University of Minnesota

nanoTECHNOLOGY news

from the University of Minnesota

Winter 2020

The Minnesota Nano Center is adding a powerful new analytical tool for those working with nanoparticles and macromolecules. The Beckman Optima analytical ultracentrifuge (AUC) has arrived at the Center and will be installed in early February. After installation and user training, the new AUC will offer researchers a state-of-the-art platform for characterizing proteins, polymers, nucleic acids, and other macromolecules, as well as measuring nanoparticle size, shape, and surface structure. The Optima AUC will be the only instrument of its kind at the University of Minnesota, and was obtained with major funding from the National Institutes of Health.

Analytical ultracentrifugation is a technique that monitors the behavior of nanoscale materials as they sediment under the large settling force developed in a specialized high speed centrifuge. Sample vials are loaded in the AUC's instrumented rotor, which has windows through which the sedimentation of suspended particles in the sample can be recorded. The rotor is spun at up to 60,000 rpm, developing a force on suspended particles equal to 250,000 times normal gravity. This huge force causes macromolecules and nanometer-scale particles to sediment (or rise, if their density is lower than that of the suspending liquid).

The sedimentation velocity measured by the AUC provides information on the size, shape, and molecular weight of macromolecules, as well as the interactions between them. This method is a direct measurement of molecular weight, and does not rely on calibration or assumptions about molecule shape. It can also reveal changes in molecular weight when molecules associate to form more complex structures, common in many biological systems.

Those working with inorganic or organic nanoparticles will also find the AUC useful, especially as an adjunct to other methods like dynamic light scattering and nanoparticle tracking analysis. Ultracentrifugation can determine size distributions of mixtures of multiple components, and no knowledge of particle optical properties is required.

We expect to complete testing on the Optima AUC by late February and to begin opening the tool for users soon thereafter. The Nano Center will be offering a series of webinars to introduce the AUC to the research community—check the Nano Center webpage for updates.

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 Nanotechnology Coordinated Infrastructure (NNCI), under Award Number ECCS-2025124."

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

characterization FACILITY news

CharFac Director,
Greg Haugstad

The Characterization Facility is excited to communicate the acquisition of two Thermo Scientific Talos 200-kV field emission gun transmission electron microscopes (TEMs), one recently installed and another to be installed next year.

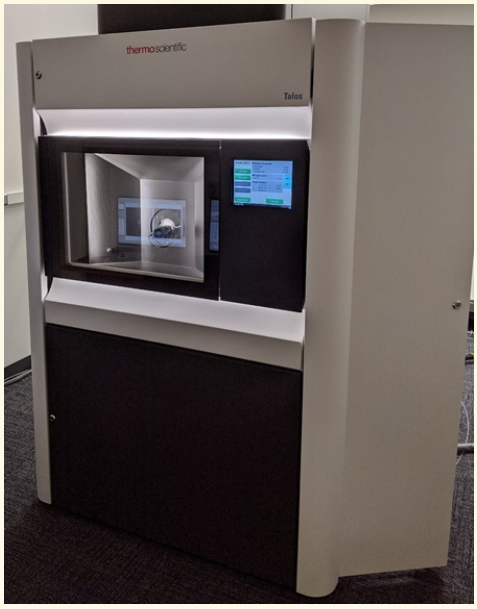
A Talos F200X TEM has been installed in our Shepherd Labs site. The microscope was primarily funded by the OVPR infrastructure program, with a large match from the CSE dean; proposal lead author was Prof. Andre Mkhoyan (an initiative that predates Covid-19). This Talos microscope supplants the FEI Tecnai F30 microscope that previously occupied the same room (now renovated) as our standard for high-resolution materials science TEM imaging. In addition to HRTEM, the microscope also brings several new capabilities to our TEM suite: fast and accessible elemental mapping in 3D via energy dispersive X-ray spectroscopy (EDS) and EDS tomography, 30+ fps imaging for *in situ* analysis using a Ceta CMOS camera, improved stability and drift-compensation from piezo-enhanced stage control, and micro electron diffraction for crystallographic analysis of nanoscale single crystals. The time frame for training will be communicated soon (contact Dr. Jason Myers, jcm@umn.edu).

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



A Talos F200C TEM will be installed at our Nils Hasselmo Hall site in 2022. The microscope and the first 2.3 years of maintenance contract are funded by a DOE Multidisciplinary University Research Initiative grant to Profs. Uwe Kortshagen, Peter Bruggeman and Andre Mkhoyan. This versatile TEM will support *in situ* plasma-grown nanoparticle research and also cryo-TEM imaging for samples in structural biology, nanotechnology and polymer science. It will be installed in a room currently housing some of our microtomes and related hardware (which will be repositioned in available space). Note that the ability to leverage grant funding opportunities to address disparate research needs is one of the main value propositions in serving both engineering and bio/soft-matter disciplines with a single electron microscopy facility.

Regarding budget: Once each of these scopes begins to accrue ongoing maintenance contract costs (i.e., beyond 1-year warranties plus maintenance contracts funded during purchase), the intent is to decommission the T12 in Shepherd and the cryo-F30 in Hasselmo (the latter is nearly 5 years away). CharFac ultimately will reap lower overall maintenance costs by decommissioning a total of three TEMs, including two 300kV machines, and adding the two 200-kV TEMs. This is on top of the scientific benefit of replacing vintage 2000's technology with vintage 2020's technology.

MINNESOTA nano CENTER news

MNC Director,
Stephen Campbell

I hope that all of you are holding up during this very stressful time. The Nano Center is seeing quite a bit of change. The front page of the Newsletter talks about our new Analytic Ultracentrifuge. We hope that this tool will attract a wide range of new users, especially nontraditional users, to MNC. Greg Cibuzar notes on this page that a new ALD tool has become available. This was funded through a successful proposal to the Office for the Vice President for Research. We thank the OVPR for their support. If you have needs for new ALD materials, please talk to Greg as we have more flexibility now. Finally, we expect our new UHV deposition/etch system to arrive in March. This will provide unique capabilities for ultra-clean films and interfaces.

Finally, I also want to thank Mark Fisher and Rich Macy for all their years of service to MNC. I can get rather caught up in talking about new pieces of equipment, but Mark, Rich, and the other staff members are absolutely critical to making these systems valuable to our users. We will miss their technical skills and their friendship. Mark and Rich are two of our very best in both.

Minnesota Nano Center at the
Univeristy of Minnesota

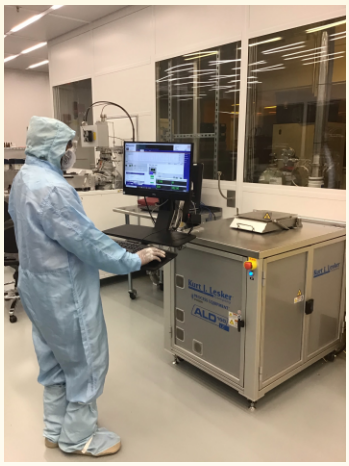
140 Physics & Nanotechnology Bldg
115 Union Street SE
Minneapolis, MN 55455

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

Steve Campbell, Director
Greg Cibuzar, Lab Manager

MNC New ALD Capability

October our new atomic layer deposition (ALD) tool from Kurt J. Lesker came on-line for use in the deposition of Al2O3 and TiO2. The KJL 150 LE is a thermal ALD that can accommodate substrates up to 150mm in size. The new tool is located in the PAN cleanroom, which now has both thermal and plasma ALD tools. We now have thermal ALD capabilities in both the Keller and PAN cleanrooms. In the next few weeks we will be adding a Zr precursor as well.



MNC Staff Update

On January 15 MNC will be losing two longtime members of the cleanroom technical staff. Mark Fisher and Rich Macy both began their careers here in 1995. Mark has been the senior process staff member and has worked with many students and companies on mask design and mask fabrication. Over the years Mark has fabricated thousands for photomasks for researchers. His wide processing experience and inquisitive manner enabled him to understand researcher's processing issues and help with solutions. Many graduate students benefited directly from his help. Rich Macy's role as a maintenance staff member was less visible to researchers, but no less important. As the senior maintenance staff member, over his 25+ years Rich has supported nearly every tool in the MNC cleanrooms. He has been instrumental in keeping our aging tool set operational, and has been an invaluable resource for more junior members of the maintenance staff as they learn their trade.

nanoTECHNOLOGY news
from the University of Minnesota

WWW.NANO.UMN.EDU

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.