



Nanoscience and Nanotechnology Institute at The University of Iowa



WINTER 2015

FROM THE DIRECTORS

This is the 10th year of NNI and we are pleased that another great year has provided students, faculty and staff with numerous opportunities in nanoscience and nanotechnology research, education and outreach at the University of Iowa!

Welcome to the 2015-16 newsletter from the Nanoscience and Nanotechnology Institute (NNI). We are already busy planning for our 2016 annual symposium which will take place on February 12, 2016 and for the 8th year of the NSF-funded Research Experience for Undergraduates (REU) program next summer.

As we reflect on a decade of NNI, the connections that the institute has made across campus exemplify the role of an interdisciplinary research institute at UI. NNI has focused on the environmental and health aspects of nanoscience and nanotechnology reflecting the research strengths across campus in these interdisciplinary areas. NNI has successfully bridged the health and environmental sciences across campus leveraging research grant support and coordinating interdisciplinary research collaborations. NNI co-director Professor Vicki Grassian served as an associate director for the ICTS from 2007-2012 and led the efforts of the key ICTS function, Development of Novel Clinical and Translational Technologies, that focused on strategically enhancing the development of novel technologies which centered around NanoHealth. The Environmental Health Sciences Research Center (EHSRC) established a Nanotoxicology Research Core in 2010 (started as a Research Initiative in 2008) directed by Grassian with the primary goal of evaluating the properties of nanoparticles including their toxicity and therapeutic use.

Strong research synergies exist between NNI faculty from CLAS, Carver College of Medicine, and the Colleges of Engineering, Pharmacy, Public Health and Dentistry.

It was a great year for several of our NNI core members. David Cwiertny became Director of the Environmental Policy Research Program within the University of Iowa Public Policy Center. Tori Forbes received a DOE Early Career award. Sara Mason became a PI within the Center for Sustainable Nanotechnology, a Center of Chemical Innovation, funded by the National Science Foundation. In this newsletter, we highlight faculty member Alexei Tivanski. His fascinating research focuses on nano- and micro-dimensional materials. We also highlight a postdoctoral research associate, for the first time, Dr. Imali Mudunkotuwa. Dr. Mudunkotuwa aspires to be a leading researcher in the field of sustainable nanotechnology. See profiles of both these NNI members on the next page.

As already noted, the NNI REU program, run by Sarah Larsen (Chemistry) and Allan Guymon (Chemical and Biochemical Engineering) is still going strong and has been highly successful in bringing undergraduates to campus to participate in summer research with mentors in four colleges. NNI has hosted over 80 REU students (selected from over 700 applicants to the program) and approximately 35% of these students were underrepresented minority students. Our former REU students have gone on to win NSF Fellowships and a Rhodes Scholarship. Applications are now being accepted for



Vicki H. Grassian
Co-Director of NNI



Sarah C. Larsen
Co-Director of NNI

Summer 2016 - more information is given on page 4.

Our Science, Technology, Engineering and Mathematics (STEM) outreach programming is going strong with visits to regional and local museums and partnerships with programs such as the Workplace Learning Connection and Project HOPE here at UI. We estimate reaching approximately 1,000 K-12 students each year through these programs.

Many seminars focusing on various research topics in nanoscience and nanotechnology take place across campus each semester. For 2016, keep up to date on these seminars through the Nano@Iowa biweekly email newsletter. If you don't receive the electronic newsletter and would like to, please send an email to nni@uiowa.edu and you will be added to the list.

Besides being a co-director of NNI, this fall Sarah Larsen has started her new position as Associate Dean in the Graduate College. Vicki Grassian will also be starting a new position as well at the University of California San Diego where she has been appointed Distinguished Professor in the Departments of Chemistry and Biochemistry, Nanoengineering and Scripps Institution of Oceanography as of January 2016.

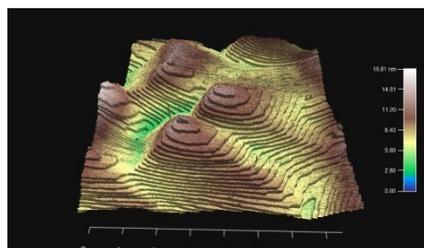
FACULTY PROFILE



ALEXEI TIVANSKI
CHEMISTRY
COLLEGE OF LIBERAL ARTS & SCIENCES
UNIVERSITY OF IOWA

Alexei V. Tivanski is an associate professor in the Department of Chemistry at the University of Iowa. The Tivanski research group focuses on interfaces with emphasis on the development of analytical methods that permit quantitative spatially-resolved (nanometer scale) studies of the mechanical, chemical and electrical properties of nano- and micro-dimensional materials and particulates. The work is very interdisciplinary and highly collaborative in nature. We utilize a cutting-edge Atomic Force Microscopy (AFM) and nanoindentation approach for our measurements. The two main research areas are nanoscience/nanotechnology and environmental/atmospheric chemistry.

The nanoscience and nanotechnology projects relate on our efforts to determine structure - property relationships in organic crystalline solids, work in collaboration with the UI colleagues Profs. MacGillivray and Arnold. AFM nanoindentation is employed to quantify mechanical properties of millimeter and sub-micrometer sized organic cocrystals, capable of undergoing single crystal-to-single crystal (SCSC) reaction in solid state. The effect of photoreaction on mechanical properties is studied for a variety of solids with the goal to design advanced material with defined stiffness for device application. Furthermore, we have demonstrated that a bulk mechanical property in the form of Young's modulus for a series of organic cocrystals is correlated to atomic polarizability. We expect present and future findings to establish atomic-to-bulk correlations that enable the rational design of a variety of multicomponent materials with desired mechanical and chemical properties. Additionally,

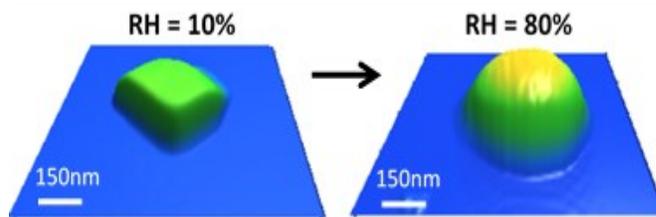


3D image of an organic crystal surface showing spiral pyramids with height of 20 nm and step of 0.7 nm and base of 2 microns.

Conductive Probe (CP-AFM) is also utilized to study electrical properties of organic materials at the nanoscale. The goal of these studies is to develop fundamental understanding of factors that

control electrical conduction at the nanoscale, potentially leading to development of novel molecular devices.

The environmental/atmospheric chemistry projects focus on characterizing morphological and water-uptake properties of individual submicron size aerosol particles with AFM. We quantify 3D morphology and phase state of nano-sized particles (ca. 10 nm – 1.5 μm). Many aspects of the work are in collaboration with Vicki Grassian and the Center for Aerosol Impacts on Climate and the Environment—an NSF-funded center for chemical innovation. Imaging at changing relative humidity allows us to study the water uptake properties of individual particles. Our group has developed force spectroscopy methodology that facilitates the quantification of surface tension of individual submicron size liquid droplets, a measurement that is inaccessible to any other technique but very important to atmospheric chemistry, as the surface tension of liquid droplets in the atmosphere dictates their cloud forming abilities. Our work is performed on both complex aerosols collected from ocean-like environments, mimicking sea spray aerosol, as well as simple single and multiple component model systems.



3D images of an individual NaCl particle at low relative humidity (10%) and corresponding liquid droplet at 80% relative humidity after absorbing water.

More information on the above research projects can be found on the Tivanski group website at: <http://www.chem.uiowa.edu/tivanski-research-group>

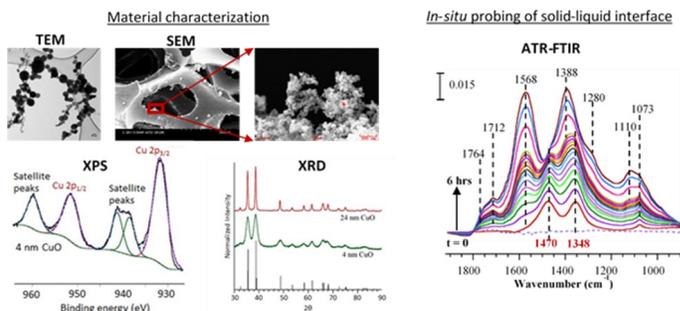
POST DOC PROFILE



IMALI MUDUNKOTUWA
POSTDOCTORAL RESEARCH ASSOCIATE
UNIVERSITY OF IOWA

Imali A. Mudunkotuwa joined the University of Iowa – Department of Chemistry as a graduate student in 2008. With her interest in environmental chemistry, she joined the Grassian research group and spent 5 productive years investigating the environmental transformations of engineered metal and metal oxide nanoparticles under various solution conditions. Her work is among the highly cited research in the broad area of environmental health and safety of nanomaterials (NanoEHS). After graduating with her PhD in Chemistry in 2013, she continued her work as a postdoctoral research scholar simultaneously working on a new collaboration with NNI Investigator Professor Tom Peters in the College of Public Health. Her current research focuses are multidimensional with developing analytical methods to assess occupational exposure to engineered and incidental nanoparticles as well as understanding nano-bio interactions. Imali A. Mudunkotuwa was the recipient of the Department Research Excellence Award (2012) and the Department Nominee for D.C. Spriestersbach Dissertation Award (2014). Her areas of expertise range from material characterization using state-of-the-art microscopy techniques (TEM, SEM-EDX) to in-situ probing of solid-liquid interfacial regions using attenuated total reflectance Fourier

transform infrared-spectroscopy (ATR-FTIR). Overall, her unique approach to her research is to combine the molecular information with macroscopic proportion. Recently, she was a scribe and primary writer of a workshop report on NanoEHS (Grassian, Haes, Mudunkotuwa et. al, *Environ.Sci.: Nano*, DOI: 10.1039/c5en00112a). Her future aspiration is to become a leading researcher to ensure the sustainability of nanotechnology.



Nanoscience and Nanotechnology Institute Spring Symposium 2015

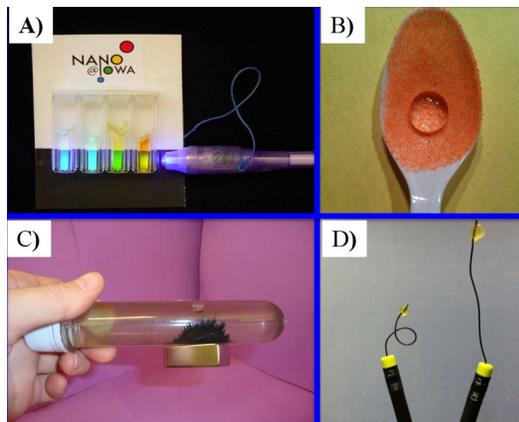
The spring symposium had nearly 100 participants and featured a one-half day morning symposium and an afternoon poster session. Speakers included NNI Associate Director Amanda Haes who spoke on “Fundamental science needs in nanoEHS” and NNI co-Director Sarah Larsen who discussed “The impact of nano-bio interactions on the toxicity of silica nanomaterials”. NNI member Tom Peters gave an excellent talk on “Lessons from the workplace: hazards from exposure to engineered nanomaterials”.

The keynote speaker, Professor Philip Demokritou gave a very well received talk entitled “In-vitro dosimetry of nanomaterials: too complicated to consider, too important to ignore”. Professor Demokritou’s research interests are primarily in the areas of aerosol science and technology and particle health effects. Dr Demokritou and his team have developed over the years many instruments and patented methods focusing on the physico-chemical and biological characterization of particles. These novel techniques have been used extensively by human exposure assessors in the United States and worldwide and helped to advance the field of particle health effects. He is a co-author of two books, numerous book chapters and articles in leading journals in the particle health effect and aerosol engineering fields. Dr Demokritou is currently an Associate Professor at Harvard School of Public Health and the Director there of the Environmental Health Nanoscience Laboratory and the Center for Nanotechnology and Nanotoxicology. It was great to have him visit NNI and to participate in the 2015 symposium. The poster session combined with the STEM Outreach Table and participation of our regional partner NanoVox provided faculty, students and staff with opportunities to discuss innovation in nanoscience and nanotechnology research, education and outreach.

STEM Outreach and Engagement



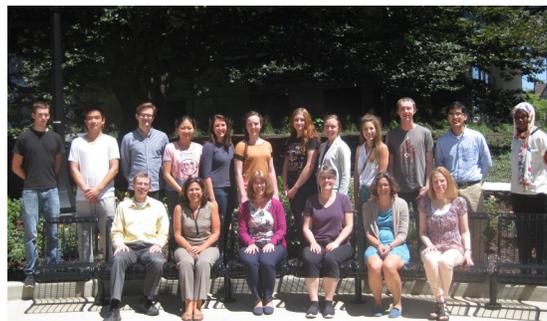
NNI continues to be active in many STEM outreach and engagement activities across the State of Iowa. This past year, we hosted several K-12 schools from Cedar Rapids, West Branch and Solon on campus. Photos are from an outreach and engagement event in Des Moines and another event where more than 100 5th grade students from the Linn Mar Elementary Gifted Program came to the University of Iowa campus as part of a chemistry unit (with a focus on nanoscience) that they worked on this past spring. We have developed a Nano-to-go kit that is available for STEM Outreach and Engagement in the State and includes hands-on demos for use with various age groups. This kit includes hands-on demos and activities (pictured), instructions for the activities and thermochromic pencils with the NNI logo to distribute to participants. The Nano-to-go kit is used regularly by NNI faculty and students. Please contact nni@uiowa.edu if you are interested in learning more about or would like to participate in our outreach and engagement activities.



Elements of our Nano-to-go outreach kit including: A) quantum dots; B) hydrophobic spoons; C) ferrofluid and D) memory metal.

National Science Foundation Research Experience for Undergraduates (NSF-REU) in Nanoscience and Nanotechnology at The University of Iowa Summer 2015

The NSF-REU program in Nanoscience and Nanotechnology at The University of Iowa welcomed 12 undergraduate students in the summer of 2015 from the University of Dubuque, Harry S Truman College, Aquinas College, Iowa State University, Ohio Northern University, Washington and Lee University, University of Nebraska - Lincoln, Agnes Scott College, Gustavus Adolphus College and the University of Iowa. The students worked in labs across campus, participated in a Technical Writing Workshop, attended seminars on various aspects of nanoscience and nanotechnology, and each presented a poster at the Summer Undergraduate Research Conference 2015 held in the Iowa Memorial Union in July. Thank you to the students and mentors for a successful summer program!





**NANOSCIENCE &
NANOTECHNOLOGY
INSTITUTE @ UI**

242 IATL | Iowa City, IA 52242-1000 | 319-384-3292

nni@uiowa.edu | <http://nanotech.uiowa.edu>

SAVE THE DATE!

Friday February 12, 2016

**Nanoscience and Nanotechnology
Winter 2016 Symposium**



Keynote Speaker: Professor Karen Wooley, Texas A&M University

Professor Karen Wooley, W. T. Doherty-Welch Professor Chair and Distinguished Professor of Chemistry at Texas A&M University will be the plenary speaker at the NNI@UI Symposium on February 12, 2016. Professor Wooley has served as the director of a Program of Excellence in Nanotechnology, which is financed by the

National Heart, Lung and Blood Institute, was the recipient of the 2014 Centenary Prize of Royal Society of Chemistry, and serves as an Associate Editor for the Journal of the American Chemical Society. In 2015, Professor Wooley was recognized by and named as a Fellow of the American Academy of Arts and Sciences for her expertise in the novel development of degradable polymers. Her group focuses on both fundamental and applied studies of these materials for the diagnosis and treatment of disease, use as non-toxic anti-biofouling coatings, and applications such as ultra-high resolution photoresists for microelectronics patterning.

Look here for future updates: <http://nanotech.uiowa.edu/events/nanoscience-and-nanotechnology-winter-symposium-2016>

REU SUMMER 2016

**National Science Foundation Research
Experience for Undergraduates (NSF-REU) in
Nanoscience and Nanotechnology at The
University of Iowa**

PROGRAM DATES:

MAY 31—JULY 29, 2016

The program will provide approximately eight undergraduate students with research experience in cutting edge topics related to environmental and health aspects of nanoscience and nanotechnology. REU participants will have the opportunity to work with faculty mentors from the departments of Chemical and Biochemical Engineering, Civil and Environmental Engineering, Chemistry, and Pharmacy.

Application deadline is March 1, 2016. For additional information, please visit the website: <http://nanotech.uiowa.edu/education/nano-reu-program>