing some of the safety related equipment and the gowning process used for the NFC cleanroom. Finally, there is training on using the Coral lab software. The safety training takes about two hours to complete, and must be done before users will be granted access to NFC facilities.

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and the National Nanotechnology Infrastructure Network.
Comments and suggestions are welcome! Would you like to be added to or removed from our distribution?
Contact: Becky von Dissen at vondi001@umn.edu or 612-625-3069

Center for Nanostructure Applications

The primary mission of the Center for Nanostructure Applications is to seed interdisciplinary nano research projects that will go on to attract external support. Active nanostructures include applications of nano as diverse as energy conservation and production, large area displays and lighting, printed electronics, smart fabrics, electronic noses, drug delivery, cancer therapy, and new types of medical imaging.

These applications often require significant participation across traditional disciplines and the Center is designed to foster the cross-disciplinary research necessary to bolster the nano applications area at the University.

The Center also organizes workshops, speaker series, and short courses, as well as serving as a focal point for nano at the University.

For more information, visit http://www.nano.umn.edu/

The National Nanotechnology Infrastructure Network

The National Nanotechnology Infrastructure Network (NNIN) is an integrated networked partnership of user facilities, supported by the National Science Foundation, serving the needs of nanoscale science, engineering and technology. The mission of the NNIN is to enable rapid advancements at the nano-scale by efficient access to nanotechnology infrastructure. The NNIN supports the Nanofabrication Center at the University of Minnesota. As a node in NSF's National Nanotechnology Infrastructure Network (NNIN), the NFC provides access to advanced multi-user facilities to both industry and academic researchers, the latter at a subsidized rate.

For more information, visit www.nnin.org