Greenlist Bulletin

From the Toxics Use Reduction Institute
at the University of Massachusetts Lowell

This Issue Features Articles on Nanotechnology

July 19, 2013

In This Issue

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This is the weekly bulletin of the TURI Library at the University of Massachusetts Lowell. Greenlist Bulletin provides previews of recent publications and websites relevant to reducing the use of toxic chemicals by industries, businesses, communities, individuals and government. You are welcome to send a message to mary@turi.org if you would like more information on any of the articles listed here, or if this email is not displaying properly.

Editor's Note

Dear Greenlist Subscribers:
We hope you enjoy the compilation of articles and resources we have assembled on nanotechnology. We encourage you to click through to the special issues of *ACS Sustainable Chemistry & Engineering* and *Environmental Toxicology and Chemistry* which are linked below featured articles in this issue. Since there is so much information to comb through on this subject, you will see the next *Greenlist Bulletin* in **two weeks!**

Stay cool!
Mary

Director's Note

Dear Greenlist Subscribers:
This week's *Greenlist Bulletin* is dedicated to my colleague, Dr. Su-Jung (Candace) Tsai. Candace, who has been affiliated with TURI and the NSF Center for High-rate Nanomanufacturing for the past nine years, is one of the world's leading researchers studying the environmental and occupational health and safety aspects of nanotechnology. Her journal articles and presentations at many national and international meetings document her groundbreaking research into methods to evaluate and control exposures to engineered nanoparticles. She has moved to Purdue University, where she is an Assistant Professor of Occupational Health in the School of Health Sciences. We wish her the best of luck in her new position. She will be missed.

Cordially,
Dr. Mike Ellenbecker, TURI

General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories

Source: National Institute for Occupational Safety and Health,

Greenlist Bulletin Archives

TURI Website

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Resources

Visit the TURI Library to view the following books on Nanotechnology:

A Research Strategy for Environmental, Health, and Safety Aspects of Engineered Nanomaterials
***
Nanoscale: Issues and Perspectives for the NanoCentury
***
Nanotechnology: Health and Environmental Risks
***
Nanoparticles in the Water Cycle
***
International Handbook on Regulating Nanotechnologies
***
Nanotechnologies, Hazards and Resource Efficiency
***
Carbon Nanotubes
***
Handbook of Nanoscience, Engineering, and Technology
***
Nanofuture
***
Principles of Nanotechnology
***
We also subscribe to the *Journal of Nanoparticle Research.*

2012

Nanotechnology, the manipulation of matter at a nanometer scale to produce new materials, structures, and devices having new properties, may revolutionize life in the future. It has the potential to impact medicine through improved disease diagnosis and treatment technologies and to impact manufacturing by creating smaller, lighter, stronger, and more efficient products. Nanotechnology could potentially decrease the impact of pollution by improving methods for water purification or energy conservation. Although engineered nanomaterials present seemingly limitless possibilities, they bring with them new challenges for identifying and controlling potential safety and health risks to workers. Of particular concern is the growing body of evidence that occupational exposure to some engineered nanomaterials can cause adverse health effects.

As with any new technology or new material, the earliest exposures will likely occur for those workers conducting discovery research in laboratories or developing production processes in pilot plants. The research community is at the front line of creating new nanomaterials, testing their usefulness in a variety of applications and determining their toxicological and environmental impacts. Researchers handling engineered nanomaterials in laboratories should perform that work in a manner that protects their safety and health. This guidance document provides the best information currently available on engineering controls and safe work practices to be followed when working with engineered nanomaterials in research laboratories.

Access publication here.

Also read European Agency for Safety and Health at Work's fact sheets for working with nanomaterials.

Environmental, Health and Safety Issues

Source: National Nanotechnology Initiative

With the advent of new technologies, including nanotechnology, one should consider the potential unintended consequences to human health and the environment that might accompany development and use of the technology. . . .

The Federal commitment to health and the environment has been part of a nanotechnology research framework since 2001. Work on an NNI Nanotechnology EHS Research Strategy began in earnest in 2006. The first strategy was published in 2008 and updated in 2011. This strategy provides guidance to the Federal agencies as they develop their agency-specific nanotechnology EHS research priorities, implementation plans, and timelines. The goal of this coordinated research effort is to provide the information necessary to regulatory agencies to perform risk assessments that protect public health and the environment and support the beneficial use of nanotechnology.

Read more...

Access the National Nanotechnology Initiative's October 2011 Environmental, Health, and Safety Research Strategy here.

EPA Needs to Manage Nanomaterial Risks More Effectively

Source: U.S. Environmental Protection Agency's Office of Inspector General, December 29, 2011

We found that EPA does not currently have sufficient information or processes to effectively manage the human health and environmental risks of nanomaterials. EPA has the statutory authority to regulate nanomaterials but currently lacks the environmental and human health exposure and toxicological data to do so effectively. The Agency proposed a policy under the Federal Insecticide,

Fungicide, and Rodenticide Act to identify new pesticides being registered with nanoscale materials. After minimal industry participation in a voluntary data collection program, the Agency has proposed mandatory reporting rules for nanomaterials under the Federal Insecticide, Fungicide, and Rodenticide Act, and is also developing proposed rules under the Toxic Substances Control Act.

Read more...

Also read from the *Journal of Nanoparticle Research*, The Massachusetts Toxics Use Reduction Act: a model for nanomaterials regulation?

Sustainable Nanomaterials: Emerging Governance Systems

Source: *ACS Sustainable Chemistry & Engineering*, June 2013
Author: Lynn Bergeson

Domestic and international laws, regulations, policies, and government and private-party governance programs are being carefully reviewed and revised to enhance their utility to nurture the commercialization of nanoscale materials. Whether existing laws are adequate to address potential risks from nanoscale materials and promote their sustainable use will inspire debate and governance initiatives for years to come.

Read more...

Access full special issue of *ACS Sustainable Chemistry & Engineering* on Sustainable Nanotechnology here.

Read an article from *Nature Nanotechnology*, The European Union's chemical legislation needs revision.

Read a report from a 2012 symposium organized by the European Union, Joint Research Center, et al., Safety Issues and Regulatory Challenges of Nanomaterials.

Also read an article from *Nanowerk*, Nanotechnology - Governance through dialogue.

Graphene microsheets enter cells through spontaneous membrane penetration at edge asperities and corner sites

Source: *Proceedings of the National Academy of Sciences of the United State of America*, June 13, 2013
Authors: Yinfeng Li, Hongyan Yuan, Annette von dem Bussche, Megan Creighton, Robert H. Hurt, Agnes B. Kane, and Huajian Gao

Understanding and controlling the interaction of graphene-based materials with cell membranes is key to the development of graphene-enabled biomedical technologies and to the management of graphene health and safety issues. Very little is known about the fundamental behavior of cell membranes exposed to ultrathin 2D synthetic materials. Here we investigate the interactions of graphene and few-layer graphene (FLG) microsheets with three cell types and with model lipid bilayers by combining coarse-grained molecular dynamics (MD), all-atom MD, analytical modeling, confocal fluorescence imaging, and electron microscopic imaging. The imaging experiments show edge-first uptake and complete internalization for a range of FLG samples of 0.5- to 10-μm lateral dimension. In contrast, the simulations show large energy barriers relative to kBT for membrane penetration by model graphene or FLG microsheets of similar size. More detailed simulations resolve this paradox by showing that entry is initiated at corners or asperities that are abundant along the irregular edges of fabricated graphene materials. Local piercing by these sharp protrusions initiates membrane propagation along the extended graphene edge and thus avoids the high energy barrier calculated in simple idealized MD simulations. We propose that this mechanism allows cellular uptake of even large multilayer sheets of micrometer-scale lateral dimension, which is consistent with our multimodal bioimaging results for primary human keratinocytes, human lung epithelial cells, and murine macrophages.

Read more...

Also read a press release on the study.

Current Intelligence Bulletin 65: Occupational Exposure to Carbon Nanotubes and Nanofibers

Source: National Institute for Occupational Safety and Health, April 2013

The Occupational Safety and Health Act of 1970 (Public Law 91-596) was passed to assure safe and healthful working conditions for every working person and to preserve our human resources. This Act charges the National Institute for Occupational Safety and Health (NIOSH) with recommending occupational safety and health standards and describing exposures that are safe for various periods of employment, including (but not limited to) the exposures at which no worker will suffer diminished health, functional capacity, or life expectancy because of his or her work experience. . . .

Results from recent animal studies indicate that carbon nanotubes (CNT) and carbon nanofibers (CNF) may pose a respiratory hazard. CNTs and CNFs are tiny, cylindrical, large aspect ratio, manufactured forms of carbon. There is no single type of carbon nanotube or nanofiber; one type can differ from another in shape, size, chemical composition (from residual metal catalysts or functionalization of the CNT and CNF) and other physical and chemical characteristics. Such variations in composition and size have added to the complexity of understanding their hazard potential. Occupational exposure to CNTs and CNFs can occur not only in the process of manufacturing them, but also at the point of incorporating these materials into other products and applications. A number of research studies with rodents have shown adverse lung effects at relatively low-mass doses of CNT and CNF, including pulmonary inflammation and rapidly developing, persistent fibrosis. Although it is not known whether similar adverse health effects occur in humans after exposure to CNT and CNF, the results from animal research studies indicate the need to minimize worker exposure.

Read more...

Access Current Intelligence Bulletin 65 here.

See U.S. Occupational Safety and Health Administration's page on Nanotechnology - Health Effects and Workplace Assessments and Controls.

Also view the National Institute of Environmental Health Sciences page on Nanomaterials.

Finally, see press release from North Carolina State University, National Study of Nanomaterial Toxicity Sets Stage for Policies to Address Health Risks, based on a recent paper in *Environmental Health Perspectives*, Interlaboratory Evaluation of Rodent Pulmonary Responses to Engineered Nanomaterials: The NIEHS Nano GO Consortium.

Nanosilver: Weighing the Risks and Benefits

Source: *Environmental Health Perspectives*, July 2013
Author: Nate Seltenrich

Nanosilver itself is nothing new. It has been used for different reasons in consumer and commercial products over the past century, although "nano" terminology does not always appear in the patent or scientific literature. Colloidal silver, in which silver particles down to the nanoscale are suspended in liquid, has been used for health and medical reasons since the early twentieth century and is now marketed as a dietary supplement and alternative medicine cure-all. Nanosilver has been used in the photo development process since the late 1800s and has been registered with the EPA for use in swimming-pool algaecides since 1954 and drinking-water filters since the 1970s.

Recent advances in the ability to synthesize nanosilver particles have led to a surge of even more innovations. Most hinge on the ability to impregnate a wide range of materials and coatings with synthesized nanosilver compounds. "What we've learned how to do is bundle silver atoms into minuscule little particles, and then we're able to take these particles and put them in places that they've never been able to get before," explains Samuel Luoma, an emeritus researcher with the U.S. Geological Survey and author of Silver Nanotechnologies and the Environment, a report published by the Pew Project on Emerging Nanotechnologies.

As a result, nanosilver has appeared in an increasingly wide range of products on U.S. shelves, among them electric shavers, athletic clothing, bed and bath linens, cosmetics, baby bottles, stuffed animals, keyboards, paints, and food containers. It's also used in hospital equipment including catheters, stents, bandages, and wound dressings, as well as on surfaces including wheelchair seats and door handles. In Southeast Asia, nanosilver is used even more commonly and often openly; it has been sprayed in Hong Kong subways and touted on Korean toothpaste tubes, for example.

Despite its widespread use, nanosilver remains a fairly poorly understood material to both regulators and scientists. Consensus remains elusive on subjects as essential as how it behaves in the

human body and the environment, and the extent to which its use may contribute to bacterial resistance.

Read more...

Read in *BioMed Research International*, Toxicity of Silver Nanoparticles at the Air-Liquid Interface.

Also view *Environmental Toxicology and Chemistry's* special issue on Nanomaterials in the Environment.

The Project on Emerging Nanotechnologies

Source: Woodrow Wilson International Center for Scholars

The Project, established in 2005, is dedicated to helping ensure that as nanotechnologies advance, possible risks are minimized, public and consumer engagement remains strong, and the potential benefits of these new technologies are realized.

Nanotechnologies are hailed by many as the next industrial revolution. They promise to change everything from the cars we drive to the clothes we wear, from the medical treatments our doctors can offer to our energy sources and workplaces. Although focused on the very small, nanotechnologies offer tremendous potential benefits. From new cancer therapies to pollution-eating compounds, from more durable consumer products to detectors for biohazards like anthrax, from novel foods to more efficient solar cells, nanotechnologies are changing the way people think about the future.

The Project on Emerging Nanotechnologies collaborates with researchers, government, industry, NGOs, policymakers, and others to look long term, to identify gaps in knowledge and regulatory processes, and to develop strategies for closing them. The Project will provide independent, objective knowledge and analysis that can inform critical decisions affecting the development and commercialization of nanotechnologies.

Read more...

Access their inventory of current research involving nanotechnology health and environmental implications here.

Read in *Ecotoxicology*, Categorization framework to aid exposure assessment of nanomaterials in consumer products.

Also read about how the Danish Environmental Protection Agency has started a public consultation for a national Nanomaterial Product Register.

Nanotechnology in the marketplace: how the nanotechnology industry views risk

Source: *Journal of Nanoparticle Research*, Volume 15, No. 5, 2013
Author: Sean Becker

Despite uncertainty about the potential human health and environmental risks of nanotechnology, major stakeholders such as regulatory agencies and the nanotechnology industry are already negotiating the emerging regulatory framework for nanotechnology. Because of a relative lack of nano-specific regulations, the future of nanotechnology development will depend greatly on the views held by the nanotechnology industry. This study fills the research gap in understanding how the nanotechnology industry perceives the risks of nanotechnology. This is the first interview-based study of the nanotechnology industry in the United States. Semi-structured, open-ended phone interviews were conducted with 17 individuals involved in the commercialization of nanotechnology in the United States. Results indicate that while the industry acknowledges uncertainty about the potential risks of nanotechnology and takes significant precaution in ensuring the safety of their products, they do not see nanotechnology as novel or risky. They do not believe that uncertainty over risk ought to delay the further development of nanotechnology. The industry sees itself as the primary agent in ensuring consumer safety and believes that consumers are adequately protected. They are also largely benefit-centric and view product labeling as inefficacious.

Read more...

Greener Nanoscience: A Proactive Approach to Advancing Applications and Reducing

Implications of Nanotechnology

Source: *ACS Nano*, March 25, 2008
Author: James E. Hutchison

Nanotechnology continues to offer new materials and applications that will benefit society, yet there is growing concern about the potential health and environmental impacts of production and use of nanoscale products. Although hundreds of studies of nanomaterial hazards have been reported, due (largely) to the complexity of the nanomaterials, there is no consensus about the impact these hazards will have. This Focus describes the need for a research agenda that addresses these nanomaterial complexities through coordinated research on the applications and implications of new materials, wherein nanomaterials scientists play a central role as we move from understanding to minimizing nanomaterial hazards. Greener nanoscience is presented as an approach to determining and implementing the design rules for safer nanomaterials and safer, more efficient processes.

Read more...

New 'Electronic Nose' Nano-Sensor Being Developed for Food Safety, Health

Source: University of California, Riverside, June 13, 2013
Author: Sean Nealon

RIVERSIDE, CA -- The "electronic nose" sensor developed by a University of California, Riverside engineering professor, and being commercialized by Innovation Economy Crowd (ieCrowd), will be further refined to detect deadly pathogens including toxic pesticides in the global food supply chain, according to a recently signed product development and distribution agreement. . . .

This is the first such agreement signed by [Nano Engineered Applications, Inc. (NEA)] in relation to Myung's "electronic nose" sensor research, which involves a nano-sensor array that can detect small quantities of harmful airborne substances. It uses functionalized carbon nanotubes, which are 100,000 times finer than human hair, to detect airborne toxins down to the parts per billion level.

Using ieCrowd's commercialization platform, NEA is developing a range of products and applications for a diverse set of industries, including industrial sites (detecting gas leaks, combustion emissions), homeland security (warning systems for bio-terrorism) and the military (detecting chemical warfare agents). This new collaboration will be the first time the sensor will be customized for food safety and potency measurements.

Read more...

Please send a message to mary@turi.org if you would like more information on any of these resources. Also, please tell us what topics you are particularly interested in monitoring, and who else should see Greenlist. An online search of the TURI Library catalog can be done at http://library.turi.org for greater topic coverage.

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