University of Minnesota

nanoTECHNOLOGY news

from the University of Minnesota

NNIN
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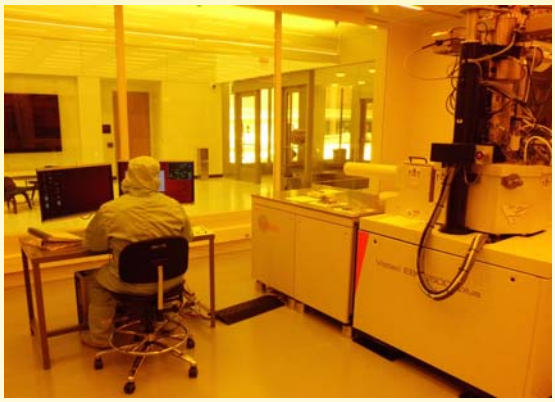
Nanoscale Science, Engineering & Technology

WINTER 2014

The completed College of Science and Engineering's Physics and Nanotechnology Building.



A user operating the Vistec e-beam lithography system. Notice the atrium and the main building entrance just outside the clean room.

The air handlers and walkable surface above the clean room. The clean room is hanging from the second floor ceiling on threaded rods.

A view of the open atrium just outside the clean room and the staircase to the second floor. This staircase employs wood stadium seating with power outlets for students to meet.

Grand Opening Celebration

The College of Science and Engineering invites you to the Grand Opening Celebration of the new University of Minnesota Physics and Nanotechnology Building. Join us for a public Open House on Thursday, April 24, 11 a.m.-2 p.m. or 4-7 p.m. Tours will be ongoing during these times. See the new 144,000-square-foot building that includes about 40 new research laboratories and more than 15,000 square feet specifically dedicated to nanotechnology research, including a 5,000-square-foot clean room.

REMINDER: If your work uses the Minnesota Nano Center (formerly NFC) please add the following in the acknowledgements section of any publication: "Parts of this work were carried out in the Minnesota Nano Center which receives partial support from NSF through the NNIN program."

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NSF

College of Science & Engineering

characterization FACILITY news

CHARFAC DIRECTOR'S MESSAGE

CharFac Director, Greg Haugstad

It is my great pleasure to introduce new staff member Klaus Wormuth, who joined the CharFac staff in late October following a lengthy career in US industry plus academic tenures in Germany. Many industrial users, clients and collaborators of the CharFac will remember Klaus from a decade (2001-2011) at then IPRIME-member SurModics in Eden Prairie, MN, primarily in analytical R&D in biomedical device coatings and surface modification. Earlier in his career Klaus worked in R&D at 3M (1990-96) and Imation (1996-99) characterizing data storage and imaging technologies. His academic stays were at University of Cologne (2011-13) working on microemulsions of water-diesel fuel, and Max Planck Institute of Colloid Chemistry in Berlin (1999-2001) working on magnetic latex. His PhD thesis research on microemulsions was with now-UMN president Eric Kaler, then at the University of Washington. Having earlier received his Bachelors of Chemical Engineering degree from the University of Minnesota, Klaus obviously has deep career roots in the Twin Cities, in addition to his personal ties of growing up in Minneapolis.

Klaus Wormuth

Klaus wears multiple hats in the CharFac. His lab work and training responsibilities are principally in X-ray microdiffraction and microcontact angle measurements; he is additionally active in analytical research using confocal Raman microscopy, FTIR spectroscopy and light microscopy (and further has hands-on experience in SEM and SPM). In addition, he is working to apply chemometric data analysis methods to mine spectral data. On top of these specific technical roles, Klaus has the meta role of Associate Director for Industrial Partnerships, liaising with current and prospective industrial collaborators and clients, with a particular expertise in biomedical materials, surface modification, surfactants, polymers and nanoparticles. Klaus' role will be large in growing the CharFac's (i) technical expertise vis-à-vis soft materials, (ii) R&D services to industry, and (iii) national reach in methods research, education and training. Klaus can be reached at kwormuth@umn.edu.

In January we installed the iCorr add-on to our FEI Spirit TEM in Moos Tower, as funded through the OVPR's RIIR competition (PI's W. Zhang and L. Mansky of the Institute for Molecular Virology and J. Mueller of Physics, plus 15 other investigative groups). iCorr is a pioneering method wherein imaging modes are combined to obtain correlative imaging at the data-acquisition level. Thus one can image a sample region with fluorescence light microscopy then switch to TEM and zoom in to overlay nanoscale features as resolved by the electron beam. On-line video demonstrations of this technology can be viewed at the vendor site, www.fei.com/correlative-microscopy/. For more information please contact staff members Wei Zhang (zhangwei@umn.edu) or Bob Hafner (hafne030@umn.edu).

A recent Grant-in-Aid award (PIs Macosko, Suryanarayanan, Haugstad) has enabled the acquisition of a Nano Thermal Analysis accessory from Anasys Instruments, which can rapidly ramp the temperature of an AFM tip and sense mechanical changes in the sample (e.g., due to glass transition, melting) akin to local DSC measurements. Also, one can image thermal conductivity or local temperature (e.g., in an operating device) via the thermal probe. Application notes can be found at the vendor site, www.anasysinstruments.com/technology/nanota-technology/, and on-line webinars also are accessible. The spatial resolution of transition temperature analysis is on the order of 100 nm. To aid with the interpretation of data on samples containing material heterogeneities on this scale (e.g., thin films), we will be adding a multiphysics finite-element simulation package (COMSOL). Together these new capabilities will push the frontiers of nanoscale materials characterization. Please email haugs001@umn.edu to discuss the potential utility in your research.

CHARFAC AT THE UNIVERSITY OF MINNESOTA

12 Shepherd Labs
100 Union Street SE
Minneapolis, MN 55455

Website: www.charfac.umn.edu
Email: charfac@umn.edu
Telephone: 612-626-7594

Greg Haugstad, Director

MINNESOTA *nano* CENTER *news*

MNC DIRECTOR'S MESSAGE

NFC Director,
Steve Campbell

As you may already know, the Minnesota Nano Center began operating as of July 1, 2013. Growing out of the University's Nanofabrication Center, the new Nano Center adds a larger, more advanced clean room for fabricating nanoscale electronic devices. Beginning in spring 2014, it will also introduce two new laboratories dedicated to nanoscale materials and the biomedical applications of nanotechnology.

The Nanomaterials Lab. A broad area of nanotechnology concerns nanoscale materials, of which nanoparticles, nanotubes, and nanocapsules are examples. A variety of nanomaterials are routinely used in many common products, such as paints, pharmaceuticals, inks, personal care products, and even food items. Researchers from the University and industry are developing new nanomaterials for applications ranging from solar cells to super-hard metal coatings to cancer therapies. To support this work, the Nano Center is opening its new Nanomaterials Lab. The lab will enable researchers to synthesize nanoparticles, chemically modify them for various applications, and characterize their key physical and chemical properties.

A large part of the lab's mission will be to provide particle characterization that is available nowhere else on campus. The Nanomaterials Lab will offer instruments to measure the size distribution, morphology, and ionic properties of particles ranging from a few nanometers to thousands of microns in size. The lab will also feature tools for particle synthesis and processing, including a full complement of chemistry lab apparatus, a controlled atmosphere glove box for protecting nanoparticles or other materials from oxygen and water, and a high purity water system. While several faculty have some of these tools in individual labs, the Nanomaterials Lab will offer a comprehensive suite of nanomaterials tools in a central core laboratory, open to users from all UM departments, other universities, and industrial labs. The Nanomaterials Lab is located directly opposite the new clean room in the Physics and Nanotechnology building, allowing researchers to more easily combine work with nanoparticles and nanoscale devices.

The Bio-Nano Lab. Also next to the new clean room is the Bio-Nano Lab, which will support researchers applying nanotechnology to the life sciences. Users of the Bio-Nano lab will be able to combine biomaterials (macromolecules, proteins, cells, tissues) with the micro- and nanoscale devices that can be fabricated in the new clean room. Researchers can also use the adjoining Nanomaterials Lab to synthesize nanoparticles, modify their surfaces, and affix them to cells for diagnostic labeling or to investigate therapies.

The Bio-Nano Lab will open in stages and will add equipment to reflect faculty interest. We plan to have several tools available for general use, including cell culturing materials, two CO_2 cell incubators, centrifuges, a laboratory refrigerator/freezer for sample storage, a fluorescence microscope with high speed camera and image analysis, and a laser scanning confocal microscope. The lab will also offer three Level 2 biosafety cabinets, a controlled atmosphere glove box, a general purpose autoclave, and chemical lab equipment for preparing and preserving samples. The new Bio-Nano Lab is intended to encourage interdisciplinary research and discovery between nanotechnology and the biosciences, and will complement other bioscience resources available at the University.

We invite the research community to visit us to learn more about our facility and new capabilities. Contact Jim Marti (jmarti@umn.edu) to set up a tour.

MINNESOTA NANO CENTER AT THE UNIVERSITY OF MINNESOTA

140 Physics & Nanotechnology Bldg
115 Union Street SE
Minneapolis, MN 55455

Website: www.mnc.umn.edu
Email: mnc@umn.edu
Telephone: 612-624-8005

Steve Campbell, Director
Greg Cibuzar, Lab Manager

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WWW.NANO.UMN.EDU

140 Physics & Nanotechnology Building
115 Union Street SE
Minneapolis, MN 55455

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Minnesota Nano Center: www.mnc.umn.edu

The MNC is a state-of-the-art facility for interdisciplinary research in nanoscience and applied nanotechnology. The Center offers a comprehensive set of tools to help researchers develop new micro- and nanoscale devices, such as integrated circuits, advanced sensors, microelectromechanical systems (MEMS), and microfluidic systems. The MNC is also equipped to support nanotechnology research that spans many science and engineering fields, allowing advances in areas as diverse as cell biology, high performance materials, and biomedical device engineering.

The MNC is composed of two main facilities. Our current clean room and associated labs, formerly known as the Nanofabrication Center, are housed in Keller Hall. The Keller Lab has a 3000 square foot Class 100 clean room, and an additional 4000 square feet of labs and support areas.

In late 2013, the MNC will open a new research facility in the Physics and Nanotechnology (PN) building. The new PN Lab facility will offer a larger and more advanced clean room, with state-of-the-art tools for fabricating structures under 10 nanometers in size. The MNC will also offer two new specialized labs to support interdisciplinary research in bio-nanotechnology and nano-and micrometer-scale materials.

The National Nanotechnology Infrastructure Network: www.nnin.org

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 Minnesota Nano 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.