University of Minnesota

nanoTECHNOLOGY news

from the University of Minnesota

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Nano Materials and Bio Nano Facilities Update

Over the past six months, new tools have been installed in the Nanomaterials and Bio-Nano labs. These tools will expand users' ability to characterize nanoparticles, apply thin films, and analyze DNA from biological samples.

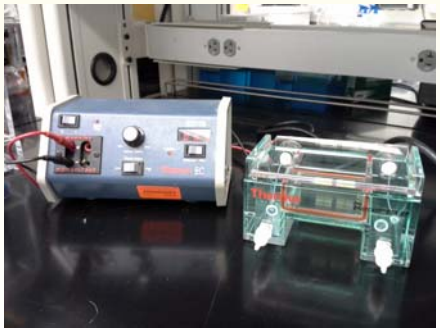
A new tool for analyzing biological particles

Several Nanomaterials Lab users have begun working with biologically-derived particles in the sub-micron size range, such as cell organelles, viruses, and liposomes (balloon-like structures that hold great interest for drug delivery applications). These biological nanoparticles can sometimes be a challenge for the particle analyzers currently in MNC labs. To provide our lab users with better methods for biological sample analysis, we applied for and won a grant under the Grant-in-Aid program to acquire a new type of nanoparticle analyzer, the qNano Gold by Izon Science. The qNano uses an electrical pulse sensing method to analyze particles from 30nm up to 10 microns in size, simultaneously measuring particle size, particle electrostatic charge (zeta potential), and particle concentration. The qNano's detection method makes it well suited to analyzing bio-nanoparticles, at the same time complementing our other light scattering-based analysis tools in the lab.

The qNano Gold was received in mid-January and will be available for user training in February. Speak to Jim Marti to learn more about how the qNano might improve your particle analyses.

A general purpose precision spin coater

Also new in the Nanomaterials Lab is a precision spin coater, the Laurell WS-650. This coater takes 100 to 150mm wafers, and since it is installed in our lab fume hood, it can be used with many solvents that may not be welcome in the MNC cleanroom spinners. See Jim Marti to learn more or to gain access to the spin coater.



New tool in the Bio-Nano Lab: Gel electrophoresis

The capabilities of the Bio-Nano lab continue to expand. Recently the lab acquired two types of gel electrophoresis systems (GES), which are used to separate mixtures of DNA, RNA, or proteins by molecular size. The basic horizontal GES may be used to separate DNA fragments of different size, and has been set up and tested. Coming soon will be a vertical GES capable of high resolution separation of proteins.

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."

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characterization FACILITY news

CharFac Director, Greg Haugstad

In January the first two (of soon four) major instruments were installed in our Shepherd Labs basement facility (#1-2 below). These systems not only modernize but also substantially expand capabilities while improving user friendliness. Those interested should contact the staff scientists managing the instruments to discuss capabilities (contact info at www.charfac.umn.edu/staff).

(1) A new Phi VersaProbe III X-ray/ultraviolet photoelectron spectrometer (XPS/UPS) has been installed in CharFac's surface-analytical area, managed by Drs. Bing Luo and Geoff Rojas. As previewed in earlier newsletters, this system is a radical improvement in both spatial and energy resolution (the latter for chemical state analysis), angle-resolved measurements and sensitivity. It adds the fundamentally new capabilities of UPS and cluster-ion beam sputtering (for compositional depth profiles). UPS enables the probing of electronic valence states as well as shallow core energy levels. Cluster-ion sputtering is ideal for soft materials by minimizing the perturbation of chemistry, a serious issue with classic single-atom sputtering gases such as argon. More detailed information is available at the vendor web site: www.phi.com/surface-analysis-equipment/versaprobe.html.

The Phi VersaProbe III XPS/ UPS in CharFac room 22.

(2) A new FEI Helios NanoLab G4 dual-beam focused ion beam (FIB) instrument has been installed in an available bay in the vibrationally isolated High Resolution Microscopy Center (HRMC), managed by Dr. Nick Seaton. The FIB provides fast, accurate, and precise milling and deposition of complex structures with critical dimensions of less than 10 nm. Its ultimate SEM imaging resolution approaches 0.6 nm. More detailed information is available at the vendor web site: www.fei.com/products/dualbeam/helios-nanolab/

The FEI Helios dual-beam FIB in CharFac's High Resolution Microscopy Center.

CharFac will retain its current SSI XPS for survey work and low-resolution applications as well as backup capacity, and recently added a scanning Auger microscope (3M gift) as described in the fall 2015 newsletter. Two currently active instruments will be sold: the JEOL 6700 SEM in Shepherd and the FEI Quanta 200 FIB in the Minnesota Nano Center. (buyers: e-mail charfac@umn.edu.)

As preview, two other major systems arriving this spring are (3) a state-of-the-art X-ray scattering system that spans from small- to wide-angle, the Xenocs GANESHA (saxslab.com/ganesha), to replace the current 2-meter SAXS line; and (4) a refurbished ultrahigh vacuum scanning tunneling microscope (STM) with capabilities for vacuum sample transfer from PI lab to CharFac, low-temperature measurements (I-V, Z-V, I-Z), and some in situ growth and sample preparation.

As a final note, also in January a new energy-dispersive spectroscopy (EDS) system was installed on our JOEL 6500 SEM in the Shepherd HRMC, replacing an aged/failed EDS. Thus now **two** SEM systems (the 2-year old Hitachi cryo-SEM in Hasselmo as well as the 6500) are equipped with new EDS technology. We plan to add an identical EDS system to the FIB in the near future. Maintaining three EDS systems is justified by a growth in usership together with multiple analytical roles of each instrument.

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Greg Haugstad, Director

MINNESOTA *nano* CENTER *news*

MNC Director,
Steve Campbell

The last few fiscal years have been difficult financially for MNC. Unanticipated expenses, coupled with a loss of internal income last year due to the extended Vistec down time caused a modest annual budget deficit. This ultimately led to our carryover going negative for the first time in quite a while. After consultation with MNC's faculty advisory committee, it was decided last summer that a modest (~4%) rate increase was needed. I am pleased to report that MNC's financial situation is greatly improved. The increase in rates, the restoration of the Vistec to its high level of uptime, and a nearly 50% increase in income from external users, have us projecting the elimination of the deficit for the current fiscal year. This spring you can expect to see the installation and acceptance of our transition metal dichalcogenide deposition system as well as the new wafer-scale AFM system in PAN.

MNC Equipment Update

The new cleanroom in the Physics-Nanotechnology building (PAN) has 3 new tools being installed. First is a CVD tool from Planartech that will be used to deposit two dimensional (2D) transition metal dichalcongenide (TMD) materials (sulfides and selenides). The tool will initially be used for MoS2 and WSe2 films, with others added moving forward. The TMD deposition tool will be operational in late spring.

The Planartech 2D transition metal dichalcongenide system.

The second tool is a glove box that will contain equipment that will allow handling of oxygen sensitive 2D materials, including exfoliation of 2D films, transferring and positioning the film to a device substrate. This is an important process for using 2D materials in devices. The third tool is a recent donation from Seagate Technologies of a Digital Instruments DI 5000 AFM tool. Currently MNC only has an older DI3000 AFM in the Keller cleanroom. The new DI 5000 will add AFM capability to the PAN cleanroom and represents a big step forward for our AFM capabilities. The tool will be ready for use later this spring.

New User Orientation

MNC is offering New User Orientation for new users twice each month. On the first Wednesday 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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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.