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SNO letter

NEWSLETTER OF THE SUSTAINABLE NANOTECHNOLOGY ORGANIZATION

Sustainable Nanotechnology Organization

Research | Education | Responsibility

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SNO Newsletter Submissions

Please send news, conference announcements, job postings, letters to the editor, and other contributions to the newsletter to Drs. Sadik or Karn
osadik@binghamton.edu
barbara.karn@susnano.org

The next newsletter will be released in April 2014.

Edited by:
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Greetings SNO Members,

Thanks to everyone who was able to make it out to the annual conference in November, we had a great turnout. Attendance was at 215, a 20% increase over last year. The conference featured an exciting three days of activities involving a diverse group of participants, including outstanding technical programs, and cutting-edge research on nanotechnology and sustainability. Presentations included 6 plenary speakers, 154 platform presentations, and 46 poster presentations drawn from early faculty career investigators, postdoctoral fellows, students, and industrial participants. In attendance were participants from almost all states of the United States, as well as international participants from Canada, France, Great Britain, India, Korea, Japan, and Poland. About 25% of the participants were women, and a sizeable student presence was recorded, indicative of the "recentness" of the field. These young scientists bring fresh appeal to the organization. Although SNO is a relatively new organization, there is ample evidence that the organization is building a firm base of diversity to carry it into a strong and sustainable future.

We are already preparing for our next conference in Boston on November 2-4, 2014. The chairs will be Dr. Jackie Isaacs of Northeastern University, and Dr. Philip Demokritou of the Harvard School of Public Health.

In this issue we will review the 2013 conference, including a highlight of our poster awardees, a photo montage, and a summary of the NanoCeria workshop. We will also discuss the upcoming events related to SNO. Joining us for our recurring Q&A session are Dr. Vinka Oyanedel-Craver from the University of Rhode Island and Prof. Greg Lowry from Carnegie Mellon University. For our first "Industry Spotlight" installment, we feature Postnova Analytics.

SNO Q & A SESSION

DR. VINKA OYANEDEL-CRAVER, UNIVERSITY OF RHODE ISLAND

Assistant Professor, SNO Secretary

(Doudrick) Vinka, thanks for joining us for the Q&A session. I'm always curious as to what draws people to SNO. So, what about SNO made you want to get involved?

(Craver) I am really interested in the core objectives of SNO, to maintain a balance among technological innovation, societal benefits and economic activity to ensure the safe application of nanomaterials. This was reflected in the our annual conference in which the economic, educational, ethical, and societal issues related to nanotechnology have their own sessions. I think we still have some work to do to bring more people together from all of these areas in more equal numbers, but, so far, we are on a good path.

(Doudrick) Regarding those cores you discussed, I see you have a strong interest in the societal impact of nanotechnology with some of the work you have done working with developing countries and using nanotechnology to provide cheaper water treatment options. What kind of impact, positive or negative, do you see nanotechnology having on developing countries?

(Craver) There are several claims related to the opportunities that nanotechnology has for solving some our global challenges such as developing inexpensive water treatment devices. Ironically, most nano-based products are manufactured in developed countries, yet developing countries usually do not have regulations or research capabilities to evaluate the impact of these nano-products. Despite this, I think nanotechnology can help in several situations, but if we are going to claim that the solution will be sustainable we will have to make sure that this technology will be transferred to developing countries in a safe manner.

(Doudrick) For sustainable design, what is your approach for engineering these new water treatment technologies?

(Craver) I am mostly interested in using ceramic filters impregnated with silver nanoparticles, and my research focuses on several sustainability related aspects covering issues from the production of the nanoparticles, occupational safety, fate of the nanoparticles during use of the filter, and finally, end-of-life disposal. The antimicrobial properties of silver nanoparticles have been widely documented. Although several of our studies have shown that this nanomaterial can indeed enhance the quality of the treated water, there are several questions regarding the long-term use, effect of water chemistry conditions, and effect of clay mineralogy on the performance of the filters.

(Doudrick) What social challenges are you faced with when implementing an emerging technology, such as nanotechnology, into cultures that may be reluctant to change?

(Craver) One of the biggest challenges is the lack of academic and technological capacity in the communities. Sometimes, explaining the link between water contamination and diseases is difficult, mostly because these diseases have been the status quo in these communities for several generations. This thought process makes it even more difficult to introduce nanotechnology concepts. Our approach is to work with schools in the communities and let the students be the messengers to the households about the solutions we are proposing.

(Doudrick) In what ways can we (SNO) educate the public about the importance of sustainable nanotechnology?

(Craver) One way is for SNO to continue their annual conference, which is one of the few truly interdisciplinary meetings with very high-quality presentations. We are also working on some educational outreach activities such as the SNO educational task force and an exhibit for the 3rd USA Science and Engineering Festival. We still have some way to go, but I think that SNO is consolidating its place in the "nanoworld."

SNO Q & A SESSION

DR. GREG LOWRY, CARNEGIE MELLON UNIVERSITY

Professor, Deputy Director for the Center for the Environmental Implications of Nanotechnology

(Doudrick) Greg, thanks for joining us. You have been involved with environmental nanotechnology for quite some time now. How did your career path lead to nanotechnology?

(Lowry) My initial involvement in nanotechnology resulted from a need for innovative groundwater remediation technologies. There was a need for injectable remediation agents with high reactivity towards groundwater contaminants. These would be used in deep or inaccessible locations, like underneath buildings, where other treatments were not feasible. Nano-sized Fe^0 particles were an ideal material for this purpose. So, like many, I started to explore how the unique features of nanomaterials could be leveraged to develop new remediation technologies. Many of the same features that make nanomaterials attractive for remediation lead to potential risks, for example, high reactivity, and high mobility in porous media. This led my group to begin exploring the environmental implications of nanomaterials, which is where we spend most of our effort now.

(Doudrick) In the beginning, how did you define sustainable nanotechnology, and how has your definition evolved over the years?

(Lowry) Initially nanotechnology was developed without regard to sustainability, or with limited justifications for sustainability like we saw with nanomaterials used for solid state lighting that resulted in increased energy efficiency. At the outset, it was all about how to create the newest and coolest materials possible. This still occurs, and I believe it should as discovery is a key component of the scientific endeavor, but the overall lifecycle impacts of a nanomaterials or nano-enabled products are now being considered in the development of products. The field has focused significantly on downstream impacts from nanomaterials like toxicity or exposure, but it is now using lifecycle approaches to reduce upstream impacts during synthesis, and optimizing designs to produce nanomaterials that maintain function while minimizing potential impacts. This safer-by-design concept is an important component of sustainable nanotechnology.

(Doudrick) You've done a lot of research on the fate, transport, and transformation of nanoparticles in the environment. So, for future EHS studies, should we continue focusing on individual nanoparticles in a system, or should we be putting more focus on nano-enabled products such as nanoparticles embedded in a composite?

(Lowry) Most nanomaterials will not be used individually, but will be used as a component in a nano-enabled system. There are some exceptions, nanoiron and polishing agents for example, but in general I think this is the case. As a result, we need to study the behavior of these "systems" since they may prove to have very different behaviors or toxicity than the individual nanoparticles. For example, nanoparticles encapsulated in a matrix may never leave that matrix and become available. Or nanoparticles released from the matrix may contain matrix components that alter its properties such as size or charge, and thereby alter its fate and effects. In this way, experiments with single nanoparticles may not represent the true exposure potential or toxicity of the material. That said, the role of reductionism in science cannot be dismissed. If we understand how the individual components behave, we may be able to predict some behaviors in more complex systems.

(Doudrick) So, do you think this same thought process we use for the environment applies to nano-enabled things that may be ingested or inhaled?

(Lowry) I think so. The environment is a very complex system, as are human guts. In both systems there are two types of complexity. One arises from the nanomaterial itself, such as the nanoparticle properties, the matrix it is used in, etc. The other arises from the environment that the nanomaterial encounters. Many nanomaterial properties are defined in part by the fluid that the particle is in, like the electrophoretic mobility and aggregation state. Thus, any changes in the system properties such as pH lead to a corresponding change in the nanomaterials properties. I have seen complex system feedbacks reported in both the environmental and in the human health literature, so a true understanding of the fate and effects of nanomaterials will have to consider the entire system response and its impact

Lowry Q&A continued

on the nanomaterial properties.

(Doudrick) For young researchers new to the sustainable nanotechnology field, do you have any advice on what directions they should head in order to advance the field?

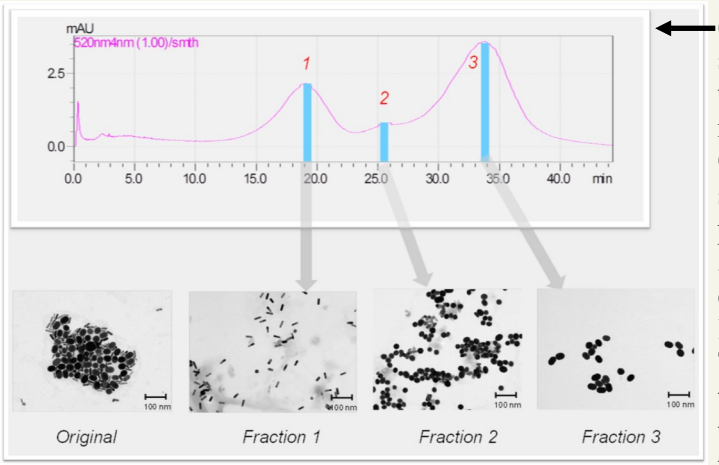
(Lowry) I think there is tremendous promise in leveraging the truly unique properties of nanomaterials for energy and environmental issues. With new materials emerging daily, and more importantly advances in the ability to control matter and create materials with the properties needed to optimize performance, there is an excellent opportunity to leverage these abilities into new technologies. Clearly, advances in the areas of solar energy conversion, water, and food are key elements of a sustainable future.

(Doudrick) How would you like to see SNO evolve over the next year?

(Lowry) I think SNO has grown into an important group for the nanomaterials environmental health and safety community. I think there are opportunities to apply the concepts that have been developed for sustainable implementation of nanotechnology to any new technology being considered. The concepts are captured nicely in the principles of green engineering, but developing the means for implementing those principles can be a focus of SNO.

Industry Spotlight

Welcome to the first edition of our "Industry Spotlight." Each issue, we will with feature a company involved in sustainable nanotechnology. First up is one of our **industry sponsors–Postnova Analytics**. Postnova is headquartered in Landsberg am Lech, Germany, and it is the sole provider for **Field-Flow Fractionation-Light Scattering systems**.



(Caption) Detector response versus retention time (top) of a gold nanorod mixture separated by Centrifugal FFF. The FFF separation shows three populations (peaks 1, 2 and 3). Narrow fractions were collected from each population (highlighted in blue). TEM analyses of the fractions confirm the separation of two nanorod structures having the same length of 35 nm but different thicknesses (10 nm and 25 nm). A third structure (spherical and round shapes) was eluted in between the nanorod peaks.

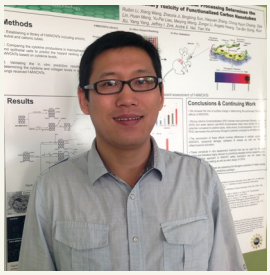
Why is Postnova interested in Sustainable Nanotechnology?
Postnova Analytics is proud of collaborating with researchers and scholars around the globe who are engaged in assessing the impact of the nanomaterials on the ecosystems. Postnova Analytics is providing analytical tools that can detect and characterize nanomaterials in the environment. This could help industries design products that would be renewable and safer.

POSTNOVA
Leading in FFF

2ND SNO CONFERENCE PHOTOS

2ND SNO CONFERENCE REVIEW

Student Poster Award Winners



1st place
Ruibin Li, UCLA

Surface Charge and Cellular Processing Determines the Pulmonary Toxicity of Functionalized Carbon Nanotubes

Dr. Ruibin Li is a postdoctoral research scientist of nanomedicine at UCLA. He received his PHD from Dalian Institute of Chemical Physics, Chinese Academy of Sciences. His researches focus on the understanding of the nano-bio interaction at molecular and cellular level, and the application of this knowledge for nano-therapy and safer design of engineering nanomaterials to promote the sustainable development of nanotechnology. He is currently working on the adverse effects of carbon nanotubes, rare earth oxide and upconversion nanoparticles.

2nd place
Marco Cinelli, University of Warwick

Development of an Approach for the Sustainability Assessment of Nanomaterials

Mr. Cinelli holds a Bachelor and a Master in Environmental Sciences from the University of Padua and Venice, respectively. He is a second year PhD student at the University of Warwick and the aim of his project is to develop a methodology by using a multi-criteria decision analysis framework and software to support the sustainability assessment of nanoproducts.

3rd place
Bill Vosti, UC Santa Barbara

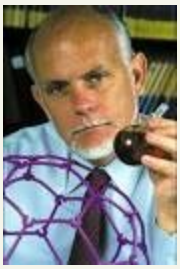
Estimating Exposure to ENMs from Personal Care Products throughout their Life Cycle

Mr. Vosti is an Environmental Science and Management master's candidate at the Bren School at UC Santa Barbara. His research interest is the fate and transport of nanomaterials. Upon graduation in June, 2013, Bill hopes to continue working in the fate and transport area in fields such as stormwater and pollution remediation management.

SNO Special Issue Publication

SNO will again publish papers from the 2nd Conference in ACS Sustainable Chemistry and Engineering. Invited authors are submitting their work for the special issue to come out this summer. These papers exemplify SNO's motto of "Research, Education, and Responsibility." Contents of last year's special issue are found under "News" on www.susnano.org.

SNO Issues and Dr. Richard Smalley



If you never had the opportunity to hear Dr. Richard Smalley talk about energy, nano, and sustainability, you can watch a lecture of his on YouTube (www.youtube.com/watch?v=CpYTVMhPUzc). Dr. Smalley (along with Sir Harry Kroto and Robert Curl) won the Nobel Prize in 1996 for the discovery of fullerenes (buckyballs). Smalley was an outspoken advocate of using nanotechnology to solve the "Top 20 Problems of Humanity for the Next 50 Years," a list he identified from his many seminars and talks. These problems are relevant to SNO researchers as we relate naotechnology to sustainability: Energy, Water, Food, Environment, Poverty, Terrorism & war, Disease, Education, Democracy, and Population. He often said, "Be a scientist, save the world." Dr. Smalley died of cancer in 2005. If he were here today, we are sure he would join us in supporting SNO's mission.

SNO to Partner with new RSC Journal

As a special membership benefit, SNO members will receive the new Royal Society of Chemistry (RSC) journal, Environmental Science: Nano (ES:Nano). The journal has been launched with SNO board member, Dr. Philip Demokritou, publishing the first paper, *A chemical free, nanotechnology-based method for airborne bacterial inactivation using engineered water nanostructures.* Member Silvana Andreescu and others have contributed papers. The nanoceria workshop results will be published in ES:Nano later this year. Editor-in-Chief, Vicki Grassian is a SNO member as are several other editors, including Greg Lowry, Rob Hamers, and Barb Karn.

Nano-Ceria Workshop

As part of the SNO conference last year, the University of Kentucky and SNO sponsored a workshop on nano-ceria. The outcome of the workshop will be published in ES:Nano along with research papers on nano-ceria. For information please contact Bob Yokel (ryolek@uky.edu).

Panel 1 topic: The current and proposed uses of nanoceria, and the basis for their use (properties) such as its catalytic activity as a fuel additive and in fuel cells; insoluble abrasive for mechanical planarization; and redox for anti-oxidative, anti-inflammatory therapeutics. Where is it being used? Why do people care?

Summary: Cerium dioxide is an extremely versatile and powerful catalytic material, owing to its intrinsic ability to form oxygen vacancies and facilitate redox chemistry. This pliable material can form a variety of simple or complex structures and its properties can be further tailored by substitutional metal doping, thus making it useful in a plethora of commercial areas, including chemical polishing and planarization, fuel cells, automotive catalytic converters, and even therapeutic applications.

Panel 2 topic: Does nanoceria behave both as a pro-and anti-oxidant depending on its synthesis, physico-chemical properties, dispersion, and environmental conditions?

Summary: The redox properties of nanoceria depend on particle size, the concentration of vacancies near the surface, the nanoparticle surface chemistry (including surfactants, salts, coupling agents, proteins, and other ligands), the pH of the environment, and ions or ligands available in its aqueous environment.

Panel 3 topic: What are the salient physico-chemical properties (size, surface chemistry, stabilizer) contributing to the potential positive and negative aspects of nanoceria in a biological system?

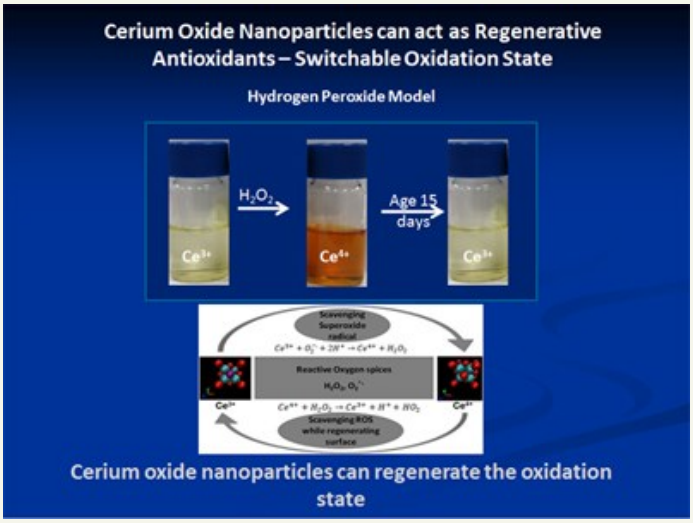
Summary: Nanoceria at the biological interface. Picture showing ultra fine ceria nanoparticles modified by biological cells. Redox chemistry of nanoceria changes as a function of its surrounding environment – showing the dynamic nature of the nanoparticle in a complex biological environment.

Panel 4 topic: The biological identity of nanoceria and its influence on the biological response.

Summary: Nanoceria that enter the body are immediately coated with biomolecules that influence the subsequent biological response. Future studies should take the biological environment into account in order to understand and manipulate the biological response to nanoceria.

Panel 5 topic: The Yang: Potential therapeutic development of nanoceria.

Summary:



Panel 6 topic: The Yin: The toxicological risks of nanoceria: accumulation, target organs and issues of clearance.

Summary: Nanoceria persists at the site of its accumulation or injection. Lung uptake is low and gastrointestinal uptake is extremely low. Adverse effects have been characterized with high exposures. The boundary between no and low effect has not been well established.

Panel 7 topic: Life cycle analysis, and environmental fate and transport of ceria.

Summary:

- Risk to aquatic and terrestrial receptors from diesel fuel additive likely negligible
- Little information available on exposures from other uses
- Some aquatic receptor species sensitive at low ug/L concentrations
- Hexamethyleneteramine coated particles far more toxic than other particle types

SNO Workshop II—Communicating Nanostuff

A workshop presented by SNO at the
3rd USA Science and Engineering Festival
Friday, April 25, 2014, 10 AM to noon
Washington Convention Center
801 Mt Vernon Pl NW Washington, DC 20001

This workshop will provide targeted communications training to teacher, scientists, and the public in general interested in nanotechnology and will enable them to more clearly convey concepts of nanotechnology and the broader scope of nanoscience to public audiences, including the news media. For more information contact Vinka Oyanedel-Craver (vinka.craver@susnano.org) or see www.susnano.org for workshop info.

ANNOUNCEMENTS

USA Science & Engineering Festival
SNO was selected to be an exhibitor at the 3rd USA Science & Engineering Festival (USASEF; www.usasciencefestival.org) Expo on April 26-27 and Sneak Peak on April 25 at the Walter E. Washington Convention Center in Washington D.C. SNO is looking for volunteers to participate in our "Nanotechnology in Our Life" with either short activities/hand-on activities related to sustainable nanotechnologies or just volunteering for an hour to attend help us to attend the booth.

SNO Session at NanoTech Conference
SNO will sponsor a session, "Sustainable Nanotechnology: Environmental Apps and EHS Implications," at the 2014 NSTI Nano Conference June 15-19.
See http://www.techconnectworld.com/Nanotech2014/sym/Sustainable_Nanotechnology_Environmental_Apps_EHS_Implications.html or
For more information contact Philip Demokritou (pdemokri@hsph.harvard.edu).

WANTED: Good ideas for SNO
SNO is your organization. If you have an idea you want to implement through SNO—a workshop, a publication, an outreach activity, a new curriculum, a different session, etc.—please let us know. We are always open to great new ideas.

We also welcome members to **post ads** including news, student/postdoc openings, job opportunities, and other member related announcements. (info@susnano.org)

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