ISSUE 1 | VOLUME 4 | FEBRUARY/MARCH 2009

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 recent report on the toxicity of metal nanoparticles in soil looks into an important but so far not widely researched area of nanotoxicology.

INVESTIGATING POTENTIAL NANORISKS AT THE BOTTOM OF THE FOOD CHAIN

The flurry of recent announcements regarding reports, international cooperations, and new research activities that deal with the potential risks of manufactured nanomaterials is a clear indication that the field of nanotoxicology is gaining momentum – and not too soon. While there still is no coherent international approach to determining if and what risks are posed by what kind of nanotechnology materials, individual research groups are picking certain areas of concern and forge ahead with – often highly specific – toxicology studies.

A lack of standards and definitions makes these early investigations hard to compare and sometimes they even contradict each other, a situation that is especially confusing in risk assessments of carbon nanotubes. Some studies, though, present findings that, on the face of it, are especially worrying in their potential implications and deserve much more attention to be sorted out one way or another. A recent report on the toxicity of metal nanoparticles in soil is such an example.

"Previous work has investigated the toxicity of metal oxide nanoparticles to plants, aquatic invertebrates, algae, bacteria and different cell lines," explains Baoshan Xing. "The effect of metal oxide nanoparticles on soil nematodes has scarcely been investigated. Soil is the medium that ultimately receives the released nanoparticles. Soil microorganisms and invertebrates play a key role in soil fertility, decomposition processes, nutrient and energy flows. Nematodes are the most abundant multicellular animals in soil and their function is irreplaceable in the soil-food web."

Xing, a professor in the Department of Plant, Soil & Insect Sciences at the University of Massachusetts and his co-authors (Dr. Huanhua Wang and Dr. Robert L. Wick) have published a paper in *Environmental Pollution* that addresses if metal oxide nanoparticles are more toxic than their bulk counterparts to *C. elegans*, especially to their reproductive capability, and further explains that the observed toxicity was not simply due to dissolved metal ions ("Toxicity of nanoparticulate and bulk ZnO, Al_2O_3 and TiO_2 to the nematode *Caenorhabditis elegans*").

The UMass team selected *C. elegans* because it is a widely used model organism in neurobiology, developmental biology and genetics due to its fast developmental biology, transparent body structure, complete genome sequence and unique biological features relevant to human disease. In addition, *C. elegans* or other nematodes could be attacked by predacious nematodes, insects and parasitic fungi, potentially transferring nanoparticles through the food chain where they could enter organisms higher up the chain.

In natural ecosystems, nematode abundance and community structure analyses have proven to be sensitive indicators of stress caused by soil pollutants and ecological disturbance. Therefore, one may try to use the *C. elegans* to develop a sensitive indicator of nanoparticle toxicity; and to model nanoparticles uptake, accumulation, and transfer in organisms at higher trophic levels.

Thus, this kind of study provides significant information about the potential environmental impact of nanoparticles.

"In our work, both mortality and sublethal effects – growth, eggs inside worm body, and offspring per worm – of nanoparticles were determined," Xing explains. "We carried out parallel tests with bulk particles and dissolved metal ions, and also compared the toxicity between supernatant after centrifugation and filtration and nanoparticle suspension to

Continued on page 4

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

Several recent trends suggest that nanotechnology-related businesses are presently in a crucial – and dangerous – period that will shape the size and scope of future litigation for decades to come.

NANOTECHNOLOGY LITIGATION: WINNING THE WAR BEFORE IT STARTS

Promising revolutions in fields as diverse as computing, alternative energy, pharmaceuticals, and material science, nanotechnology's allure is undeniably irresistible. Several hundred nanomaterial-containing products ranging from air purifiers to zinc oxide sunscreens are already commercially available, and while analysts disagree about the proper definition (and thus true size) of the current "nanotechnology market," consensus exists for dramatic global expansion in the next few years. Although it remains to be seen, the incoming Obama administration's reported support for aggressive deployment of cleantech and alternative energy projects could portend a particularly rapid expansion of nanotechnology products and applications related to those areas.

Companies manufacturing, using, or selling nanoproducts in the Unites States would be well-served, at this early stage, to think proactively about minimizing future litigation risks. Candidly, the legal world has thus far lagged behind the growth in nano-related products and enterprises. But if the encyclopedic history of toxic tort, product liability, and environmental litigation in this country is any guide whatsoever, there is no reason enterprising plaintiffs' attorneys are less likely to tackle nanotechnology than other lucrative products and technological advances. Indeed, references to a potential link between carbon nanotubes and lung cancer have already sprouted on plaintiff-oriented websites across the country.

Several recent trends suggest that nanotechnology-related businesses are presently in a crucial – and dangerous – period that will shape the size and scope of future litigation for decades to come. Particularly in a society that increasingly views chemical substances as "dangerous," these developments may foreshadow significant future litigation risk for nanotechnology companies.

Growing Focus On Health and Environmental Risks

First, calls for research into nanotechnology's potential health and environmental hazards are gaining real traction. Advocacy groups like Greenpeace and the NRDC are becoming increasingly vocal about nanotechnology's purported health and environmental implications, and the National Research Council recently issued a report criticizing federal efforts to evaluate nanotechnology risks as inadequate. These calls are beginning to resonate with the mainstream media, as underscored by a December 4, 2008 New York Times article describing "nanophobia," or "the fear that that tiny components engineered on the nanoscale… could run amok inside the body."

More importantly, efforts to boost nanorisk research are yielding concrete results. The federal EH&S budget coordinated via the National Nanotechnology Initiative has grown from $35 million in 2005 to more than $76 million in 2009, and multiple agencies are ramping up nano-related activity. In late 2007, for example, the Agency for Toxic Substances and Disease Registry formally indicated interest in developing a full toxicological profile for undefined "nanomaterials." EPA's Nanoscale Materials Stewardship Program, launched in January 2008, seeks voluntary submissions on potential nanomaterial risks (including data on potential health hazards, worker and other human exposures, environmental releases, and risk management procedures). NIOSH has similarly adopted a wide-ranging, multiyear research agenda that includes worker exposure routes, nanoparticles toxicities, and risk assessment models.

Coupled with emerging research in the dozens of nanotechnology-related journals launched in recent years (as well as even more government-funded research programs in the EU and elsewhere), these kinds of federal initiatives signal that significant strides forward in knowledge about nanotechnology's potential health and environmental risks are coming.

An Emerging Trend Toward Active Regulation

Second, an historical regulatory reluctance to treat nanoparticles differently than other chemical substances may be evaporating. In October 2008, EPA gave public notice that carbon nanotubes may be considered new chemical substances - and thus subject to onerous reporting requirements - under the federal Toxic Substances Control Act (TSCA). See 73 Fed. Reg. 64946. EPA has also taken preliminary steps to regulate certain silica and alumina nanoparticles as significant new uses under TSCA, and recently solicited public comments on the potential regulation of all nanosilver-containing products under the Federal Insecticide Fungicide and Rodenticide Act. See 73 Fed. Reg. 65743, 65763 and 73 Fed. Reg. 69644.

It is hardly a stretch to envision this trend toward nano-specific regulation accelerating under a Democratic administration in 2009 and beyond. As agency rulemaking gains steam, reports will be generated about the purported dangers underlying each new regulation. Plaintiffs' lawyers pursuing claims against nanotechnology-related defendants will inevitably use these documents as a backdrop for future claims.

Public Opinion is Largely Unformed, And Potentially Negative

Third, public perception of nanotechnology is still nascent and largely unshaped. According to a recent poll published by the Project on Emerging Nanotechnologies at the Woodrow Wilson Institute, only 25% of American adults have heard a significant amount about nanotechnology. In contrast, three-fourths of American adults have heard little to nothing at all about nanotechnology. Public opinion – and thus future juror opinion – remains precariously subject to influence by advocacy groups and others aligned with the plaintiffs' bar.

To the extent any public opinion has coalesced, other reports should give nanotechnology businesses cause for concern. In a 2008 study, researchers from the University of

Continued on next page

Nanotechnology Litigation…

Continued from previous page

Wisconsin-Madison and elsewhere polled 1,015 U.S. adults and found that only 29.5 percent deemed nanotechnology "morally acceptable." A follow up study released in December concluded that religious attitudes strongly influence public opinion about nanotechnology, and that the American public is less accepting of nanotechnology than European countries.

Winning the War Before it Starts

This unique conflux of scientific, regulatory, and public opinion forces represents a critical period that could shape the litigation landscape for many years to come. The good news, however, is that this formative period also offers businesses an extraordinary opportunity to minimize future liabilities and legal costs.

As an initial step, nanotechnology companies should begin crafting careful responses to foreseeable inquiries from employees, stockholders, and the media as coverage about nanotechnology's supposed dangers builds. Being caught flat-footed is a surefire way for businesses to look bad, provide inaccurate answers, and ultimately lose the battle for public opinion. Conversely, thoughtful and accurate responses can help ensure that defendants get a fair shake in the jury system later.

Nanotechnology businesses should also consider monitoring scientific and regulatory developments across all sectors, and weighing in where appropriate. Through active and transparent participation in the growing public discourse about nanotechnology's potential hazards, companies can help ensure that future rulemakings proceed based on balanced, objective evidence. Failure to participate now may cause irretrievable harm in future litigation.

Additionally, companies need not wait for formal regulation before reducing potential worker exposures and environmental releases. Not only should businesses identify and eliminate exposures and releases where feasible because it is the right thing to do, but from a legal perspective, anticipatory action may reduce the number of future claimants. Moreover, rapidly emerging hazard information will be used to support arguments about corporate indifference many years after the fact. Voluntary adherence to guidance documents and industry standards now may demonstrate the kind of good faith efforts necessary to defeat punitive damages claims in future litigation.

Finally, companies manufacturing and selling nano-related products should weigh the possible implications of any information (or lack thereof) in labeling, Material Safety Data Sheets, and product literature. "Failure to warn" claims have proven fertile grounds in past personal injury cases and consumer product class actions. Even though the risks purportedly associated with nanomaterials remain speculative, businesses should think, on a case-by-case basis, about opportunities to mitigate future claims through appropriate disclosures.

In the 6th century B.C., Chinese strategist Sun Tzu observed that "victorious warriors win first and then go to war, while defeated warriors go to war first and then seek to win." These words remain instructive for 21st century nanotechnology companies inevitably facing growing litigation risks as concerns about health and environmental implications continue to mount. As scientific research, regulatory action, and public opinion begin to crystallize, businesses still have a rare chance to shape the future fight. By anticipating trends and taking proactive measures now, nanotechnology companies may even win the war before it starts.

By Orlyn "Skip" Lockard, III. Skip Lockard is a partner in the Atlanta office of Alston & Bird LLP. His practice focuses on toxic torts, mass actions, and environmental litigation. Alston & Bird also has extensive experience in pre-litigation management of product liability and toxic tort issues. Mr. Lockard can be contacted at (404) 881-7126 or skip.lockard@alston.com.

New European interdisciplinary network to study the effects of engineered nanomaterials

EC Awards €3.4M To Study Toxicity Of Nanomaterials

Researchers from Sweden, Finland, Germany, Switzerland, UK, and the U.S. have been awarded €3.4 from the European Commission to study the hazardous effects of engineered nanomaterials on the immune system (NANOMMUNE). The project is coordinated by Bengt Fadeel, at the Institute of Environmental Medicine, Karolinska Institute, in Stockholm, and will continue for 3 years.

The interdisciplinary network consists of experts in material sciences, cell biology, immunology, toxicology, systems biology and risk assessment. Engineered nanomaterials (ENs, particles < 100 nm) offer tremendous opportunities in industry, daily consumables, medicine, electronics and numerous other areas. However, there are considerable knowledge gaps concerning the potential hazardous effects of ENs on human health and the environment. The NANOMMUNE partnership is committed to filling these knowledge gaps through a comprehensive assessment of ENs, with particular focus on effects on the immune system.

Through a comprehensive approach, which combines different disciplines, the team aims to analyze and predict the toxic potential of existing and emerging ENs on key functions of the immune system. A detailed physico-chemical characterization of ENs is also an integrative part of the project. Overall, the NANOMMUNE project results will enhance the understanding of possible adverse effects of nanomaterials and will contribute to a continuous and sustainable growth of the nanotechnologies.

The project is funded by the European Commission through the 7th Framework Programme by the funding scheme of Collaborative projects.

Nanorisks At The Bottom Of The Food Chain…

Continued from page 1

clarify if the toxicity was caused by the particles per se or the dissolved metal ions."

The team experimented with three types of commonly used metallic nanoparticles: zinc oxide, aluminum oxide, and titanium dioxide. They exposed *C. elegans* to both nanoparticulate and bulk versions of each metal in an aqueous exposure medium. The results show that these three metal oxides in nanoparticulate form are more toxic to *C. elegans* than in bulk form, especially to its reproductive capability.

Xing points out that this toxicity could not be adequately explained by dissolution of the particles alone: "This conclusion is mainly based on two considerations: First, the lethal concentration values of aluminum oxide and titanium dioxide nanoparticles were significantly lower than their bulk particles, respectively; second, the toxicity of supernatant of the three tested metal nanoparticles after centrifugation and filtration at selected concentration was significantly lower than the corresponding suspensions of nanoparticles, especially for the number of eggs inside body and offspring per worm. Therefore, we think that these metal nanoparticles are more toxic than their bulk counterparts; and toxicity of the nanoparticles could not be explained by the dissolved ions alone, and a nanoparticle-specific toxic mechanism may exist."

The researchers hypothesize that other possible toxicity mechanisms may include disruption of cell membranes, oxidation of proteins and enzymes, and formation of reactive oxygen species (ROS). "However" says Xing, "from our current research we do not know the exact location of nanoparticles in the *C. elegans'* body and active sites at which ROS production can take place."

These findings suggest that follow-up studies should aim at identifying the mechanism of reproductive capability decrease of nematodes upon exposure to nanoparticles – an issue that could be critical to biodiversity and ecosystem health.

Nematodes are pretty much at the bottom of the food chain and if they are capable of absorbing nanoparticles then another point of great interest and concern is the possible transfer and accumulation of nanoparticles through the food chain.

Xing's experiments were conducted in a laboratory under controlled conditions. A major challenge for this and other toxicity studies is their application to the milieu and complex nature of real soils and their varying properties.

"Natural organic matter in soil may interfere with biological systems via the induction of biotransformation enzymes, the production of internal oxidative stress, or through feminization," Xing explains. "Therefore, future research should investigate if natural organic matter affects nematode reproduction and has the potential to modulate the transcriptional response within the whole genome in the presence of metal oxide nanoparticles."

A new report by the International Risk Governance Council (IRGC) provides an overview what is being discussed and researched with regard to risk governance for nanoparticles in food and cosmetic applications.

Governing the risk of nanotechnology in food and cosmetics

In case you want to get up to date on what's happening around the world with regard to the development of risk governance for nanotechnology applications in food and cosmetics, a new report just out from the International Risk Governance Council (IRGC) provides a good overview. An early version of this report was originally written as a briefing paper for an expert workshop organized by the IRGC in 2008. It is also a companion to the IRGC Policy Brief due for publication in early 2009. While this report does not include any primary research, is is a useful primer for anyone who wants to get an overview of what is happening in this area.

IRGC is an independent organization whose purpose is to help the understanding and management of global risks that impact on human health and safety, the environment, the economy and society at large. The organization's focus on risk governance strategies for nanotechnology applications in food and cosmetics is based on rising public concerns:

"Qualitative surveys of consumer opinion provide evidence of a positive to indifferent attitude towards nanotechnologies and their application, with one exception: foods. Concerns about cosmetics are also rising and consumer advocacy groups and independent experts have recommended that more risk assessments should be conducted before cosmetics containing nanoscale materials are put on the market. Public authorities in several countries have stressed the need for extended risk assessments and careful oversight."

Consequently, the IRGC's nanotechnology project has the following objectives

- to explore the different definitions and frames that are used in the debate on nanoscaled material in food and cosmetics
- to identify the current and future food and cosmetic products containing nanomaterials
- to review the current studies and investigations with respect to risk assessment
- to review existing risk management activities and regulatory activities in different countries and continents (Europe, US, Japan, Korea, and others)
- to compare how different international actors (different countries, international organizations) are making tolerability and acceptability judgments
- to identify deficits and develop options for the global risk governance of nanotechnology applications in food and cosmetics.

Continued on next page

Nanotechnology In Food And Cosmetics…

Continued from previous page




Agriculture	Food Processing	Food Packaging	Supplements
• Single molecule detection to determine enzyme/ substrate interactions • Nanocapsules for delivery of pesticides, fertilizers and other agrichemicals more efficiently • Delivery of growth hormones in a controlled fashion • Nanosensors for monitoring soil conditions and crop growth • Nanochips for identity preservation and tracking • Nanosensors for detection of animal and plant pathogens • Nanocapsules to deliver vaccines • Nanoparticles to deliver DNA to plants (targeted genetic engineering)	• Nanocapsules to improve bioavailability of neutraceuticals in standard ingredients such as cooking oils • Nanoencapsulated flavor enhancers • Nanotubes and nanoparticles as gelation and viscosifying agents • Nanocapsule infusion of plant based steroids to replace a meat's cholesterol • Nanoparticles to selectively bind and remove chemicals or pathogens from food • Nanoemulsions and –particles for better availability and dispersion of nutrients	• Antibodies attached to fluorescent nanoparticles to detect chemicals or foodborne pathogens • Biodegradable nanosensors for temperature, moisture and time monitoring • Nanoclays and nanofilms as barrier materials to prevent spoilage and prevent oxygen absorption • Electrochemical nano-sensors to detect ethylene • Antimicrobial and antifungal surface coatings with nanoparticles (silver, magnesium, zinc) • Lighter, stronger and more heat-resistant films with silicate nanoparticles • Modified permeation behavior of foils	• Nanosize powders to increase absorption of nutrients • Cellulose nanocrystal composites as drug carrier • Nanoencapsulation of neutraceuticals for better absorption, better stability or targeted delivery • Nanocochleates (coiled nanoparticles) to deliver nutrients more efficiently to cells without affecting color or taste of food • Vitamin sprays dispersing active molecules into nanodroplets for better absorption

Examples for nanotechnology applications in food and agriculture (Source: Nanowerk)

In the absence of reliable data, the IRGC author group (Dr. Antje Grobe, Professor Ortwin Renn and Alexander Jaeger of Dialogik) has used a Nanowerk chart from these articles: "Nanotechnology food coming to a fridge near you" and "The promises of food nanotechnology" that provide an overview of what nanotechnology applications are currently being researched, tested and in some cases already applied in food technology.

After describing the use of nanomaterials in food and cosmetics, summarizing opinion research on public perception and reviewing the regulatory background and legal requirements for risk assessment, the report highlights risk assessment studies for three sample nanoscale materials: synthetic amorphous silica, titanium dioxide, and encapsulated vitamins.

The authors then review the currently available codes and frameworks that provide guidelines for risk assessment, management and communication:

- Responsible Care®, an overall approach by the chemical industry to demonstrating corporate responsibility
- The European Commission's Code of Conduct for Responsible Nanoscience and Nanotechnologies Research
- The Responsible Nano Code initiated in the UK; and
- The Nano Risk Framework initiated by DuPont and Environmental Defense Fund.

The report's authors suggest that voluntary codes such as these offer an alternative to regulation (some of the problems with this approach are highlighted in this article: "Implementing successful voluntary nanotechnology environmental programs appears to be a challenge"). The main reason for that is that regulation is extremely difficult to design because of the problems of defining novel nanoscaled materials.

"Although new regulations specific to nanotechnology, whether in food and cosmetics or in other sectors such as medicine, appear unlikely at the present time, industry would be well advised to establish an enforceable, transparent and inclusive process of self-regulation through a voluntary code. However, this step may not satisfy concerned NGOs: 'Voluntary initiatives are wholly inadequate to oversee nanotechnology... the public overwhelmingly prefers mandatory governmental oversight to voluntary initiatives'."

The report "Risk Governance of Nanotechnology Applications in Food and Cosmetics" (pdf, 1.4 MB) can be downloaded from the IRGC's website.

The EPA has release an interim report on its progress with the voluntary Nanoscale materials Stewardship Program.

EPA Releases Nanomaterial NMSP Interim Report

On January 12, 2009, the Environmental Protection Agency (EPA) in the U.S. released its interim report on the Nanoscale Materials Stewardship Program (NMSP). The document is available as a download from the EPA site (PDF, 872 KB).

The Nanoscale Materials Stewardship Program (NMSP) was developed to help provide a firmer scientific foundation for regulatory decisions by encouraging submission and development of information for nanoscale materials. The NMSP comprised two sub-programs, the Basic Program and the In-Depth Program. When the NMSP was initiated, EPA committed to issue this interim report after one year. The Agency welcomes comments on this interim report EPA will issue a more detailed final report and program evaluation at the conclusion of the NMSP in early 2010.

Under the Basic Program, EPA invited participants to voluntarily report available information by July 29, 2008 on the engineered nanoscale materials they manufacture, import, process or use. By that date, the Agency received submissions from 16 companies and trade associations covering 91 different nanoscale materials. As of December 8, 2008, twenty-nine companies or associations submitted information to EPA covering 123 nanoscale materials and a further seven companies have outstanding commitments to the Basic Program. EPA also invited participants to submit new data that became available for nanoscale materials already reported or to identify additional nanoscale materials to report under the Basic Program. EPA is evaluating the information submitted under the Basic Program through a process similar to that of a new chemical review.

Under the In-Depth Program, EPA invited participants to work with the Agency and others on a plan for the development of data on representative nanoscale materials over a longer time frame. By the 6-month mark, one company had agreed to participate in the In-Depth Program; by December 8, 2008, 4 companies have agreed to participate.

Based on the current interim results, the NMSP can be considered successful. However, a number of the environmental health and safety data gaps the Agency hoped to fill through the NMSP still exist. EPA is considering how to best use testing and information gathering authorities under the Toxic Substances Control Act to help address those gaps.

EPA will continue to review new chemical nanoscale materials submitted under the Toxic Substances Control Act sections 5(a) and 5(h)(4) and apply, as appropriate, testing requirements and exposure controls under section 5(e) and Significant New Use Rules (SNURs) under section 5(a)(2).

EPA continues to welcome new participants and information submissions for the NMSP, which will continue until January 2010. The Agency will also continue to explore the best ways to gather the information needed to provide a firmer scientific foundation for regulatory decisions on nanoscale materials.

Upcoming Events
Looking At The Risky Side Of Nano

2nd Annual Conference on Nanotechnology Law, Regulation and Policy
February 18-19, 2009, Washington D.C. (USA)
You'll get an opportunity to hear directly from officials from the Obama Administration and the new Congress on their regulatory plans.

Nanotoxicology: Health & Environmental Impacts
February 27, 2009, Welwyn Garden City (UK)
This symposium is aimed at bringing together eminent scientists at the forefront of the nanotoxicology field to present their current research findings and discuss the potential impact of nanomaterials on human health and the environment.

Greener Nano 2009
March 2-3, 2008, Eugene, OR (USA)
SNNI's 4th annual conference focuses on cutting edge research in greener nanomaterials design and production.

International Advanced Course: Public Communication & Applied Ethics of Nanotechnology
March 22-27, 2009, Oxford (UK)
This intensive, highly diverse, one week course consists of an alternating program of expert lectures, case studies, exercises, role play, group discussions and debate.

Theoretical Assessment of the Biological Effects of Nanomaterials (Symposium)
March 23-24, 2008, Stockholm (Sweden)
The aim is to to present and discuss their latest research related to the environmental and biological effects of nanomaterials.

NanoImpactNet – for a healthy environment in a future with Nanotechnology
March 23-27, 2009, Lausanne (Switzerland)
This workshop by the European NanoImpactNet network addresses nanotoxicology, exposure assessment, environmental dispersion, standardization and life cycle.

Joint FAO/WHO Expert Meeting on the Application of Nanotechnologies in the Food and Agriculture Sectors: Potential Food Safety Implications
June 1-5, 2009, Rome (Italy)
Scope: The application of nanotechnologies in all aspects of the primary production of foods of plant and animal origin; in food processing, packaging and distribution; and the use of nano-diagnostic tools for detection and monitoring in food and agriculture production.

IN SHORT – PAPERS, INITIATIVES & UPDATES

REPORT: CELL PEN considers health risks of nanomaterials in relation to cellular translocation

In a report (pdf, 518 KB) published by DEFRA in late January, the Institute of Occupational Medicine, Edinburgh, together with a team of multi-disciplinary experts presents an informed commentary and research agenda toward elucidating the importance of translocation in nanoparticle toxicology. The project focussed on several key target sites of concern for particle translocation, namely; 1) pulmonary interstitium; 2) other lung cells; 3) blood; 4) blood vessel wall; 5) placenta/foetus; and 6) brain.

PAPER: Systematic review of carbon nanotube cytotoxicity

Owing to the novel properties of carbon nanotubes, a series of problems associated with in vitro toxicity assessments of carbon nanotubes have appeared in many literatures. In order to properly evaluate the potential risk to human health, the cell toxicity assay of nanotubes cannot be conducted by traditional methods employed in common toxicology. Ying Zhu and Wenxin Li in Laboratory of Nano-biology and Medicine, Shanghai Institute of Applied Physics, Shanghai, P. R.China gave this point of view in their review articles. This paper, "Study on Cytotoxicity of Carbon Nanotubes" was published in Issue 51 (November, 2008) of the *Science in China Series B: Chemistry*.

INITIATIVE: New Center for Pharmaceutical Nanotechnology and Nanotoxicology in Denmark

Prof. Moein Moghimi (Professor of Biopharmacy and Nanomedicine, Department of Pharmaceutics and Analytical Chemistry, University of Copenhagen) and colleagues have received 28 million DKK (approximately 3.75 million Euros) from the Danish Council for Strategic Research (DSF) to set up The Centre for Pharmaceutical Nanotechnology and Nanotoxicology (CPNN) at the Faculty of Pharmaceutical Sciences, starting April 2009. Prof. Moghimi will act as the Director of the Centre and Prof. Thomas Bjørnholm (Head of the NanoScience Centre) will be the Chairman of the Steering Committee.

PAPER: Surface Characteristics, Copper Release, and Toxicity of Nano- and Micrometer-Sized Copper

This research effort was undertaken to assess the toxic aspects of thoroughly characterized nano- and micrometer-sized particles of oxidized metallic copper and copper(II) oxide in contact with cultivated lung cells, as well as copper release in relevant media. This study observes a clear size-dependent effect from both a copper release and a toxicity perspective. In agreement with greater released amounts of copper per quantity of particles from the nanometer-sized particles compared to the micrometer-sized particles, the nanometer particles cause a higher degree of DNA damage (single-strand breaks) and cause a significantly higher percentage of cell death compared to cytotoxicity induced by micrometer-sized particles. Cytotoxic effects related to the released copper fraction are found to be significantly lower than the effects related to particles. No DNA damage is induced by the released copper fraction.
DOI: 10.1002/smll.200801220

REPORT: An outline scoping study to determine whether high aspect ratio nanoparticles should raise the same concerns as do asbestos fibers

Potential concerns about the potential health effects of high aspect ratio nanoparticles (HARN) are based primarily on toxicology studies of industrial fibres including asbestos. The objectives of this study (pdf, 1.7 MB) are: 1) to undertake a scoping study to review the existing literature on industrial fibres and HARN to determine whether they should raise the same concerns as do asbestos fibres and 2) to set out a research strategy towards determining whether the health concerns about HARN are well–founded. The review has identified many similarities between HARN and asbestos with regard to their physico-chemical properties and toxicological effects and has concluded that there is sufficient evidence to suggest that HARN which have the same characteristics (diameter, length and biopersitance) as pathogenic fibres are likely to have similar pathology.

PAPER: Natural Organic Matter-Mediated Phase Transfer of Quantum Dots in the Aquatic Environment

Imminent commercialization of semiconductor quantum dots (QDs) has raised concerns regarding the potential environmental impact of these materials. Understanding the partitioning behavior and obtaining information on the mobility and persistence of QDs in water is key to evaluating potential ecological hazards posed by QDs. This study presents the first evidence of the stabilization of QDs in water by humic substances in real environmental samples, illustrating that interactions with NOM will play a significant role in the fate and transport of QDs in natural aquatic systems.
DOI: 10.1021/es8017623

PAPER: Cytotoxicity of Metal and Semiconductor Nanoparticles Indicated by Cellular Micromotility

In this study, a research team from Germany shows that the micromotility of animal cells as monitored by electrical cell-substrate impedance analysis (ECIS) is highly suitable to quantify *in vitro* cytotoxicity of semiconductor quantum dots and gold nanorods. The method is validated by conventional cytotoxicity testing and accompanied by fluorescence and dark-field microscopy to visualize changes in the cytoskeleton integrity and to determine the location of the particles within the cell.
DOI: 10.1021/nn800721j

PAPER: Cytotoxicity and Genotoxicity of Silver Nanoparticles in Human Cells

This study examined the toxicity of starch-coated silver nanoparticles using normal human lung fibroblast cells (IMR-90) and human glioblastoma cells (U251). The results indicated mitochondrial dysfunction, induction of ROS by Ag-np which in turn set off DNA damage and chromosomal aberrations (comet assay and CBMN analysis). DNA damage and chromosomal aberrations are believed to be the prime factors resulting in cell cycle arrest.
DOI: 10.1021/nn800596w

In This Issue

Articles

Tidbits

Updates

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). For a complete list of all published nano*RISK* newsletters please go to http://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.