April 2015

CNMS User Newsletter

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Important Dates:

- Call for User Proposals: *Deadline April 29*
- CNMS User Meeting *September 1—2*
- Webinar on PFM *May 4 and May 6*
- Joint NSRC Workshop *June 8—10*

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Message from the UEC Chair

Welcome to the Spring 2015 CNMS Newsletter.

We have a full set of news for you, but first and foremost, I want to start by drawing your attention to the dates for our Annual User Meeting: The meeting will be held on Wednesday, September 2, 2015.

The format for the meeting this year has substantially changed from previous years. Specifically, we are going to have five roundtables, highlighting emerging topics, of general interest to the CNMS user community and staff. This format was chosen to enhance the contribution of the user (and future user) community into the strategic planning for CNMS. We are hoping to create a format that will result in open discussions on current challenges and future directions, identify areas of growth need for CNMS, and result in fruitful future collaborative and teaming efforts.

Each session will have multiple invited talks and allow for general contributions, too. However, all talks will be accompanied by posters, and the oral presentations will be kept in short format, focused on emerging opportunities and directions forward. All sessions will include a substantial amount of open floor discussion, which are expected to result in a set of recommendations to be discussed at the plenary Strategic Planning session with the CNMS leadership and all the meeting attendees. The UEC plans to submit the resulting document, after appropriate reorganization and write-up, to the CNMS leadership, as direct input from the users cohort for the 2015-2016 CNMS Strategic Planning process.

I want to also draw your attention to the update to the CNMS webpage on Operating Hours. We want to stress once more that in many cases, it is possible to arrange for after-hours operations after direct discussion with the appropriate staff members. Such arrangements will be especially useful if made in advance of the visit. New emphasis was placed on this directly after input from the UEC to the CNMS leadership, based on the annual User satisfaction survey. I want to reiterate that is vital for you to continue communicating directly with the UEC and the CNMS. Send us an email, pick up the phone and call us (our contact info is on the User Group webpage). We want to hear from you: any idea, suggestion and recommendation has the potential to make CNMS is a better place for both the staff and the external users.

Remember to save the date for our Annual meeting in September and I am looking forward to meet you there.

Nazanin Bassiri-Gharb
Georgia Institute of Technology, Atlanta, GA, USA

Upcoming Events

Spring 2015 Call for User Proposals

The spring proposal call was announced March 2 with a proposal deadline of Wednesday, April 29. Notifications of proposal decisions should be made during the week of June 22 and approved projects eligible to start work beginning August 1. If you have a project due to expire on July 31, 2015, and would like to continue, this is the time to submit a new proposal. See User Program >> Active Projects on the CNMS website for a list of projects and PIs with expiration dates.

*** It is important to use the latest version of the **CNMS Proposal Form** because the equipment offered is subject to change and only the latest form contains the up-to-date list.***

About the UEC
-Contact information
-Web links

2015 User Meeting: September 1-2

The CNMS UEC continues to develop plans for the 2015 CNMS User Meeting. Current plans are for this year's meeting to be concentrated into one day on Wednesday, September 2, and have a different format than past meetings. The format is being revised to increase opportunities for members of the user community to provide input and feedback to CNMS and the UEC, especially to make the meeting more forward-looking rather than reflective on past research accomplishments. In the current plan, the core of the User Meeting will consist of several parallel discussion sessions providing opportunities for attendees to exchange perspectives on various aspects of the CNMS Strategic Plan with CNMS management and staff. Results of those break-out sessions will be shared in a Strategic Planning session at the end of the day, which will provide a basis for the UEC to generate a set of recommendations for consideration by CNMS management during the annual update of the CNMS Strategic Plan later this year. Featured workshops are being planned for the day before the User Meeting, September 1.

Webinar on Piezoresponse Force Microscopy: May 4 and May 6

CNMS' Sergei Kalinin will join Asylum Research President and co-founder Dr. Roger Proksch to co-host a two-part webinar series May 4 and May 6 on piezoresponse force microscopy in electromechanical coupling as one of the fundamental mechanisms underlying the functionality of many materials. For more information or to register for this webinar visit http://www.asylumresearch.com/News/News.shtml#PFM-Webinar.

Joint NSRC Workshop on Materials Imaging: June 8-10

The five Nanoscale Science Research Centers are jointly organizing a workshop on "Big, Deep, and Smart Data Analytics in Materials Imaging" to be held at ORNL on June 8-10. This workshop will bring together researchers from different imaging disciplines (electron microscopy, scanning probe microscopy, focused x-ray, neutron, atom probe tomography, chemical imaging, optical microscopies) as well as experts in mathematical/statistical/computational approaches to discuss opportunities and future needs in the integration of advanced data analytics and theory into imaging science. For more information, see the workshop description.

News from CNMS

CNMS Response to UEC Recommendations on the 2014 User Satisfaction Survey

The January 2015 newsletter described how the CNMS UEC reviewed the results of the 2014 User Satisfaction Survey and generated several recommendations for CNMS to improve certain communications with its user community. In response to those recommendations, CNMS has made the following changes:

- ORNL holidays are now listed on the Working at CNMS >> Operating Schedule web page;
- Clarification has been added to the Working at CNMS >> Operating Schedule web page explaining that users can request extended hours in certain CNMS facilities and such requests may be granted on a case-by-case basis subject to user proficiency and availability of equipment and staff;
- To further reduce the number of instances where a proposal requests instrumentation that is not offered by CNMS, notices have been added to the CNMS proposal submission instructions and the proposal form stressing the importance of using the latest version of the proposal form, which contains the most up-to-date instrument list.

Change in Photo Identification Requirements for ORNL Entry

Effective March 30, 2015, ORNL has become fully compliant with the federal REAL ID Act of 2005. This Act requires that anyone accessing a Federal Facility such as ORNL must present a compliant form of photo identification. Driver's licenses issued by certain states and territories are not REAL ID compliant and these can no longer be accepted as proof of identity for entry to ORNL. Please visit http://www.dhs.gov/real-id-enforcement-brief for an up-to-date list of noncompliant states. Users who carry a driver's license from one of these noncompliant states will need to provide some other form of approved identification as listed at http://www.tsa.gov/traveler-information/acceptable-ids. Users will not be allowed entry to any ORNL facility without some form of compliant identification. Note that this change does not affect foreign nationals, who must always present a Visa and Passport upon arrival at the ORNL Visitor Center to receive their ORNL badge.

Recent Staff Changes

Welcome Olga Ovchinnikova to CNMS! Olga had been a staff member in the Chemical Sciences Division at ORNL and transitioned to CNMS on April 6. She joins the Chemical Functionality task within the Nanomaterials Synthesis and Functional Assembly (NSFA) group. At CNMS, she will combine her expertise in chemical imaging and laser spectroscopy with Chemical Functionality activities and research across the NSFA area, including use of the He-ion microscope.

Viviane Schwartz, a staff scientist associated with the Chemical Functionality task in CNMS, left at the end of March to take a position at Basic Energy Sciences headquarters as a Program Manager for Catalysis Science.

Pam Fleming, a technician in the Nanomaterials Synthesis and Functional Assembly Group, retired at the end of February, after 40 years of service at ORNL.

Career Opportunities at CNMS

Visit the website for more information and links to view open positions as well as other opportunities at ORNL.

Export Control Review of User Proposals

Along with reviews for feasibility, safety and health, and scientific merit, all CNMS user proposals are also reviewed to identify potential for any export control requirements, including the possibility of deemed exports (technology transfer to a Foreign National within the United States), that may require an export license or exception/exemption authorization.

The vast majority of user research at CNMS is intended for publication and is therefore considered fundamental research, defined by the U.S. Government as "basic and applied research in science and engineering, where the resulting information is ordinarily published and shared broadly within the scientific community." Information resulting from fundamental research is normally outside the scope of U.S. export controls and does not require an export license as long as no restrictions are placed on the dissemination of the information resulting from the research.

Consequently, the initial step in export control review for CNMS user proposals is to determine whether such restrictions on publication may in fact exist. While very rare in CNMS user proposals, we occasionally identify proposals that may be subject to publication restrictions for either or both of the following reasons:

(1) The research is related to activities that are prohibited by the US Departments of Commerce or State [Military/Aerospace/Missiles, Nuclear Reactors or Enrichment, Advanced Encryption, or Weapons of Mass Destruction], and/or

(2) The sponsoring contract for U.S. government-funded research includes specific prepublication controls giving the government the right to withhold permission for publication or to restrict dissemination, which is often the case for research contracts sponsored by the US Department of Defense.

When the initial screening indicates that publication restrictions may apply, CNMS enlists the aid of subject matter experts from ORNL's Export Control Compliance Group (ECCG) to determine if a license or other controls may be required in order to conduct the research. In the course of their evaluation, ECCG members occasionally need to contact the project PI for more information than is contained in the user proposal. This happens very rarely and we've experienced great cooperation by the affected PIs to quickly address any questions. To date, not a single CNMS user project has been interrupted or delayed due to export control issues. Thanks for your cooperation, past and future!

Research Highlights

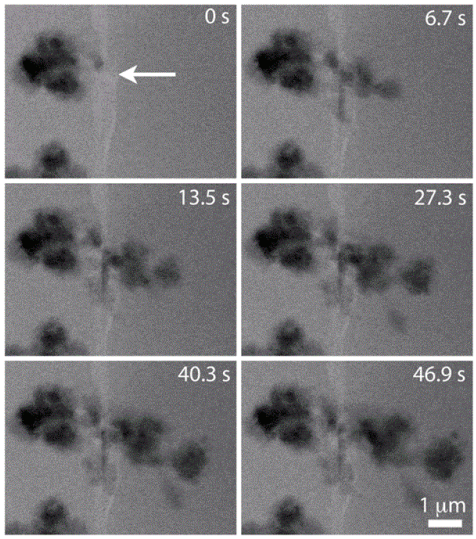
Robert L. Sacci
Postdoctoral Fellow, Physical Chemistry of Materials Group
Materials Science and Technology Division, ORNL

"I am interested in phenomena that take place at the fluid-solid interface. Interfacial chemistry is by nature a nanoscale field; spatially resolved chemical information at surfaces is difficult to separate from bulk solution. Therefore, my research has centered on developing new techniques that allow scientists to probe reactions and structures that occur/form at interfaces in real time. That is, I seek to provide direct imaging of interfaces at the nanoscale while they are undergoing change. I am currently using *in situ* neutron scattering at the Spallation Neutron Source and electron microscopy techniques to probe interfaces important to supercapacitors and batteries. I work extensively with the electron microscopist at CNMS and I am planning to expand my use of CNMS to include more interface-sensitive techniques to study how ionic liquids interact with charged surfaces. The collaborative nature of the Center along with the rich expertise allows me to carefully design my experiments for impactful results. The state-of-the-art instruments along with modelling teams are well suited in inspiring young scientists and establishing an environment for success."

Dr. Sacci is currently a postdoctoral researcher in the Materials Science and Technology Division at ORNL, and supported by the Fluids Interface Reactions, Structure and Transport (FIRST) Center, an Energy Frontiers Research Center (EFRC). He received his Ph.D. in Chemistry from the University of Victoria (Canada) in 2012 specializing in on-the-fly electrochemical impedance spectroscopy of electrocatalytic systems.

Here's a recent highlight from Dr. Sacci's work as a CNMS User that was published in *Nano Letters*.

Watching what happens in an operating battery, at the nanoscale



Time-lapse electron microscopy images showing the nucleation and growth of lithium dendrites during battery operation.

Scientific Achievement

A new microscopy technique (*in situ* electrochemical scanning transmission electron microscopy, or *in situ* ec-S/TEM) allows scientists to observe how the components of a Li-ion battery change while the battery is used.

Significance and Impact

The performance of a Li-ion battery is intrinsically linked to how internal components change during cycling. Being able to observe these changes will lead to ways to control them.

Research Details

- The formation of a solid electrolyte interphase (SEI), the changes in its density, and the nucleation and growth of Li features (dendrites) were observed with *in situ* ec-S/TEM.
- Simultaneous electrochemical measurements were performed on the sample being imaged.

Work was performed as User Project at the Center for Nanophase Materials Sciences.

R.L. Sacci, *et. al.*, *Nano Lett. (2015)*, DOI: 10.1021/nl5048626

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OAK RIDGE National Laboratory

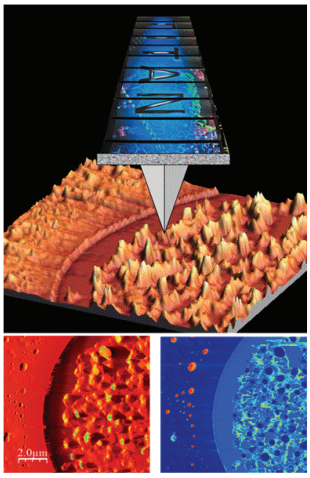
Alexei Belianinov
Postdoctoral Fellow, Imaging and Nanoscale Characterization Group
Center for Nanophase Materials Sciences, ORNL

"The focus of my research is material characterization via scanning probe microscopy techniques in different environments. Primarily, I am interested in developing methods that allow in-depth understanding of surface processes, at all scales, beyond observation but rather through mechanical, electrical, magnetic, etc., interactions with the material and subsequent multivariate statistical analysis of the data stream. Microscope quality, both probe- and electron-based, has been steadily improving over the last two decades due to technological breakthroughs and the reduction of component costs. However, data capturing and analysis modes have remained largely invariant since the inception of the techniques. In our group we work on incorporating Big Data, High Performance Computing, and Support Vector Machines directly into our instrumentation on the measurement level, as well as incorporating them into robust post-processing techniques. What makes this sort of research possible is the unique position of the CNMS as a user facility as well as a standalone research center at ORNL. Without the expertise of our local staff and the ease of collaboration across ORNL directorates, with the driving force the needs of the user community, the work that we are carrying out today could only be found on the pages of sci-fi literature."

"Prior to coming to CNMS I received my Ph.D. in 2012 in Analytical Chemistry from Iowa State University/Ames Laboratory under Prof. Patricia Thiel. What attracted me to CNMS was the vast availability of analytical techniques and projects, as well as scientific powerhouse that makes up the CNMS staff. While working with users may at times feel overwhelming, in the long run I consider it to be one of the CNMS strengths, as exposure to new science, people, and different modes of thinking has definitely contributed to my intellectual growth. In my spare time I enjoy the company of my friends, pets, and outdoor activities."

Following is a highlight from Dr. Belianinov's research in CNMS that was recently published in *Nature Communications*.

"Googling" the Wealth of Information Available from Microscopy



Atomic Force Microscopy (AFM) imaging of mixed polymer plastics (polystyrene and polycaprolactone). The response of the cantilever excitation is analyzed using supercomputing power (Titan) to extract many material parameters from a single experiment, for example material stiffness (bottom left) and electrostatic response (bottom right).

Scientific Achievement

Measurements of local properties over a large dynamic range, by capturing all relevant information of tip-surface interactions in large data sets, and analyzing them using a supercomputer.

Significance and Impact

Previous techniques often capture only the information that is deemed valuable. The current method provides a way to collect complete sets of data, without imposed operator bias. Big data algorithms then provide maximal understanding of materials. Supercomputers make this fast enough for real-time feedback to the microscopists.

Research Details

- Full acquisition of the motion of a scanning probe microscope's cantilever during an experiment, with subsequent analyses of the data yields all relevant information about the response.
- Data analytics enable exploration of physics in an objective and unbiased manner.

Work was performed at the Center for Nanophase Materials Sciences.

A. Belianinov, S. Kalinin, S. Jesse, *Nature Communications (2015)* DOI:10.1038/ncomms7550.

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CNMS Honors and Awards

CNMS researcher Sergei Kalinin has been awarded the inaugural Medal for Scanning Probe Microscopy by the Royal Microscopical Society. This award celebrates outstanding progress made in the field of scanning probe microscopy (SPM) and is one of several new medal awards introduced by the Society to mark its 175th Anniversary. In addition to his role as a Theme Leader in CNMS, Sergei also directs ORNL's Institute for Functional Imaging of Materials and is an adjunct associate professor of materials science and engineering at the University of Tennessee, Knoxville. Past accomplishments include a 2009 Presidential Early Career Award for Scientists and Engineers and two *R&D 100* awards. He has authored more than 350 publications and several patents on various aspects of SPM. Sergei will be presented with a certificate and a medal at the Microscience Microscopy Congress 2015 this summer in Manchester, England.

We encourage feedback and suggestions for the content of future newsletters. We are especially interested in receiving research highlights from CNMS users that may be featured in future issues of this newsletter. Please email us any time you have an important paper that is accepted for publication.