ISSUE 4 | VOLUME 3 | AUGUST/SEPTEMBER 2008

A CONSTRUCTIVE CONTRIBUTION TO THE RESPONSIBLE DEVELOPMENT AND USE OF ENGINEERED NANOMATERIALS

nanoRISK

OPTIMIZING THE BENEFITS OF NANOTECHNOLOGY WHILE MINIMIZING AND CONTROLLING THE RISKS

Insider Report

A new study has made the first step toward the development of both a fast and fairly comprehensive method of screening of biological activity and cytotoxicity of nanoparticles.

FINGERPRINTING NANOPARTICLES TO ASSESS CYTOTOXICITY

High content analysis (HCA) is a powerful platform that combines cell-based assays with traditional microscopy and automated, sophisticated image processing and analysis software. This technology is capable of using living and fixed cells, typically with fluorescently labeled antibodies and reagents. It has been widely adopted in the pharmaceutical and biotechnology industries for target identification and validation. HCA has made particular inroads into R&D applications where high throughput screening has proven inadequate, such as measuring multiple biological pathways simultaneously, or revealing off-target drug effects. HCA has stepped into this void by demonstrating how particular proteins are affected by the application of a molecule to the cell line of interest.

HCA is also used as a secondary screen to reveal potential toxicities. While detecting structural and biochemical changes in cells is vital to the discovery and development of new pharmaceuticals, it is also critical in measuring their toxicity during the early stages of drug screening. Automating the analysis of images of cells allows drug companies to use "high content screening" to measure subtle but important changes both rapidly and accurately.

A new study conducted by a joint U.S. – Irish team has now made the first step toward the development of both a fast and fairly comprehensive method of screening of biological activity and cytotoxicity of nanoparticles.

Continued on page 4

A group of researchers explored the 12 lessons from a 2001 EU report on technological hazards in the context of nanotechnology.

LATE LESSONS FROM EARLY WARNINGS FOR NANOTECHNOLOGY

One term you hear quite often in discussions about the potential risks of nanotechnology is 'precautionary principle'. This moral and political principle, as commonly defined, states that if an action or policy might cause severe or irreversible harm to the public or to the environment, in the absence of a scientific consensus that harm would not ensue, the burden of proof falls on those who would advocate taking the action. The principle aims to provide guidance for protecting public health and the environment in the face of uncertain risks, stating that the absence of full scientific certainty shall not be used as a reason to postpone measures where there is a risk of serious or irreversible harm to public health or the environment.

In 2001, an expert panel commissioned by the European Environment Agency (EEA) published a report, *Late Lessons from Early Warnings: The Precautionary Principle 1896–2000*, which explored 14 case studies, all of which demonstrated how not heeding early warnings had led to a failure to protect human health and the environment. This report's stated goal was to gather "information on the hazards raised by human economic activities and its use in taking action to protect better the environment and the health of the species and ecosystems that are dependent on it". It looked at controversial topics such as asbestos, Mad Cow Disease, growth hormones, PCBs and radiation – all of which demonstrated how not heeding early warnings had led to a failure to protect human health and the

Continued on page 5

nanoRISK is published bimonthly by Nanowerk, LLC | Annual Subscription Rate US$49 | For subscription information e-mail subscriptions@nanorisk.org | Address all content-related inquiries to Editor, nanoRisk: editor@nanorisk.org | www.nanorisk.org

New research reveals that zinc oxide nanoparticles at certain concentrations could adsorb onto ryegrass root surface, damage root tissues, enter root cells, and inhibit seedling growth.

NANOPARTICLE UPTAKE BY PLANTS

Nanoparticles with at least one dimension of 100 nanometers or less fall in the transitional zone between individual atoms or molecules and the corresponding bulk material, which can drastically modify the physicochemical properties of the material and may generate adverse biological effects in organisms. As the discussion about potentially undesired side effects of engineered nanoparticles heats up, research on toxicological effects of nanomaterials gets increasing attention. Nanotoxicology is quickly being established as a new field, with its major focus on human and animal studies. However, very few studies have been conducted to assess the toxicity of nanomaterials to ecological terrestrial species, particularly plants. So far, the mechanisms of nanoparticle phytotoxicity – the ability to cause injury to plants – remain largely unknown and little information on the potential uptake of nanoparticles by plants and their subsequent fate within the food chain is available.

One material that is of great interest to nanotoxicologists is zinc oxide (ZnO). ZnO nanoparticles are being used in personal care products (e.g. sunscreen lotions) and coatings and paints on the account of their UV absorption and transparency to visible light. Acute toxicity of ZnO nanoparticles has been observed in bacteria. Another study also showed phytotoxicity of ZnO nanoparticles. However, the experiments performed in this study took place in Petri dishes to examine the inhibition of ZnO nanoparticles on seedling root elongation; plant uptake and rhizosphere dissolution of the ZnO were not investigated.

In a follow-up study, the scientists used a hydroponic culture system to examine plant cell internalization and possible upward translocation of ZnO nanoparticles. The dissolution of ZnO nanoparticles and its contribution to the phytotoxicity were also investigated. Ryegrass (Lolium perenne) was used as a model plant for its wide distribution and common use in phytotoxicity study.

"Our research revealed that ZnO nanoparticles at certain concentrations could adsorb onto ryegrass root surface, damage root tissues, enter root cells, and inhibit seedling growth" says Dr. Baoshan Xing. "We also found that the phytotoxicity of ZnO nanoparticles could not primarily come from their dissolution in the bulk nutrient solution or the rhizosphere."

Xing, a professor in the Department of Plant, Soil & Insect Sciences at the University of Massachusetts, together with Dr. Daohui Lin from the Department of Environmental Science at Zhejiang University in PR China, published these recent findings in *Environmental Science & Technology*.

Nanoparticles may increase lipid membrane peroxidation upon contact to cells due to the reactive oxygen species (ROS). More severe subsequence, such as genotoxicity, may happen after nanoparticles entering into cells. Therefore, increasing investigations focused on mammalian or bacterial cell uptake of nanoparticles and the subsequent damage.

"However, to our knowledge, limited or no information was available on plant cell internalization of nanoparticles or other particles" Xing says. "Dissolution of metal-based nanoparticles is a debatable mechanism for the nanotoxicity; researches reported either positive or negative evidence for the mechanism. We believe that toxicity of nanoparticles depends on their property, test organism species, and surrounding solution conditions. If a test organism is very susceptible to a metal ion, the toxicity of metal-based nanoparticles could be overwhelmed by the dissolved metal ions. Therefore, more research is needed to clarify the contribution of dissolution to the toxicity of metal-based nanoparticles."

Xing explains that the current study was aimed at examining any potential eco-effect of nanoparticles in higher plants and to answer two questions: One is whether plants can uptake and transport nanomaterials. The other is the contribution of dissolution to the phytotoxicity of metal-based nanomaterials.

The researchers used Zn^{2+} ions to compare and verify the root uptake and phytotoxicity of ZnO nanoparticles in a hydroponic culture system. The root uptake and phytotoxicity were visualized by light, scanning electron, and transmission electron microscopes. In the presence of ZnO nanoparticles, ryegrass biomass significantly reduced, root tips shrank, and root epidermal and cortical cells highly vacuolated or collapsed.

"Zn^{2+} ion concentrations in bulk nutrient solutions with ZnO nanoparticles were lower than the toxicity threshold of Zn^{2+} to the ryegrass; shoot Zn contents under ZnO nanoparticle treatments were much lower than that under Zn^{2+} treatments" Xing explains. "Therefore, the phytotoxicity of ZnO nanoparticles was not directly from their limited dissolution in the bulk nutrient solution or rhizosphere. ZnO nanoparticles greatly adhered onto the root surface. Individual ZnO nanoparticles were observed present in apoplast and protoplast of the root endodermis and stele, indicating that nanoparticles could be internalized by plant cells. However, translocation factors of Zn from root to shoot remained very low under ZnO nanoparticle treatments, and were much lower than that under Zn^{2+} treatments, implying that little (if any) ZnO nanoparticles could translocate up in the ryegrass in this study."

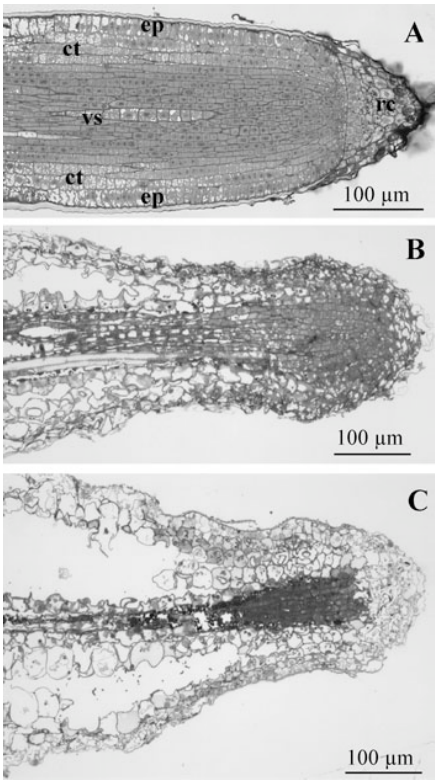
The scientists examined the toxic symptoms of ZnO nanoparticles and Zn^{2+} to the ryegrass by light microscopy of the longitudinally sectioned primary root tips (see figure below). Xing explains that in the control, root tips developed very well with the usual three tissue systems (epidermis, cortex, and vascular cylinder) and an intact rootcap at the apex observed (A); longitudinally and transversely dividing cells were evident. "However, shrank morphology of the root tips (B and C, respectively) indicates the severe impact of ZnO nanoparticles and Zn^{2+} ions. In the presence of 1000

Continued on next page

Nanoparticle Uptake …

Continued from previous page

mg/L ZnO nanoparticles or Zn^{2+}, the epidermis and rootcap were broken, the cortical cells were highly vacuolated and collapsed, and the vascular cylinder also shrank. No living cells in the root tips could be observed in the presence of



Light microscopic observation of longitudinal sections of ryegrass primary root tips under treatments of control (A); 1000 mg/L ZnO nanoparticles (B); 1000 mg/L Zn^{2+}(C). rc: rootcap; ep: epidermis; ct: cortex; vs: vascular cylinder. (Reprinted with permission from American Chemical Society)

1000 mg/L Zn^{2+}, whereas part of the vascular cells seems still alive with 1000 mg/L ZnO nanoparticles, though not active as the control."

In order to develop a comprehensive toxicity profile for engineered nanoparticles – including the life cycle of these materials from creation to disposal – a thorough understanding of the phytotoxicity mechanism and uptake potential by plants, and the subsequent impact on human and environmental health through food chains, is required.

This study on ryegrass is just one example of what needs to be done, but different types of nanoparticles and plant species need to be examined to clarify nanoparticle uptake by plant and the subsequent fate within food chains.

Xing points out that one of the main challenges today to conduct this type of research is the problem of accurately detecting and assessing nanoparticles in plants and their tissues. Nevertheless, he explains the need for future studies to be directed into the underlying biochemical mechanism of phytotoxicity, for example, how would nanoparticles damage plant cells? What is the interaction between nanoparticles and cell organelles? If and how nanoparticles can be transported within plant? Can nanoparticles transport to flowers and seeds?

Upcoming Events

Looking At The Risky Side Of Nano

NanoImpactNet Workshops
September 3-5, 2008, Zurich (Switzerland)
The 3 workshops will address: Strategies to standardize nanomaterials for environmental and ecotoxicological research; NanoLifeCycle: Development of approaches and methodologies for assessing the whole life-cycle of nanomaterials and nanoproducts; Nanomaterial Environment Health and Safety Research in the EU: Building a sustainable multi-stakeholder dialogue.

Nanotoxicology – 2nd International Conference
September 7-10, 2008, Zurich (Switzerland)
This conference will bring you up to date with important research developments in nanotoxicological sciences.

Nano Risk Analysis: Advancing the Science for Nanomaterial Risk
September 10-11, 2008, Washington, DC (USA)
This workshop brings together experts from diverse disciplines to evaluate how the field of risk analysis can address the considerable uncertainties currently associated with impacts from nanoscale materials and nanotechnologies.

Environmental Effects of Nanoparticles and Nanomaterials
September 15-16, 2008, Birmingham (UK)
While the production of nanomaterials is undergoing exponential growth, their biological effects and environmental fate and behaviour are relatively unknown. This meeting is the third international meeting on this topic.

Nanotechnologies at the OECD - 6th Session of the Intergovernmental Forum on Chemical Safety
September 15-19, 2008, Dakar (Senegal)
The objective of the Working Party on Manufactured Nanomaterials is to promote international co-operation in human health and environmental safety related aspects of manufactured nanomaterials, in order to assist in the development of rigorous safety evaluation of nanomaterials.

4th International NanoRegulation Conference
September 16-17, 2008, St. Gallen (Switzerland)
The topic of this year's NanoRegulation Conference are voluntary measures in the identification, assessment, control and communication of nanotechnology risks (Nano Risk Governance).

Nanotech Northern Europe 2008
September 23-25, 2008, Copenhagen (Denmark)
One theme of the conference deals with "Safe Development of Nanotechnology". This track will cover the latest scientific research into the biological impact of engineered nanoparticles on the human body and the environment, in order to disseminate findings and to create cooperation and exchange in this field.

Fingerprinting ...

Continued from page 1

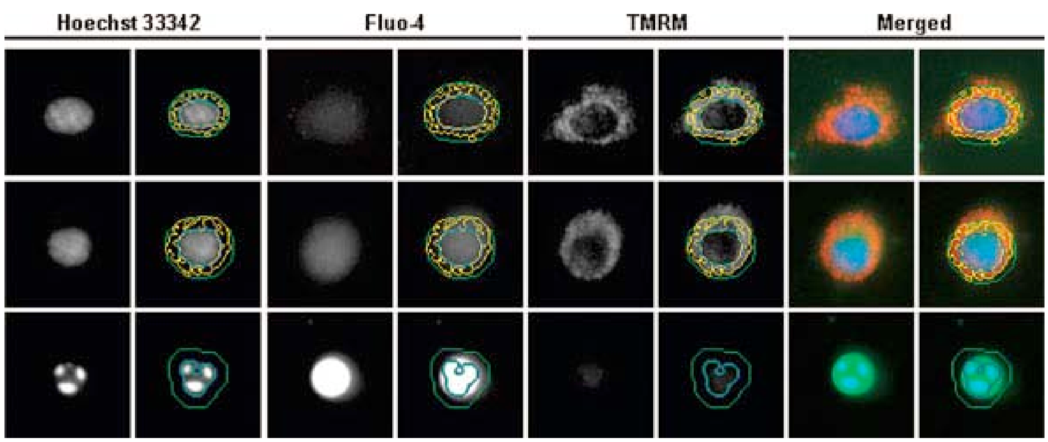
"We see two important factors that necessitate the development of such protocols" says Dr. Nicholas Kotov. "Firstly, the synthesis of nanoparticles is much simpler than the synthesis of proteins and other drugs. Since minor changes in the synthetic protocol are likely to affect their interactions with cells, one can expect to see a tremendous surge of potential candidates for toxicity/biological activity screening. Secondly, considering the diversity of nanoparticles being synthesized, one needs a unified approach for screening nanomaterials. Such a systematic approach is not only fundamental to the construction of a unified database for biological and cytotoxic effects of nanomaterials but will also enable scientists to synthesize safer and more efficacious nanostructures at an ever-more efficient rate."

Kotov, a Professor in Chemical Engineering at the University of Michigan, in collaboration with the research group of Dr. Yurii Gun'ko from the Trinity College Dublin, Ireland, says that we can expect the engineering of biologically functional nanostructures to follow the path of synthetic pharmaceuticals in drug discovery: "In the near future, panels of nanoparticles with slightly varying properties and structures will be synthesized and evaluated for cytotoxicity before qualified candidates are designated subsequent developments."

In a paper in *ACS Nano*, the researchers describe their universal approach to the investigation of toxicity of nanoparticles and other nanocolloids. This method in effect suggests that the treatment of nanoparticles in respect to cells would be similar to that of drug candidates, for evaluation of which HCA is widely used.

Kotov says that the team's motivation was to accelerate and systematize the process of assessing the effects of nanoparticles on cells. "There are so many parameters of both cells and nanoparticles that can effect toxicity. One has to screen the nanoparticles in respect to size, core material, composition of the stabilizer shell, length of exposure, and concentration. HCA is a marriage between a computer and confocal microscopy, and thus, it offers substantial advantages in the form of automated screening and uniform processing of the results. In the end, one can quickly obtain 'fingerprints' of the toxic effects of nanocolloids in respect to numerous characteristics."

In future, the multiparametric nature of these fingerprints – or profiles – will allow cytotoxicity analyses to be conducted at much higher throughput and accuracy. Kotov points out that the application of HCA technology in the study of nanomaterials is not limited to colloidal nanoparticles and cytotoxicity studies, as the team already is in the process of demonstrating its novel use on biocompatibility assessment of multilayer thin films produced from a layer-by-layer assembly.



Representative fluorescence images of a healthy (first row), an impaired (middle row), and a dying (last row) cell acquired and processed by the IN Cell HCS system. The nucleus, stained by Hoechst 3342, is outlined by a blue circle. The cell body or the intracellular region is enclosed by a green circle, within which the intensity of Fluo-4 fluorescence is measured. The punctuate, TMRM-bound mitochondrial organelles in the cytosol are identified by the yellow inclusions. In the merged images, Hoechst 3342, Fluo-4, and TMRM stains are shown in blue, green, and red, respectively. As the health condition of cells deteriorates, the nucleus shrinks and becomes fragmented, the Fluo-4 stain intensifies and signals a sharp increase in intracellular free calcium concentration, and the TMRM stain diminishes as a result of reduction in mitochondrial membrane potential. (Reprinted with permission from American Chemical Society)

While understanding the detailed mechanism of the toxic effects of nanoparticles is certainly one obvious application for this technique, others include studies of anticancer formulations based on nanoparticles. A recent example of such an application is gold particles with antileukemia drug attached to the surfaces as described in one of Kotov's recent publications.

In addition to adapting the HCA technique to nanoparticulate material, the researchers also report two other interesting findings: "Most importantly, we demonstrated that undifferentiated and differentiated cells respond differently to quantum dot (cadmium telluride) induced cytotoxicity" says Kotov. "Specifically, the differentiated cells are more sensitive and vulnerable to quantum dot treatment, which can be

Continued on page 6

Late Lessons From Early Warnings…

Continued from page 1

environment.

The expert group that compiled the EEA report identified 12 'late lessons' on how to avoid past mistakes as new technologies are developed.

"These lessons bear an uncanny resemblance to many of the concerns now being raised about various forms of nanotechnology" says Steffen Foss Hansen. "A comparison between the EEA recommendations and where we are with nanotechnology shows we are doing some things right, but we are still in danger of repeating old, and potentially costly, mistakes."

Hansen, a researcher in the Department of Environmental Engineering and NanoDTU Environment at Technical University of Denmark (DTU), together with Anders Baun from DTU, Andrew Maynard from the Project on Emerging Nanotechnologies and Joel A. Tickner from the Department of Community Health and Sustainability at the University of Massachusetts, have published a commentary in *Nature Nanotechnology* in which they explore these 12 lessons in the context of nanotechnology. These are the 12 lessons outlined by the EEA:

- Acknowledge and respond to ignorance, uncertainty and risk in technology appraisal.
- Evaluate alternative options for meeting needs, and promote robust, diverse and adaptable technologies.
- Provide long-term environmental and health monitoring and research into early warnings.
- Ensure use of 'lay' knowledge, as well as specialist expertise.
- Identify and work to reduce scientific 'blind spots' and knowledge gaps.
- Account fully for the assumptions and values of different social groups.
- Identify and reduce interdisciplinary obstacles to learning.
- Maintain regulatory independence of interested parties while retaining an inclusive approach to information and opinion gathering.
- Account for real-world conditions in regulatory appraisal.
- Identify and reduce institutional obstacles to learning and action.
- Systematically scrutinize claimed benefits and risks.
- Avoid 'paralysis by analysis' by acting to reduce potential harm when there are reasonable grounds for concern.

Hansen, Baun, Maynard and Tickner argue that the question seems not to be whether we have learnt the lessons – as outlined by the EEA report – but whether we are applying them effectively enough to prevent nanotechnology being one more future case study on how not to introduce a new technology.

In their commentary, the scientists go through the 12 EEA lessons and, where appropriate, apply them to the current issues, regulatory and commercial activities, and scientific knowledge surrounding current nanotechnology developments. Hansen summarizes his and his colleagues concerns in three key points:

1) We seem to ignore some valuable lessons from the past and thus are in danger of repeating old, and potentially costly, mistakes.

2) The global response to these warning signs has been patchy. Although we have gotten the early warning signs, we risk putting off future commercial and social benefits of nanotechnology by not addressing the EHS- and regulatory issues fullheartedly and efficiently

3) Many governments still call for more information as a substitute for action.

In an ideal world, politicians and regulators would look to scientists as the ultimate authorities when it comes to making regulatory decisions about technology risks and science would be able to provide useful and unambiguous answers (for the sake of this argument, let's ignore for a moment the tremendous influence of industry lobbies and the distorting effects of political ideology). Here, the article provides a striking example of what it calls 'institutional ignorance' – instances where research throws up useful information which then is ignored and overlooked by the regulators:

"They [the authors of the EEA report] cite cases where regulators made inappropriate appraisals because of the blinkers imposed by their specific disciplines – such as the preoccupation of medical clinicians with acute effects when dealing with radiation and asbestos. There is a real danger of similar errors being made with nanotechnology, which crosses many fields of expertise. One needs to draw on physics, chemistry, computer sciences, health and environmental sciences to understand nanomaterial properties and risks. Consequently, a number of multidisciplinary centers for nanoscience and nanomanufacturing have been established around the world, but only a few of these address health, environmental, and social aspects. Setting aside resources to create an infrastructure that gets people working together across disciplines is critical."

Hansen and his co-authors argue that, "despite a good start", it seems that we have become distracted because

- nanotechnology is being overseen by the same government organizations that promote it;
- research strategies are not leading to clear answers to critical questions;
- collaborations continue to be hampered by disciplinary and institutional barriers; and
- stakeholders are not being fully engaged.

"In part this is attributable to bureaucratic inertia" says Hansen, "but comments from some quarters – such as 'risk research jeopardizes innovation' or 'regulation is bad for business' – only cloud the waters when clarity of thought and action are needed."

The authors concede that the picture is not as bleak as it could be: "Although progress towards developing sustainable nanotechnologies is slow, we do seem to have learnt some new tricks: asking more critical questions early on; developing

Continued on next page

Fingerprinting…

Continued from page 4

understood as the demonstration of adaptability of cells in undifferentiated state. This difference should be taken into account in the establishment of treatment dosage for any NP-based biological studies or therapies."

The scientists are also exploring the use of HCA technology to study the transport and localization of engineered nanoparticles in living cells by proposing a broader change in the way nanoparticles' effect on cells are evaluated.

"HCA is used for screening drugs and by using the method, we basically open a wide field of subtle interactions of nanoparticles with cells, which eventually can lead to new advances in medicine. We believe this endeavor ultimately will help to shed light on the development of new drugs and drug delivery strategies based on nanomaterials."

Kotov is quick to stress the limitations of traditional ex vivo nanoparticle toxicity tests related to the two-dimensional nature of cell cultures: "Cellular response in 2D cell cultures was shown to be different than cells in the natural tissue environment. More adequate 3D cell culture techniques – giving much better representation of the actual processes taking place in human tissues – need to be developed. HCA does afford analysis of 3D images in a similar way as we presented here, however, the 3D approach will indeed require development of appropriate 3D matrixes (scaffolds), cell culture techniques, and refinement of software algorithms for image analysis."

Late Lessons From Early Warnings…

Continued from page 5

collaborations that cross discipline, department and international boundaries; beginning the process of targeting research to developing relevant knowledge; engaging stakeholders; and asking whether existing oversight mechanisms are fit for purpose. But are we doing enough?"

Interestingly, they conclude their commentary with a cautionary and feeble 'perhaps': "If we are to realize the commercial and social benefits of nanotechnology without leaving a legacy of harm, and prevent nanotechnology from becoming a lesson in what not to do for future generations, perhaps it is time to go back to the classroom and relearn those late lessons from early warnings."

Shouldn't it be a basic requirement for our regulators and science community to heed lessons from the past?

The City of Cambridge, MA should not enact an ordinance to regulate the use of nanoparticles, according to a report released by the city's public health department. Instead, the city should collect information on a voluntary basis from businesses and researchers who work with nanoparticles, the report says.

Report Urges Cambridge not to Enact Nanoparticle Regulations

"Until you know more about what's going on, plowing ahead with a regulatory requirement might overshoot the mark," said Sam Lipson, the director of environmental health at the Cambridge Public Health Department.

In 2006, Berkeley, Calif., became the first US city to regulate nanoparticles as potentially hazardous chemicals. The Berkeley ordinance requires that companies and research labs tell the city how much of the material is stored on their premises on a typical day, where the material came from, what it's used for, and anything they know about how the material can affect human health and the environment.

In January 2007, the Cambridge City Council asked the health department to study the Berkeley ordinance and report on whether Cambridge should enact a similar regulation. A committee headed by Lipson met with officials from companies involved in nanotechnology, researchers from Harvard University and the Massachusetts Institute of Technology, and environmental health and safety specialists. The committee concluded that there isn't enough information about the health effects of nanoparticles to justify a law to regulate their use.

For instance, Lipson said a scientific study detected health problems in rats that had nanoparticles injected into the linings of their lungs. But he said such a test provides no insights on how the particles would affect a person who merely inhaled them. Lipson said such research is needed, but has not yet been done. "We're just at too early a point to expect that kind of literature to be available," he said.

Future scientific discoveries may justify tougher regulation of nanoparticles, Lipson said. He wants the health department to issue updates of the report every two years. Meanwhile, the committee will call for a voluntary program to take an inventory of Cambridge businesses and research labs that work with nanoparticles. The list would be compiled with help from the Cambridge Fire Department, which already keeps track of hazardous chemicals stored by companies.

The committee also suggests that the public health and fire departments devise a program to inform businesses and researchers of the latest health and safety information about nanoparticles. The program would also help nanoparticle users develop safe material handling and storage practices. In addition, the committee recommends a public education program to inform citizens about safety issues related to nano materials.

In Short – Papers, Initiatives & Updates

INITIATIVE: Trade Unions call for REACH amendment to cover nanomaterials

European labor unions have called on the European Commission to amend the REACH regulation on chemicals to better protect workers against nanomaterials throughout their lifecycle. Their call comes shortly after the EU executive argued that nanotechnology is already covered by existing EU regulation. "Workers all along the production chain from laboratories through to manufacturing, transport, shop shelves, cleaning, maintenance and waste management" are exposed to nanomaterials manufactured and placed on the market without true knowledge of their potential impacts on human health and the environment, states a resolution adopted by the European Trade Union Confederation (ETUC).

PAPER: Study shows quantum dots can penetrate skin through minor abrasions

Researchers have found that quantum dots can penetrate the skin if there is an abrasion, providing insight into potential workplace concerns for healthcare workers or individuals involved in the manufacturing of quantum dots or doing research on their potential biomedical applications. While the study shows that quantum dots of different sizes, shapes and surface coatings do not penetrate rat skin unless there is an abrasion, it shows that even minor cuts or scratches could potentially allow these nanoparticles to penetrate deep into the viable dermal layer and potentially reach the bloodstream.
DOI: 10.1159/000131080

INITIATIVE: OECD launches sponsorship program for safety testing of nanomaterials

OECD's Working Party on Manufactured Nanomaterials has launched a "sponsorship program" in which countries will share the testing of specific nanomaterials at its 3rd meeting in November 2008. Much valuable information on the safety of nanomaterials can be derived by testing a representative set for human health and environmental safety. In launching this sponsorship program the Working Party agreed a priority list of nanomaterials for testing as well as a list of endpoints for which they should be tested. The document – List of Manufactured Nanomaterials and List of Endpoints for Phase One of the OECD Testing Programme – shows the results, so far, from the project Safety Testing of a Representative Set of Manufactured Nanomaterials.

PAPER: Pulmonary applications and toxicity of engineered nanoparticles

The respiratory system is susceptible to injury resulting from inhalation of gases, aerosols and particles, and also from systemic delivery of drugs, chemicals and other compounds to the lungs via direct cardiac output to the pulmonary arteries. As such, it is a prime target for the possible toxic effects of engineered nanoparticles. The purpose of this article is to provide an overview of the potential usefulness of nanoparticles and nanotechnology in respiratory research and medicine and to highlight important issues and recent data pertaining to nanoparticle-related pulmonary toxicity.
DOI: 10.1152/ajplung.00041.2008

PAPER: Interaction between manufactured gold nanoparticles and naturally occurring organic macromolecules

It is of paramount importance to study how natural aquatic colloids can interact with manufactured gold nanoparticles as these interactions will determine their environmental fate and behaviour. In this context, this work aims to quantify the effect of naturally occurring riverine macromolecules on citrate- and acrylate-stabilized gold nanoparticles. Evidence was found that these molecules enhance particle stability at extreme pH values (ionic strength < 0.01 M) by substituting and/or over-coating the original stabilizer on the gold nanoparticle surface, thus affecting surface charge and chemistry. These findings have important implications for the fate and behavior of nanoparticles in the environment and their ecotoxicity.
DOI: 10.1016/j.scitotenv.2008.04.023

INITIATIVE: Environmental Defense Fund and DuPont expand global accessibility of Nano Risk framework

In an effort to expand the global accessibility of the Nano Risk Framework, Environmental Defense Fund (EDF) and DuPont announced the release of new translations of the Framework in three additional languages - Mandarin, French and Spanish. (The Framework executive summary also is available in Portuguese.) EDF and DuPont launched their partnership on nanotechnology in September 2005 to develop a systematic and disciplined process for evaluating and addressing the environmental, health and safety risks of nanomaterials across all stages of a product's lifecycle - from initial sourcing through manufacture, use and recycling or disposal. The resulting Framework, launched on June 21, 2007, offers a thorough and usable six-step process for organizations to identify, assess and manage potential risks. To download a copy in English, visit www.NanoRiskFramework.com.

INITIATIVE: EPA Nanotechnology Voluntary Program risks becoming a 'black hole'

Six months after launching its voluntary reporting program for nanomaterial producers, EPA has made virtually no information public about the limited number of submissions it has received. As a result, the public can have little confidence that the program is providing the information the Agency will need to protect citizens, consumers, workers and the environment from the potential risks of nanotechnology, according to Environmental Defense Fund (EDF).

The EPA intended its Nanoscale Materials Stewardship Program (NMSP) to provide both EPA and the public with a better understanding of what nanomaterials are being produced, how they're being used and what their producers know about them. The only information EPA has provided on its website is a list of companies that have made submissions (nine companies as of today) or said they intend to (11 companies as of today). To put these numbers into perspective: When it launched the NMSP, EPA said it expected to receive 240 submissions from 180 companies under the basic program, and to attract 15 participants in the in-depth program.

IN THIS ISSUE

Subscription

6 pdf issues per year (ISSN: 1931-6941)

1-year subscription (6 issues): ❒ US$49

Payment:

- ❒ US$ check enclosed payable to Nanowerk LLC
- ❒ Credit Card (please order online at www.nanorisk.org)
- ❒ Please send me a receipt

Subscriber Information

Name: ………………………………………………………………………

Organization/Company: ……………………………………………..

………………………………………………………………………………

Position/Title: ……………………………………………………….

Address: ……………………………………………………………………

………………………………………………………………………………

City: ……………………………………………………………………….

State/Province: ………………………………………………………

Postal Code: ……………………………………………………………

Country: …………………………………………………………………

E-mail: ……………………………………………………………………

Signature: ………………………………………………………………..

nano*RISK*

Nanowerk LLC
700 Bishop Street, Suite 1700
Honolulu, HI 96813, USA
Tel: +1 808 741-1739
Fax: +1 808 396-0493
E-mail: editor@nanorisk.org
Web: www.nanorisk.org

OPTIMIZING THE BENEFITS OF NANOTECHNOLOGY WHILE MINIMIZING AND CONTROLLING THE RISKS

The nano*RISK* newsletter is dedicated to providing objective and accurate information about critical issues and developments related to the risks arising from engineered nanomaterials. nano*RISK* appears bi-monthly. ISSN 1931-6941. A compilation of weblinks relevant to this edition of the newsletter can be found on www.nanorisk.org.

nano*RISK* is published by Nanowerk LLC, a publisher and information provider in the area of nanoscience and nanotechnology. Editor: Michael Berger. For further information about Nanowerk visit www.nanowerk.com.