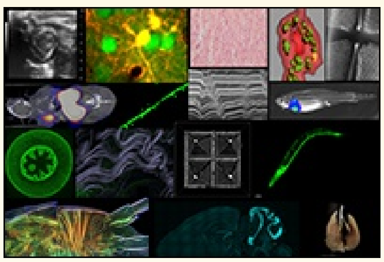
University of Minnesota
nanoTECHNOLOGY news
from the University of Minnesota
Winter 2020

University Imaging Centers

The University Imaging Centers (UIC) at the University of Minnesota is a University-wide fee-for-use resource offering imaging services across three sites on the twin-cities campus: Jackson Hall and the Cancer and Cardiovascular Research Building (CCRB) in Minneapolis and Snyder Hall in St. Paul.



The UIC offers a complete pipeline of imaging resources that integrate into other shared resources at the UofM in genomics, proteomics and computation. We have instrumentation and expertise available for teaching, training, acquisition and analysis. These services are offered over a wide range of imaging modalities and resolutions, ranging from electron microscopy to meso-scale in-vivo imaging. We house basic to advanced versions of super-resolution, multi-photon, light-sheet and high-content optical microscopy. Many of these modalities include environmental control.

UIC facilities also offer full sample preparation methods for light and electron microscopy; including serial block-face SEM and tissue clearing. Poster and 3D printing services are also available.

We are excited to announce the addition of Multi-plex Ion Beam Imaging (MIBI) to be added in February 2020, adding the ability to image tissue sections labeled with 40+ antibody/rare earth isotopes at variable resolutions up to that equaling diffraction-limited optical systems.

The UIC has been a Nikon Center of Excellence for 8 years–one of a select group of centers in the country. The designation recognizes the exemplary performance of the UIC as a service provider and as an integral component of fundamental research on imaging technology. This allows UIC users to evaluate and test cutting-edge imaging technology and expand its role as an international learning resource center.

The University Imaging Centers operates under the direction of Mark Sanders, and includes eight full-time staff and multiple undergraduate student employees. The future is bright, and quantifiably so.

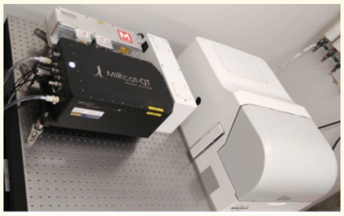
ACKNOWLEDGEMENT REMINDER
If your work uses the Minnesota Nano Center, please add the following in the acknowledgements section of any publications: "Portions of this work were conducted in the Minnesota Nano Center, which is supported by the National Science Foundation through the National Nano Coordinated Infrastructure Network, Award Number NNCI -1542202."

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

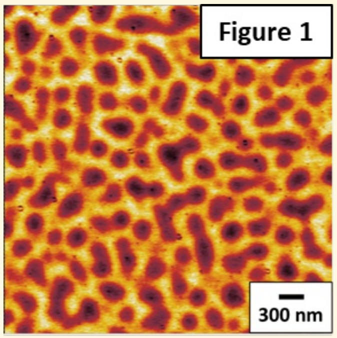
National Nanotechnology Coordinated Infrastructure

CharFac Director,
Greg Haugstad

In the fall we announced the soon-installation of two Bruker atomic force microscopy systems in the CharFac. These systems are now open for analytical work and training: the Dimension Icon (22 Shepherd Labs) and the NanoIR3 (1-206 Nils Hasselmo Hall). Here we feature the NanoIR3.

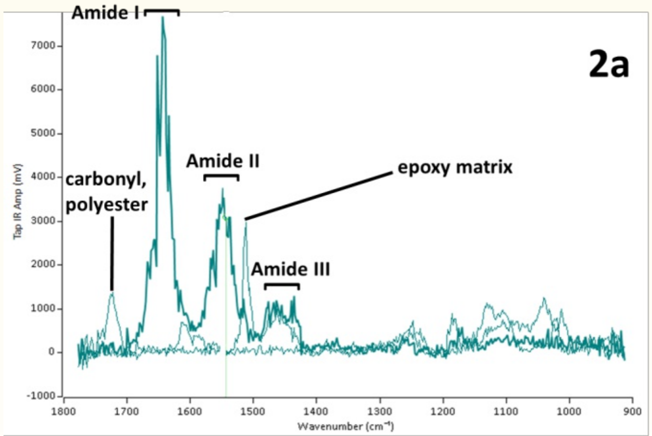


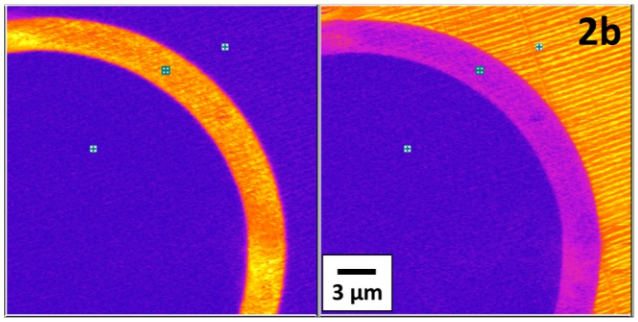
The photo shows the system on its optical table. It includes two laser types (left) spanning wave number ranges of 900-1800/2000-2300 cm^{-1} (via an assembly of 4 QCL chips, black box) and 2700-3600 cm^{-1} (OPO laser with red sticker). The AFM is inside the acoustic/thermal isolation container at right. The instrument confines the detection of IR absorption to the AFM *tip-sample interaction zone* such that the lateral resolution reaches 10's of nanometers (compared to ~10 *microns* with conventional IR microscopes). There can be a number of tip-sample interaction details that affect the quality and usefulness of the IR spectroscopy and imaging; thus we are eager to conduct feasibility work on a variety of sample types (contact cfac-spm@umn.edu with questions or to schedule a discussion).



Good examples of the sensitivity and resolution of the NanoIR3 are images of polymer blends or block copolymers. Figure 1 is an IR absorption image of a thin film of a 50:50 blend of poly ethyl:methyl methacrylate at **1026 cm^{-1}** laser irradiation, more strongly absorbed by PEMA compared to PMMA, resulting from the differences in side chains.

A second example is a cross-sectioned core-shell polymer fiber 40 microns in diameter. The polyamide nature of a 3-µm thick shell is obvious in a spectrum acquired local to this region, shown in Figure 2a (boldest plot). Figure 2b contains IR absorption images acquired at laser excitations of **1652 cm^{-1}** (left, an amide I absorption line) and **1512 cm^{-1}** (right), with three image markers denoting the acquisition sites of the spectra of 2a. In the right image the epoxy matrix (for microtomy) absorbs the strongest (brightest), followed by weak absorption by the polyamide shell, with little absorption by the polyester core (darkest).





CharFac at the
Univeristy 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

MNC Director,
Stephen Campbell

We submitted a successful proposal to the Office of the Vice President for Research which enabled us to add a second thermal ALD system. It is intended to provide backup on our current Savannah tool and to provide a wider range of materials. We had Kurt Lesker and Ultratech (current owner of Cambridge Nano) in to present their systems. Bids are due in mid-January. We expect the system to be available for use by the end of the summer.

Another new tool is a replacement for our 20-year old deep trench etcher. The reliability of this system has been declining in recent years and it finally failed in a way we could not repair. Watch your email for announcements about vendor talks.

Finally, we submitted an MRI proposal to NSF for an ultrahigh vacuum deposition and etching tool. Designed for qubit research, it is a rather unique system that combines confocal sputtering, closely spaced sputtering, e-beam and thermal evaporation, and an ion mill in a single vacuum system for sequential process recipes. We should hear back from NSF by late summer.

Minnesota Nano Center at the
Univeristy of Minnesota

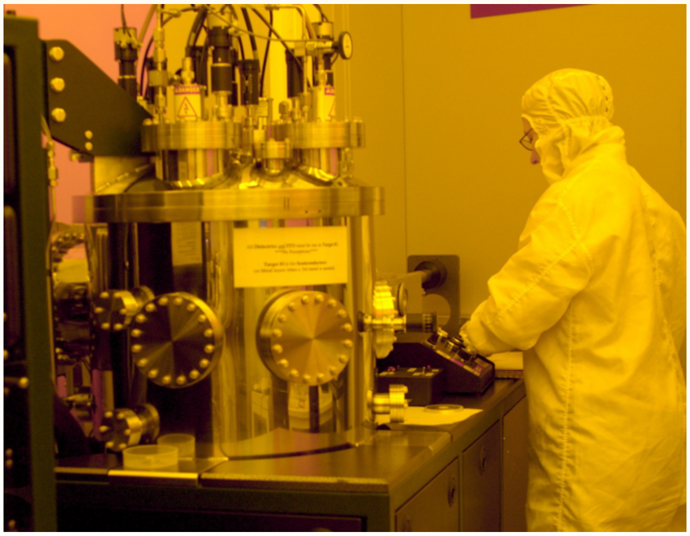
140 Physics & Nanotechnology Bldg
115 Union Street SE
Minneapolis, MN 55455

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

Steve Campbell, Director
Greg Cibuzar, Lab Manager

Processing Capability - Thin Film Deposition Techniques

An important aspect of many micro- and nanofabrication processing sequences is the deposition of thin films. The films may be conductors, insulators, semiconductors or magnetic materials. At the Minnesota Nano Center we have several different process tools for deposition of a wide variety of thin films using the techniques of evaporation and sputtering. We currently have 3 different electron beam evaporation systems in our cleanrooms. The CHA evaporator has complete automation capability, a six pocket gun, fixturing for both planetary and lift-off deposition, and heated deposition capability. The Temescal is an older, manual operation system with a four pocket gun and lift-off fixturing. Both systems can support four to six inch wafers and smaller. Commonly deposited films include Cr, Ti, Ni, Al, Au, Pt, Pd, Ag, Mo, Cu, and Ge. MNC sputtering capabilities are centered around two AJA International systems. These tools have both RF and DC guns (2 each), load lock loading, single wafer deposition up to 8 inch diameter, and heated deposition. Common materials include Al, Al_2O_3, Au, Cr, Cu, Ge, ITO, Ni, SiO_2, Ta, Ti and W. If thin film deposition is needed for your project, consider having the work done at MNC on these excellent systems.



The AJA sputter system at MNC.

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

Minnesota Nano Center and the National Nanotechnology Coordinated Infrastructure

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.

In September 2015, the National Science Foundation funded the National Nanotechnology Coordinated Infrastructure (NNCI). MNC is part of this initiative, along with our partner facility at North Dakota State University. The NNCI aims to advance research in nanoscale science, engineering and technology by enabling NNCI sites to provide researchers from academia, small and large companies, and government with access to university user facilities with leading-edge fabrication and characterization tools, instrumentation, and expertise within all disciplines of nanoscale science, engineering and technology. The NNCI framework builds on the National Nanotechnology Infrastructure Network (NNIN), which enabled major discoveries, innovations, and contributions to education and commerce for more than 10 years.

Nanotechnology News from the University of Minnesota
Published by the University of Minnesota's Nano Center.
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

This publication is available in alternative formats upon request.
Direct requests to Becky von Dissen, 612-625-3069/vondi001@umn.edu.
The University of Minnesota is an equal opportunity educator and employer.