Center for Integrated Nanotechnologies

CINT Newsletter

Winter 2009

In this issue:

CINT Management Changes

UEC Elections

User Proposals

What is a Rapid Access Proposal

Nano Images

Awards

Science Highlight

Note from the Director and Co-Director

We're excited by all the recent happenings at CINT, and we invite you to catch up on them through this edition of the newsletter. Our user program continues to be an exciting and vibrant source of scientific interactions, and we received a large number of excellent proposals in response to our most recent call. Since our last newsletter, we've also hosted meetings of CINT's Science Advisory Committee and Governance Board. These distinguished scientists and technical leaders provide us with invaluable input, and we truly appreciate their willingness to serve the CINT community. The scientific staff and the users at CINT also continue to garner attention and recognition for their work, and we highlight some awards recently received by the CINT community. We'd also like to announce that Normand Modine has moved into the role of Thrust Leader of Theory and Simulation of Nanoscale Phenomena. Finally, as you'll read below, there have also been some recent changes in the overall leadership of CINT. We greatly appreciate the leadership that Toni Taylor has provided CINT over the last several years, and we wish her well in her new position and with her new responsibilities. We hope you enjoy learning more about some of our recent activities, and look forward to working with you and hearing from you as we move forward.

- Bob Hwang (Director) and
Andy Shreve (Acting Co-Director)

CINT Management Changes

We are pleased to announce recent changes in the CINT leadership team. Toni Taylor, former CINT Director, has assumed the position of Division Leader for the Materials Physics and Applications (MPA) Division at Los Alamos National Laboratory. MPA Division is the administrative unit in which CINT resides at LANL. In her new role as the MPA Division Leader, she will remain actively engaged in CINT's success and looks forward to working with her successor on the CINT management team.

Bob Hwang is now the CINT Director. Andy Shreve will serve as the Acting CINT Co-Director while we complete a national search for the new CINT Co-Director at Los Alamos. Andy will remain as the CINT thrust leader for the Soft, Biological and Composite Nanomaterials Thrust.

Toni Taylor talking with Senator Bingaman at the CINT Gateway dedication in 2007.

Co-Director Search

CINT is currently searching for a LANL Co-Director to replace Toni Taylor. Details of the job posting can be found on the CINT website (cint.lanl.gov) by following our job opportunities link. John Sarrao (sarrao@lanl.gov) and Julie Phillips (jmphill@sandia.gov) are co-chairing the search committee and would welcome inquiries from potentially interested applicants.

What is a Rapid Access Proposal?

For most research projects, the semi-annual Call for User Proposals enables timely access to CINT expertise and capabilities. In between these submission cycles, a prospective user may submit a Rapid Access Proposal to request brief access to CINT for time-critical, high-impact research.

As with a regular user proposal, the Rapid Access Proposal (2-page maximum pdf file) is submitted via the web (https://cint-proposals.lanl.gov/). In addition to describing the proposed work, it must clearly justify the time-critical need for CINT.

Approval of a Rapid Access Proposal is conditional upon passing the feasibility screening, subject to the availability of the requested capability, and at the discretion of CINT management. Rapid Access User Projects automatically expire at the beginning of the next semi-annual cycle. The user must submit a regular proposal in the next available User Proposal submission cycle in order to continue the research initiated under an approved Rapid Access Proposal.

User Proposals

In response to the Fall 2008 Call for User Proposals, CINT is pleased to accept 107 proposals. Of those, 39 were continuations of ongoing projects and 68 were new projects. The approved projects involve researchers in 25 States and 7 foreign countries.

The Spring 2009 Call for User Proposals will be published on the web (http//CINT.lanl.gov) and distributed via e-mail during the first week of February. Proposals must be submitted via the web site and will be accepted through Monday, March 16, 2009

UEC Elections: Vote now!

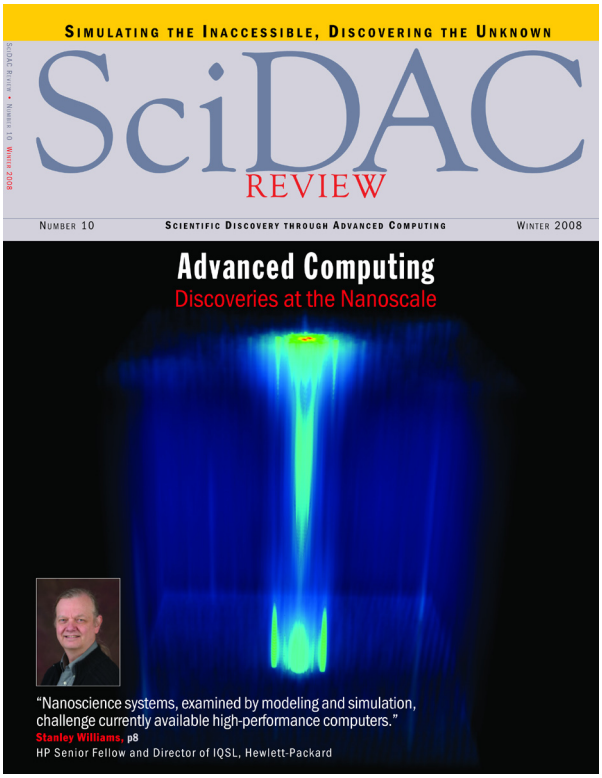
The CINT User Association asks all CINT users to take a moment and vote electronically for two new members of the Users Executive Committee (UEC). They will serve three-year terms 2009-2011. Elections are open from January 21, 2009 - Friday, February 6, 2009. Election results will be announced the following week.

The UEC represents the larger population of CINT users. It serves as an advocacy group for the Facility and its user community, provides advice to the CINT management on matters affecting the user community and assures open communication between the users and management.

The nominees for the two open seats on the UEC are:

Carl Batt (Cornell University)
Suneel Kodambaka (UCLA)
Dvora Perahia (Clemson University)
Elba Serrano (New Mexico State University)

Brief biographical sketches and easy e-ballot information is available on the web at: http://cint.lanl.gov/association.shtml



Nano Images

An article and cover image from the CINT visualization facility is featured in the most recent issue of the DOE Scientific Discovery Through Advanced Computing (SciDAC) publication. The cover image (seen on the left) is a visualization rendering of a Scanning Tunneling Microscopy (STM) measurement. STM enables to measure inelastic processes at the nano-scale. The figure shows the volume rendered STM image as a 3D still image, which is color coded by the intensity of the second derivative of the tunneling current (I) with respect to bias voltage (V). Sasha Balatsky and his team used the visualization capabilities at CINT to analyze and render the data in stereo. This image encodes the dispersion W(kx, ky) of the inelastic scattering process of electrons in high-temperature copper-oxide superconductors that might be related to the pairing interaction or glue that produces superconductivity in these materials. They point out that the corresponding real space data ubiquitously show the nanoscale inhomogeneity in these materials.

CINT Community Awards

CINT User Ed Flynn Honored

Dr Ed Flynn

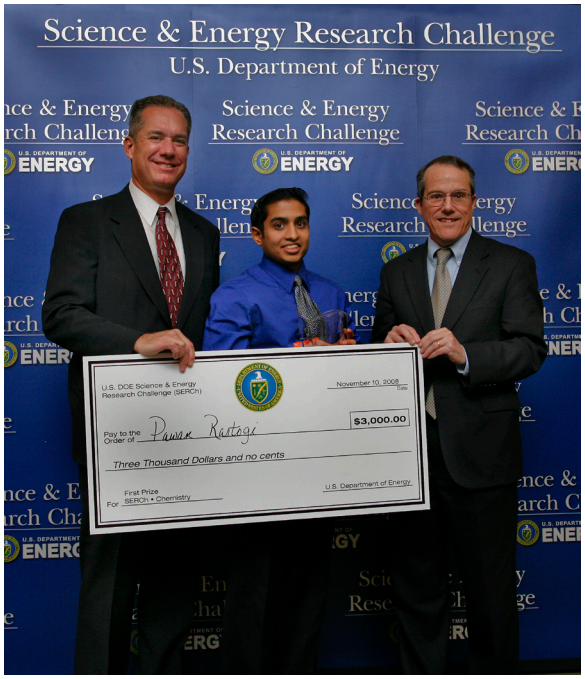
CINT user, and president of Senior Scientific LLC, Dr Edward Flynn was honored at a recent meet¬ing held by the National Cancer Institute (NCI) of the U.S. National Institutes of Health (NIH). The NCI chose his project, which uses magnetic nanoparticles in conjunction with a magnetic needle for higher sensitivity leukemia biopsies, as an "exemplar" to represent the cutting edge of transla¬tional medical research in the NIH's research portfolio. He was invited to present a poster, coau¬thored by a CINT scientist, Dale Huber, at a special National Cancer Institute Translational Science Meeting. A total of 547 exemplars chosen from the thousands of active NIH projects were in attendance at the meeting held in November at the Grand Hyatt Hotel in Washington, D.C. The final session of the meeting, titled "Selected Presentation of Translation Research Opportunities" was presented by Dr. Gary Dorfman, special assistant to NCI. In this session twelve posters were on display and were discussed by. Dorfman,. Flynn's project and poster were among the dozen further selected for this additional honor.

CINT Student Places at DOE Poster Competition

Pawan Rastogi of Material Physics and Applications Division at Los Alamos National laboratory took first place in chemistry at the 2008 DOE Science and Energy Research Challenge (SERCh) poster competition, held in November at Oak Ridge National Laboratory. Pawan recently graduated from Columbia University with a Bachelor's degree in chemistry. He began a Summer Undergraduate Laboratory Internship (SULI) at the Center for Integrated Nanotechnologies (CINT) in May 2008 under the mentorship of CINT Scientist, Dr. Jennifer Hollingsworth.

The SERCh Competition showcases the research projects of DOE-funded students and interns at the national laboratories. Only 100 student researchers were accepted to convene and present their work at Oak Ridge National Laboratory. The researchers vie for scholarships of $3,000, $1,500, or $1,000, for 1st, 2nd, or 3rd place finishes, in each of five categories. As first place finisher in the chemistry category, Pawan received the $3,000 award.

During his internship, Pawan worked hard to learn nanochemical synthesis and characterization, a completely new field to him. His award winning work titled, "Sensitizing and Protecting Lanthanide Ion Emission Using Optically Active Nanocrystals," involves the synthesis and use of quantum dots to exploit the optical properties of lanthanide ions. Lanthanide ions are characterized by their ultra-narrow band emissions of visible to near-infrared light with long luminescence lifetimes; making them ideal candidates for applications in lasing, up-conversion, and bioimaging. On the other hand, Pawan explains that such applications are difficult due to the specific and narrow absorption bands of lanthanide ions. Furthermore, lanthanide ion luminescence is vibrationally quenched in common solvents.



Pawan Rastogi (center) receives his award for 1st place poster in Chemistry.

To tackle this problem, Pawan worked closely with Director-Funded Postdoctoral Fellow, Dr. Javier Vela. Together, Dr. Vela and Pawan incorporated lanthanide ions into semiconductor nanocrystal host matrices and analyzed their optical properties. By doping lanthanide ions into these nanocrystals, the two scientists were able to effectively protect lanthanide ion emission from common solvent quenching. More importantly, lanthanide ion emission was 'sensitized' via energy transfer from the nanocrystal host matrix. The combined protection and sensitization was specifically demonstrated by synthesizing novel europium-doped indium oxide nanoparticles.

Jennifer Martinez receives Presidential Early Career Award for Scientists and Engineers

Jennifer Martinez receiving a PECASE award from DOE Secretary Bodman

Jennifer S. Martinez of CINT received a prestigious Presidential Early Career (PECASE) Award for Scientists and Engineers. John Marburger, science advisor to President George W. Bush and director of the White House Office of Science and Technology Policy, presented the award to Martinez at the White House. She is one of 67 researchers to receive the award, which is the highest honor the U.S. government bestows to outstanding scientists early in their careers. Nine federal departments and agencies annually nominate scientists and engineers whose work shows exceptional promise for leadership at the frontiers of scientific knowledge for the PECASE Award. The Award embodies the high priority the government places on maintaining the leadership position of the U.S. in science by producing outstanding scientists and engineers who will broadly advance science and the missions important to the participating agencies. Martinez is one of eight DOE-funded researchers to be recognized.

Jennifer is a CINT scientist in the Soft, Biological and Nanocomposite Materials Thrust, where she uses biomolecular recognition strategies to template, solubilize, and assemble nanomaterials. Her research has been published in Science, Proceedings of the National Academy of Sciences, Journal of the American Chemical Society, and Langmuir. She has also received a LANL award for mentoring postdoctoral scientists. Congratulations to Jen!

CINT Scientists chosen as LANL Fellows Prize Recipients

Amit Misra

The LANL Fellows Prize for Research recognizes high-quality investigations in science or engineering by LANL technical staff and encourages publication in appropriate journals, books, or reports. The research must have been performed at the Lab, published within the last 10 years, and have had a significant effect on its discipline or program. Amit Misra of CINT was one of the two recipients of a 2008 Fellows Prize for Research.

Misra is recognized for "his longstanding research contributions to the understanding of deformation in materials, and particularly for his recent accomplishments in nanomechanics". A technical staff member in CINT, Misra has a Ph.D. in materials science and engineering from the University of Michigan and joined LANL more than 11 years ago. He is PI of the DOE Basic Energy Sciences program on deformation physics of ultrafine scale materials and holds an adjunct professor appointment at The Ohio State University. He has co-supervised the research of more than 15 graduate students and postdoctoral researchers. He served as guest editor of three journal special issues, co-chaired nine symposia/workshops at professional society meetings and international conferences, is the current elected chair of the Nanomechanical Behavior Committee of The Minerals, Metals and Materials Society, and was appointed 2009 Volume Organizer of the journal MRS Bulletin of the Materials Research Society. DOE/BES invited him to chair their topical workshop in the area of Mechanical Behavior and Radiation Effects in Materials.

Andy Shreve

The Fellows Prize for Leadership recognizes the value of leadership in science and engineering at LANL and stimulates the interest of talented young staff members in developing the skills and making the personal sacrifices necessary to become effective leaders. Andrew Shreve is the recipient of the 2008 Fellows Prize for Leadership. He is being recognized for "his stimulation of young Laboratory staff to develop skills and to make personal sacrifices necessary to become effective leaders". Shreve has a Ph.D. in physical chemistry from Cornell University and is a technical staff member in CINT, where he is a leader of the soft, biological and composite nanomaterials thrust area.

Science Highlight

Percolation in Carbon Nanofiber – Polymer Nanocomposites

CINT: Julia W. P. Hsu and Aaron Trionfi
User: Richard A. Vaia, AFRL

Percolation theory has been applied to explain a wide variety of phenomena, such as gelation when boiling eggs, spreading of forest fires, and oil exploration. In one current project, CINT scientists and users from the Air Force Research Laboratory have focused on understanding how carbon nanofibers form conducting networks in an insulating polymer (polyimide). The common theme for these seemingly different phenomena is that the system can be described with two components, and there exists a critical concentration, pc, at which one component would form a network that spans across the entire system. Physical properties typically vary in a power law fashion as the concentration approach pc with the exponents called the critical exponents. Two systems with the same critical exponents belong to the same universality class in percolation theory. Hence, it is important to study the critical exponents.

While there are many theoretical models and simulation results, experimental results so far are mostly on bulk conductivity measurements, with measured critical exponents rarely agreeing with the theoretical predictions given by the lattice model. While the theoretical models can be modified to explain the experimental observations, microscopic measurements, for example of geometric properties, are required to conclusively differentiate different models. Thus, studies with nanoscale resolution offer new opportunities for the understanding of percolation phenomena. In this work, we directly measure (Fig. 1) the percolation probability and its associated critical exponent, β, in carbon nanofiber loaded polyimide nanocomposites using conducting-tip atomic force microscopy (C-AFM). By analyzing real-space conductance maps and applying a well-established identity of stereology known as the Principle of Delesse, we find that in this system both the conductivity and the percolation probability exhibit behavior that cannot be described using lattice theory. One possible source of the observed deviation might the high aspect ratio (~100) of carbon nanofibers, which has been shown to lower pc. How aspect ratio affects the critical exponents is currently not understood. Our approach can be applied to other electrical composites. These results should stimulate theoretical and experimental research in percolation. (Contact: Julia Hsu, jwhsu@sandia.gov).

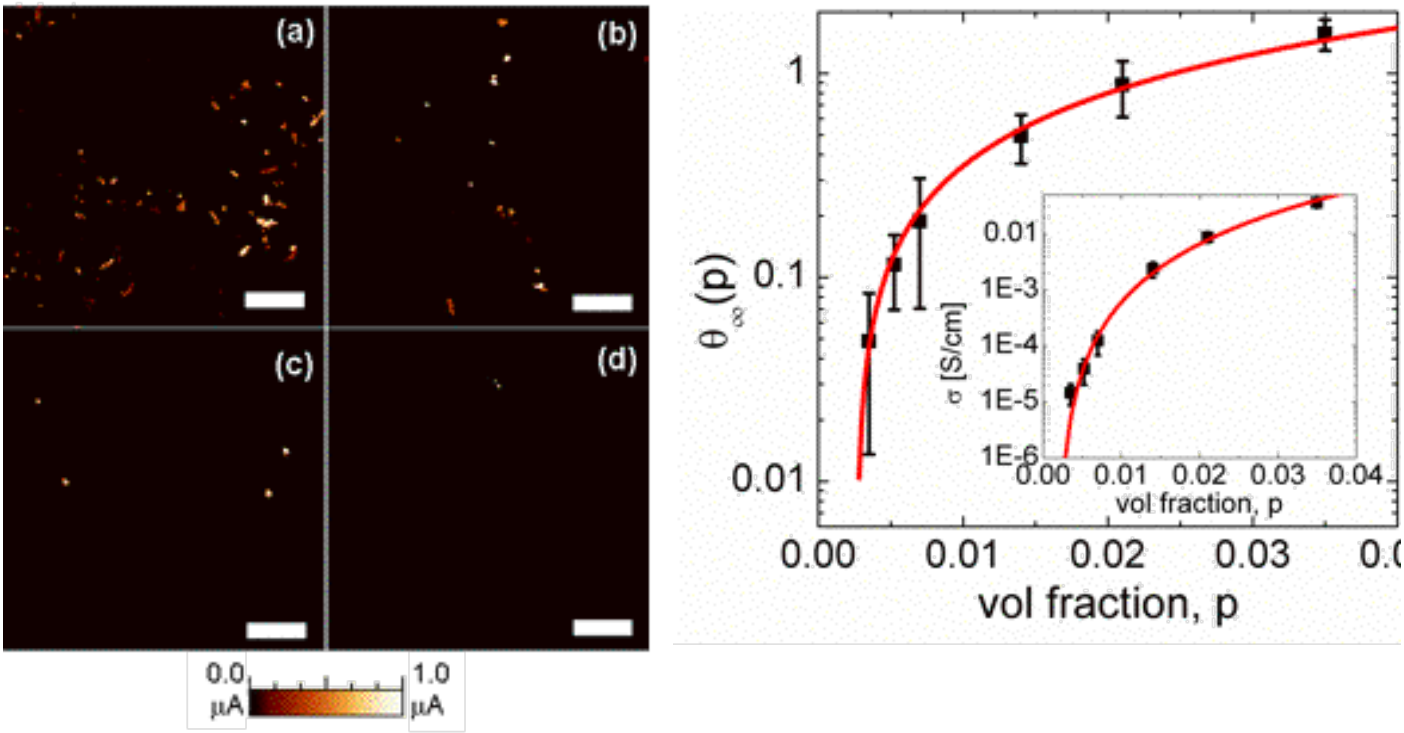


FIG. 1 a) Example of current maps taken with C-AFM for carbon nanotubes in polyimide matrices (scale bar: 4 μm).
b) Percolation probability as a function of carbon nanotube volume fraction for the nanocomposite. The inset shows the bulk conductivity of the nanocomposite as a function of carbon nanofiber volume fraction. The red line in both curves is a best fit to the data.