University of Minnesota

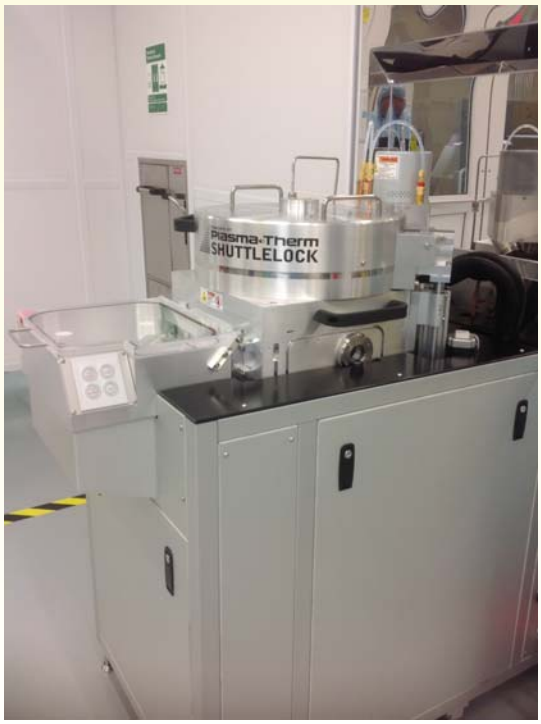
nanoTECHNOLOGY news

from the University of Minnesota

WINTER 2016

New Deposition Tools in the PAN Cleanroom

The new Fiji 200 Gen 2 plasma-assisted atomic layer deposition (PE-ALD) tool that we recently ordered from Ultratech has been installed in bay 3 of the PAN cleanroom. This tool extends the capabilities of our existing thermal ALD tool that is focused on oxide films such as silicon dioxide, titanium dioxide and hafnium dioxide. The Fiji tool will greatly expand our ALD capabilities to include nitride and metal films. Specific films will include titanium nitride, hafnium nitride, silicon nitride as well as silver and platinum films. The Fiji has a loadlock chamber to allow the deposition chamber to remain under vacuum at all times to reduce contamination effects of oxygen and water vapor. The chamber can accommodate wafers up to 200mm in diameter and has film thickness variations of less than +/-2% across a wafer (5mm edge exclusion), as well as from wafer to wafer. The substrate temperature range is 0 to 400°C. The Fiji is installed, operational, has passed the acceptance criteria and is ready for use.



The new Apex SLR HDP-CVD tool from Plasmatherm is a high density ICP plasma source tool for chemical vapor deposition (CVD) of a variety of films. While similar to a standard plasma-enhanced CVD tool, the high density plasma source enables high quality films at much lower deposition temperatures, even under 100°C. The ability to deposit films at lower temperatures will allow substrates with lower melting temperature materials to be coated with high quality films, which cannot be done with our current PECVD tool. The Apex SLR tool is set up for depositing the following films: silicon nitride, silicon dioxide, doped silicon dioxide (boron or phosphorus), silicon carbide, and diamond-like carbon (DLC). The tool has a loadlock chamber capable of handling wafers up to 200mm in diameter. Film uniformity specifications are +/- 4% on a 100mm wafer, with deposition rates more than 6nm/min for all films. The tool has been received and sited in the PAN cleanroom and is currently being connected to the necessary support utilities. We expect the tool to be ready for users in March.

REMINDER: If your work uses the Minnesota Nano Center, please add the following in the acknowledgements section of any publications: "A portion of this work was carried out in the Minnesota Nano Center which receives partial support from the NSF through the NNCI program."

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

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CHARFAC DIRECTOR'S MESSAGE

CharFac Director, Greg Haugstad

CharFac is currently gauging interest in new spectral imaging systems with submicron spatial resolution. These methods utilize technologies very similar to AFM (i.e., sharp stylus probes) along with laser irradiation to produce near-field enhanced scattering or photothermal absorption. Our organized workshops in May 2015 and January 2016 introduced these new technologies by vendors Anasys (Santa Barbara, CA) and Neaspec (Munich, Germany). Upcoming demos will be performed by Anasys at their headquarters in mid March and by Neaspec in the CharFac in early April. Thus we are seeking diverse samples with which to test these capabilities. The range of materials can span all (solid) classes in principle, the key being submicron chemical or dielectric heterogeneity (perhaps as small as ~20nm). Indeed the broader the range of successfully demonstrated capabilities, the greater the likelihood of assembling funding to purchase a system; and the easier to cover ongoing operations costs from user revenue. If interested in submitting samples for (free) analysis by these methods please email haugs001@umn.edu.

In other instrumentation news, we have upgraded both of our Bruker scanning probe microscopes to the latest control computers and electronics. This positions the CharFac to benefit from ongoing developments (which require newer electronic systems and a 64-bit version of Windows). Among the current new capabilities are improvements in force(-distance) curve measurement and calibration as well as new physical algorithms for tip-sample adhesive contact mechanics. Moreover, one can point to a spot of interest within an actively acquiring image and collect a force curve and related physical information. The setting of parameters and extraction of physical information is also improved in tapping mode (resonant dynamic or AC AFM). And the selection of and sensitivity to setpoint, for both fast force curve imaging (peakforce) and tapping mode, have been improved.

The CharFac is excited to add a fresh face to the technical staff, Geoff Rojas. Geoff is a condensed matter physicist with a Ph.D. from the University of Nebraska, Lincoln. His graduate work was followed by a two year postdoctoral appointment at the Imaging Characterization user facility at Oak Ridge National Laboratory. His research focused on *in situ* growth and characterization of ultrathin films using a variety of techniques including scanning tunneling microscopy, local probe spectroscopy, X-ray diffraction, and X-ray and ultraviolet photoelectron spectroscopy. He came to the University of Minnesota in 2013 as a postdoctoral associate to study interface chemistry, printing techniques, and scanning force microscopy. A committed researcher at the University of Minnesota, his interests include the development of multidimensional surface probe techniques, nanoscale characterization of mechanical and chemical properties of active biological systems, and the *in situ* study of functional materials using both local and integral spectroscopy methods.

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Greg Haugstad, Director

MINNESOTA *nano* CENTER *news*

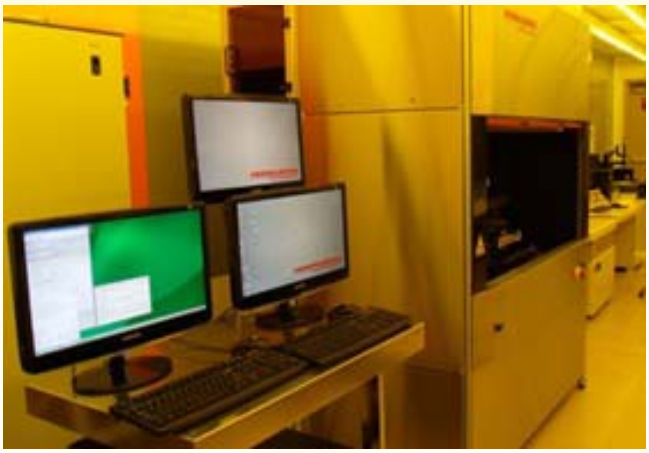
MNC DIRECTOR'S MESSAGE

MNC Director, Steve Campbell

In this newsletter you will find information about two new deposition systems that are about to come on line at the MNC. Beyond that are two more deposition systems for supporting the National Nanotechnology Coordinated Infrastructure (NNCI) new focus area in two dimensional (2D) materials. Prof. Steve Koester (Electrical and Computer Engineering department) and I developed a reactor for forming thin layers of graphene on copper foil. In the next few months this system will be made available to other users. Watch for announcements. I have also secured funding to acquire systems for depositing transition metal dichalcogenides (TMDs), a very popular set of 2D materials. The proposed system will have two reaction tubes. The first will be used for sulfides such as MoS_2 and WS_2, while the second will be dedicated to selenides. The system will employ a load lock to allow samples to be transferred between the tubes without air exposure, and can be run in either a vapor transport (the current default way to make TMDs) or chemical vapor deposition modes. The latter is a process currently under development at multiple labs. I expect this system to be delivered in the summer of 2016.

New Rates For Photomasks

With our recent purchase of a DWL200 laserwriter system from Heidelberg Instruments, we are now able to provide improved maskmaking capabilities at a lower cost. We have two laser write heads for the DWL200, one capable of features down to 1.5 microns, the other to 1.0 microns. Previously we could not routinely go below 1.5 microns. This new system also allows simplified design rules and lower pricing. Pricing for academic masks is $230 for features down to 1.5 microns, and $410 down to 1.0 microns. Industrial pricing has also been reduced to $485 for features down to 1.5 microns. The design rules and mask submission form can be found on the left side of the MNC home page (www.mnc.umn.edu). Questions can be emailed to nfcmasks@umn.edu.



Heidelberg DWL200 Laserwriter

New User Orientation

MNC is offering New User Orientation for new users twice each month. On the first Thursday of every month, the session begins at 1:00pm, and on the third Thursday of the month the session begins at 10am. A MNC staff member provides a tour showing some of the safety related equipment and the gowning process used for the MNC cleanroom. There is also training on using Badger, the lab software. The safety training takes about one hour to complete, and must be done before users will be granted access to MNC facilities. See the 'For New Users' section of our website for complete information: www.mnc.umn.edu/newusers.php.

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Nanotechnology News from the University of Minnesota
Published by the University of Minnesota's Nano Center.
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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. The Keller Lab has a 3000 square foot Class 100 clean room, and an additional 4000 square feet of labs and support areas.

In January 2014, the MNC opened a new research facility in the Physics and Nanotechnology (PAN) building. The new PAN facility offers a larger and more advanced clean room, with state-of-the-art tools for fabricating structures under 10 nanometers in size. The MNC also offers two new specialized labs to support interdisciplinary research in bio- nanotechnology and nano-and micrometer-scale materials.