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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

New research *addresses the interaction of carbon nanotubes with the human immune system, an interdisciplinary field that concerns both the positive and negative health aspects of nanotechnology*

CARBON NANOTUBES INTERFERING WITH THE HUMAN IMMUNE SYSTEM

The toxicity issues surrounding carbon nanotubes (CNTs) are highly relevant for two reasons: Firstly, as more and more products containing CNTs come to market, there is a chance that free CNTs get released during their life cycles, most likely during production or disposal, and find their way through the environment into the body. Secondly, and much more pertinent with regard to potential health risks, is the use of CNTs in biological and medical settings. CNTs interesting structural, chemical, electrical, and optical properties are explored by numerous nanomedicine research groups around the world with the goal of drastically improving performance and efficacy of biological detection, imaging, and therapy applications. In many of these envisaged applications, CNTs would be deliberately injected or implanted in the body. For instance, CNT-based intercellular molecular delivery vehicles have been developed for intracellular gene and drug delivery *in vitro* (see: "Nanotechnology based stem cell therapies for damaged heart muscles").

Some groups are using CNTs in research for vaccination as well as gene and cancer therapy. Here, the CNT applications are designed to interact directly with the immune system. Understanding the interplay between CNTs and immune proteins is therefore critical for both improving CNT applications in biology and medicine and avoiding potentially noxious immune responses.

New work by researchers in France addresses the interaction of carbon nanotubes with the human immune system, an interdisciplinary field that concerns both the positive and negative health aspects of nanotechnology.

"Taking a molecular approach to the immunological properties of CNTs, we studied the interaction of the complement activation protein C1 of the human innate immune system with CNTs," says Wai Li Ling. "We show, for the first time, organized crystal-like binding and continued accumulation of human protein complexes along the full length of carbon nanotubes visualized by electron microscopy. We show, also for the first time, that CNTs fail to directly activate the C1 complex of complement."

The C1 complex is an important component of the complement system, a group of serum proteins forming part of the innate immune system. Besides foreign objects such as pathogens, C1 is involved in recognizing and clearing altered self-structures and is associated with apoptotic cell clearance, neurodegenerative and autoimmune diseases, among many vital bodily processes and disorder.

In their transmission electron microscopy studies, the research team analyzed the binding of C1 components on commercially available single-wall, double-wall, and multi-wall CNTs. Besides the ordered packing of the first monolayer on the CNTs, they found that proteins continued to stack on the fully covered CNTs, thereby depleting the proteins in the solution. Independent of the results of the binding experiments, the important observation is that all CNTs failed to activate the C1 complex *in vitro*.

"Our results that CNTs bind and accumulate C1 components yet fail to activate the complex suggest that carbon nanotubes will interfere with the immune system when entering the bloodstream" explains Ling. "This should raise warning flags with regard to applications of CNTs in biomedicine but,

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A new dossier clarifies nano-textile manufacturing processes and application areas, and gives an overview about the potential effects on the environment and health

Fabrics Treated With Nanoparticles - A Health Issue?

"Nano Textiles" can be produced by a variety of methods. The key difference among them is whether synthetic nanoparticles are integrated into the fibres or the textile, or are applied as a coating on the surface, and/or whether nanoparticles are added to the nanoscale fibres or coating. However, information about manufacturing methods, the nanomaterials themselves and the quantities used, as well as the "life cycle" of the "nano-treated" textile for sale is largely unavailable to the consumer. The present dossier therefore clarifies nano-textile manufacturing processes and application areas, and gives an overview about the potential effects on the environment and health. Many questions remain unanswered, however, there is a need for considerably more research not only for product development but also into the usefulness and risks which nano-textiles give rise to. The open questions have prompted the Swiss Textile Federation to undertake a joint project with the Swiss Federal Laboratories for Materials Science and Technology (EMPA) entitled "Nanosafe Textiles" and to initiate discussions on the topic.

Manufacturing processes

In principle, a distinction has to be made as to whether the manufacturing process involves the use of nanoparticles or whether it uses nanostructures (nanometer-thin fibres, nanoporous fibres) without synthetic nanoparticles. Nanoparticles can be introduced into a synthetic material (polymer) and fibres can then be spun from the resulting nanocomposite material, which have a nanoscale, or larger, diameter. Nanometer-thin fibres can however also be manufactured from synthetic material or cellulose without synthetic nanoparticles. In this case the term nanofibre is used to refer to the tiny diameter of the fibres.

A further possibility is the so-called "refining" of chemical and natural fibres by which nanoparticles themselves are either bonded to the fibre surfaces or are embedded in a coating on them. However, textiles and fibres can also be refined by means of nanoscale metal or polymer coatings, produced by immersion, spraying or plasma processes which do not contain synthetic nanoparticles. As in the case of fibre manufacture "nano" is used in this instance to refer to the nanoscaling of the coating.

Application areas and products

The potential of nanotechnology in the development of new materials in the textile industry is considerable. On the one hand, existing functionality can be improved using nanotechnology and on the other, it could make possible the manufacture of textiles with entirely new properties or the combination of different functions in one textile material. Foremost among the applications currently feasible are, in particular dirt and/or water-repellent and antibacterial textiles and, although they are as yet produced on a very small scale, textiles which give UV radiation protection and so-called "Cosmeto-textiles" (e.g. ladies tights) with woven-in nano-capsules containing special body care substances. Bullet-proof vests containing carbon nanotubes are also currently available, as are heat isolating and moisture-absorbent textiles.

"Smart clothes" are clothes in which the textile structures themselves perform electronic or electric functions. Despite all the promises, however, they are not yet commercially available. The scenario envisaged involves electronic components which have been reduced in size by means of nanotechnology being completely fused with the textile material resulting in that textile and non-textile components cannot be differentiated and "foreign particles" can no longer be seen or felt. At present initial trials are still focussing on electronic devices or sensors, for example to monitor body functions, being woven into the textiles using conventional clothing technology (e.g. pockets).

Researchers are also investigating textile materials made from nanofibres which can act as a filter for pathogens (bacteria, viruses), toxic gasses, or poisonous or harmful substances in the air. Medical staff, fire fighters, emergency services or military personnel could all benefit from protective garments made from materials such as these. Certain nanofibres can absorb a large amount of moisture, hence textile materials are also being studied for use in agriculture: soaked with pesticides, they could be planted together with seeds, rot at the end of the vegetation period and at the same time fertilize the ground. Futuristic visions even include textile sensors which not only detect pathogens by simply wiping a surface (e.g. of food or surgical instruments), but record them and warn the user, possibly by changing color.

Are synthetic nanoparticles released from nano-textiles?

There are different manufacturing processes by which nanoparticles can be integrated in fibres or textiles, besides which there can be variation in how tightly woven the nanoparticles are into the textile material (fibre or coating). It is these factors and the use to which the textile is subjected that determine whether and to what extent nanoparticles can be released from it. It is known that textiles lose between 5% and 20% of their weight during use as a result of abrasion, mechanical influence, irradiation, water, sweat, washing detergents or temperature variations. The possibility therefore cannot be ruled out that nano-textiles might release individual nanoparticles, agglomerates of nanoparticles or small particles of textile with or without synthetic nanoparticles. To date, however, there have been few experimental investigations performed.

In the case of textiles made from fibres with integrated nanoparticles, however, a lasting functionality at least appears more likely compared with nano-textiles in which nanoparticles are only present in the surface coating or which have been impregnated with them. The few investigations there have been with textiles containing nano-silver show that some products

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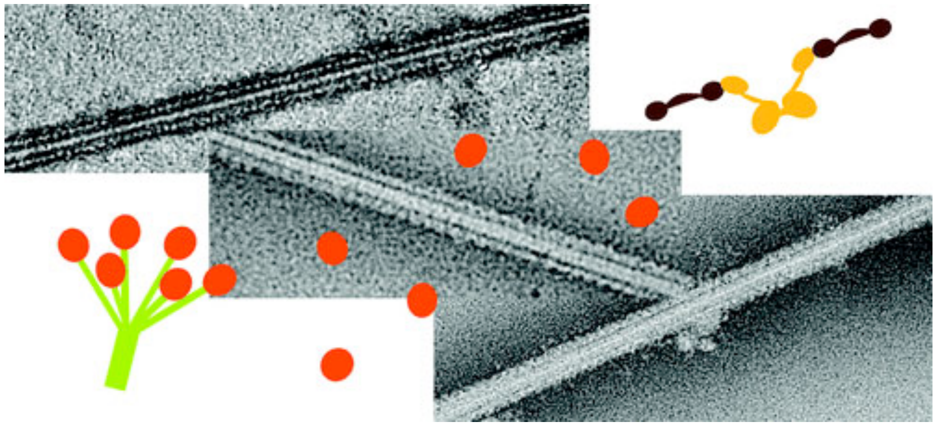

Cartoons of the C1 components, left to right: recognition unit C1q, globular head domains of C1q, and proenzyme C1s-C1r-C1r-C1s, and the organized arrays they form respectively on multi-walled carbon nanotube as visualized by electron microscopy. (Image: Wai Li Ling)

on the other hand, it also opens possibilities of novel CNT applications concerning the many biochemical processes involving the versatile C1 macromolecule."

Ling, a researcher at the Institut de Biologie Structurale and Minatec in Grenoble, France, is first author of a recent paper in *ACS Nano* ("Proteins of the Innate Immune System Crystallize on Carbon Nanotubes but Are Not Activated") where an interdisciplinary team of researchers from various institutes present their findings.

From a scientific point of view, the organized binding of the protein complexes on CNTs demonstrated in this study offers insights into the adsorption mechanisms of macromolecules on CNT surfaces –something that still is poorly understood.

"From our experiments with various proteins and from studying published results, we propose that interaction among the macromolecules may be an important factor in determining whether a stable overlayer of macromolecules, which leads to the solubilization of CNTs, can occur on the nanotube surface" says Ling. "The binding results demonstrated in the study also present an encouraging step in using CNTs to solve protein structures. Proteins are nanomachines and their structures tell us how they function. Solving protein structures is also like finding out the shape of a piece of puzzle. From that, we can find out how the different pieces work together."

Due to the delicate and often flexible nature of proteins, solving their structure is far from trivial. For instance, despite years of effort, the two human immune proteins studied in this work have failed to crystallize in 3D, a pre-requisite for x-ray structural studies.

"The fact that they form organized arrays on the CNTs gives us hope that we may be able to use CNTs to form helical arrays for solving their structures," explains Ling. "It will be great if we get another tool in our bag to solve hard-to-solve protein structures."

The human immune system is a very complex system with many components and feedback systems. It will be important to employ both top-down and bottom-up approaches to study the immunological properties of nanoparticles. While clinical studies will be indispensable, it will also be important to find out how the different members in the immune system interact with the CNTs to fully understand their immunological properties.

NEW ISO STANDARD ADDRESSES TOXICITY OF NANOPARTICLES

With the rapid growth of nanotechnology-based products, researchers, manufacturers, regulators and consumers are increasingly concerned with their safety and environmental impact. To help address this issue, ISO has published an International Standard to support the inhalation toxicity testing of nanoparticles.

Carefully monitored tests are used to establish the inhalation toxicity of airborne nanoparticles. The new standard, ISO 10808:2010, Nanotechnologies – Characterization of nanoparticles in inhalation exposure chambers for inhalation toxicity testing, helps ensure that the results of such tests are reliable and harmonized worldwide.

ISO 10808 establishes a battery of inhalation toxicity testing chamber monitoring, including a differential mobility analyzing system (DMAS), for determining particle number, size, size-distribution, surface area and estimated mass dose, as well as morphological examination using transmission electron microscopy (TEM) or scanning electron microscopy (SEM) equipped with an energy dispersive X-ray analyzer (EDXA) for chemical composition.

ISO 10808:2010 was developed by ISO technical committee ISO/TC 229, Nanotechnologies, and is available from ISO national member institutes.

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lose up to 35% of the silver in the washing water after only one wash.

Health impact

It appears to be emerging that during the production process of certain nanoparticles occupational exposure can have negative effects on the health. However there is currently far too little data from laboratory and animal tests to be able to conduct a comprehensive risk assessment. Long and stiff CNT in particular are currently regarded as hazardous, which primarily affects those involved in their manufacture and who need to have appropriate protection from exposure. The extent to which nanoparticles woven into textiles may or may not be harmful to consumers' health is as yet unknown. As described above, the release of nanoparticles from textiles as a result of use, aging, abrasion etc. cannot be ruled out. Nevertheless, suitable studies are absent to clarify the exposure as well as the possible hazard potential. Nano-silver is already used for its antimicrobial properties in a wide range of consumer products and hence also textiles.

Some dubious product value conflicts with potentially negative effects on health. On the one hand, materials with nano-silver particles (integrated into textile fibres or as a fibre coating) are used to manufacture textiles that are relatively odourless, yet the effects on the natural skin flora have not been tested (see below). Nano-silver is also used for clothing which is supposed to protect people suffering from neurodermatitis (atopic dermatitis) from becoming infected with staphylococcus aureus, a bacterium which is suspected of exacerbating the symptoms of neurodermatitis. Clinical studies have so far not confirmed an actual positive effect of textiles with nano-silver in cases of neurodermatitis. The German Federal Institute for Risk Assessment (BfR) does not see any advantage in the reduction of bacteria on textiles and warns against potential negative effects such as a weakening of the immune system and the possibility of silver-resistant bacterial strains development. The Institute also fears that consumers could develop a false sense of security and neglect general hygiene (washing garments).

Effects of nano-silver in textiles on skin flora

In recent years antibacterial textiles using nano-silver have been developed to minimise odour formation by reducing the number of bacteria. Fresh sweat is initially entirely odourless. It is only the influence of certain bacteria of the skin flora that produces the typical, and to some extent unpleasant, body odour. Silber ions are effective against a broad spectrum of bacteria and this mechanism is supposed to be used to kill the odourforming bacteria. In other words, when contact is made with the skin an unspecific effect can be expected on the skin flora. The Hohenstein Institutes have carried out *in vitro* tests with antibacterial textiles and examined their effects on skin flora. The results indicate that bacteria are evidently only killed in very close and direct contact with antimicrobial- treated fibres. In the case of human skin flora this means that it can only be influenced when it is in direct contact with the treated fibre. However, since only a few textile fibres have direct and, at most, temporary points of contact with the skin, depending on their construction and the type of fibre, no dramatic transformation in the skin flora is to be expected in respect of the number of bacteria. Furthermore, investigations with disinfectants show that approximately 20% of skin flora bacteria are located too deep in the skin for them to reach. The bacteria population is hence only reduced for a short period and after some time the skin bacteria are filled up again from deeper skin depots (sweat pores, hair follicles) to make up the deficit created. The same effect may be expected where nano-silver is used. However, more investigations are needed since silver nanoparticles can also penetrate into deeper skin layers because they are so small, and release their antimicrobial effect on the resident skin flora. To date there have been no significant studies of the longterm effects of nano-silver in textiles on natural human skin flora.

Environmental impact

As there have been no investigations on the release of nanoparticles from textiles, their potential risk to the environment cannot be assessed. Most probably however nanoparticles are released during washing, entering the environment via the waste water. In this case it is principally nano-silver's antimicrobial properties which make it hazardous because silver ions are toxic for aquatic organisms as well as for microorganisms in the soil. Damage to the bacteria used in the biological purification of waste water in sewage plants likewise cannot be ruled out.

Initial studies substantiate the fact that nanosilver can be released from textiles in differing quantities and forms. One study has investigated the quantities and forms of silver (nano-sized or larger) which were released from nine different fabrics into the water whilst washing in the washing machine. It concluded that the percentage of the released silver varied considerably between individual products (1.3 to 35%) and is dependent on the manufacturing method. Products which had the silver woven into the fibres released very little silver. Silver was mostly released from materials washed in the washing machine in particle sizes of >450 nm, which the authors interpreted as an indication of the importance of the mechanical influence. A product with conventional silver refining (several µm-thick silver coatings of the fibres) showed no significant differences in respect to the distribution of sizes of the silver particles released. Nano-titanium dioxide, which is also used in the manufacture of nano-textiles, also has to be considered hazardous because of its potential environmental impact. When water and UV exposure are present nano-titanium dioxide produces free oxygen radicals which are toxic for aquatic microorganisms. This can damage the ecological balance of stretches of water. However, there are still no investigations to the mechanisms of the toxicity or the impact on natural ecosystems.

(*This article has been adopted from a dossier by the Austrian NanoTrust, an initiative of the Austrian Academy of Sciences.*)

NANOTOXICOLOGY: AN INTER-DISCIPLINARY CHALLENGE

Do we need a new discipline, nanotoxicology, to evaluate the risks? Harald F. Krug and Peter Wick of the Swiss Federal Laboratories for Materials Science and Technology discuss these questions in the journal *Angewandte Chemie* ("*Nanotoxicology: An Interdisciplinary Challenge*").

"Research into the safety of nanotechnology combines biology, chemistry, and physics with workplace hygiene, materials science, and engineering to create a truly interdisciplinary research field," explain Krug and Wick. "There are several factors to take into account in the interaction of nano-objects with organisms," they add. The term nanotoxicology is fully justified. "Nanoscale particles can enter into cells by other means of transport than larger particles."

Another critical feature is the large surface area of nano-objects relative to their volume. If a similar amount of substance is absorbed, an organism comes into contact with a significantly larger number of molecules with nanoparticles than with larger particles. Dose–effect relationships cannot therefore be assumed to be the same. Furthermore, chemical and physical effects that do not occur with larger particles may arise.

"Whether the larger or smaller particle is more toxic in any given case cannot be predicted," according to the authors. "Clearly, the type of chemical compound involved and its conformation in a specific case can also not be ignored."

Carbon in the form of diamond nanoparticles is harmless, whereas in the form of nanotubes—depending on length and degree of aggregation—it may cause health problems. It is also thus impossible to avoid considering each nanomaterial in turn.

For a risk assessment, it is also necessary to keep in mind what dosage would be considered realistic and that not every observed biological effect automatically equates to a health risk.

Krug and Wick indicate that a large amount of data about the biological effects of nanomaterials is available, but not all studies are reliable. Sometimes it is not possible to reproduce the specific material tested or the conditions. "By pointing out methodological inadequacies and making concrete recommendations for avoiding them, we are hoping to contribute to a lasting improvement in the data," they state.

About the authors: Krug is Director of the "Materials Meet Life" department at the Swiss Federal Laboratories for Materials Science and Technology (Empa), member of the Governing Board of the DECHEMA (Society for Chemical Engineering and Biotechnology) working group on the responsible use of nanomaterials, and advises German federal government departments, as well as government departments in Switzerland, on the subject of nanotechnology. Wick is Director of the Materials-Biology Interactions division of Empa and works on national and international projects concerned with nanosafety as well as serving on the Editorial Board of the journal *Nanotoxicology*.

FINDINGS ON POLLUTION DAMAGE TO HUMAN AIRWAYS COULD LEAD TO NEW THERAPIES

Researchers from Duke University Medical Center have identified how nanoparticles from diesel exhaust damage lung airway cells, a finding that could lead to new therapies for people susceptible to airway disease. The scientists also discovered that the severity of the injury depends on the genetic make-up of the affected individual.

"We gained insight into why some people can remain relatively healthy in polluted areas and why others don't," said lead author Wolfgang Liedtke, M.D., Ph.D., assistant professor in the Duke Department of Medicine and an attending physician in the Duke Clinics for Pain and Palliative Care.

The work was published on-line in the journal *Environmental Health Perspectives* ("TRPV4-Mediated Calcium-influx into Human Bronchial Epithelia upon Exposure to Diesel Exhaust Particles").

Diesel exhaust particles, a major part of urban smog, consist of a carbon core coated with organic chemicals and metals. The Duke team showed that the particle core delivers these organic chemicals onto brush-like surfaces called cilia, which clear mucus from the airway lining. Contact with these chemicals then triggers a "signaling cascade," as the cells respond. In some patients, who have a single "letter" difference in their DNA, a circuit called the TRPV4 ion channel signals more strongly in response to the pollutants.

Previous research showed that this gene variant makes humans more liable to develop chronic-obstructive disease (COPD), and the current study provides an explanation for this observation. About 75 percent of people have the version of the gene MMP-1 that leads to greater production of the molecule MMP-1 mediator, which destroys lung tissue. This genetic make-up allows for a turbo-charged production of MMP-1, which damages airways and lungs at multiple levels, Liedtke said.

A more fortunate 25 percent of people escape this high level of production of MMP-1, which may be reflected in the fact that certain individuals can better manage the effects of air pollution without grave airway damage.

The new study also provides a direction for developing therapeutics for those who are genetically more susceptible to air pollution and airway damage, Liedtke said. "If we can find a way to stop the hyperactivation of MMP-1 in response to diesel-engine exhaust particles and reduce it to levels that the airways can manage, then we will be helping a large number of people worldwide," he said. "It is attractive to envision inhaled TRPV4 inhibitor drugs, rather than swallowing a pill or taking an injection. I envision this as rather similar to inhaled drugs for allergic airway disease that are currently available."

EFSA Launches Public Consultation On Nanomaterials

The European Food Safety Authority (EFSA) has launched a public consultation on its draft guidance document for engineered nanomaterial (ENM) applications in food and feed. The guidance document, prepared by the Scientific Committee in response to a request from the European Commission, outlines that in this evolving area of science, it remains essential to adequately characterise the ENM following classical risk assessment practices; hazard identification and hazard characterisation followed by exposure assessment and risk characterisation. The EFSA guidance sets out for applicants, the data needed to understand the specific properties of the ENM, allowing a risk assessment to be carried out.

Biomagnification Of Nano-materials In Simple Food Chain

An interdisciplinary team of researchers at UC Santa Barbara has produced a groundbreaking study of how nanoparticles are able to biomagnify in a simple microbial food chain.
"This was a simple scientific curiosity," said Patricia Holden, professor in UCSB's Bren School of Environmental Science & Management and the corresponding author of the study, published in an early online edition of the journal *Nature Nanotechnology* ("Biomagnification of cadmium selenide quantum dots in a simple experimental microbial food chain"). "But it is also of great importance to this new field of looking at the interface of nanotechnology and the environment."

In an earlier study, the researchers observed that nanoparticles formed from cadmium selenide were entering certain bacteria (called *Pseudomonas*) and accumulating in them. "We already knew that the bacteria were internalizing these nanoparticles from our previous study," Holden said.

The scientists repeated the growth of the bacteria with quantum dots in the new study and and coupled it to a trophic transfer study — the study of the transfer of a compound from a lower to a higher level in a food chain by predation. "We looked at the difference to the predator as it was growing at the expense of different prey types — 'control' prey without any metals, prey that had been grown with a dissolved cadmium salt, and prey that had been grown with cadmium selenide quantum dots," Holden said.

What they found was that the concentration of cadmium increased in the transfer from bacteria to protozoa and, in the process of increasing concentration, the nanoparticles were substantially intact, with very little degradation. The researchers were able to measure the ratio of the cadmium to the selenium in particles that were inside the protozoa and see that it was substantially the same as in the original nanoparticles that had been used to feed the bacteria.

An implication is that nanoparticles inside the protozoa could then be available to the next level of predators in the food chain, which could lead to broader ecological effects.

Upcoming Events
Looking At The Risky Side Of Nano

Reproducible Uptake & Quantification of Nanoparticles in vitro (and in vivo)
February 17, 2011, Lausanne (Switzerland)
The third NanoImpactNet Training School in the series on *"Handling protocols and toxicological testing strategies"* will focus on methods of ensuring reproducible presentation of nanoparticles to cells and on methods to quantitate the uptake of nanoparticles into cells.

Nano4Life 2011
February 24, 2011, London (UK)
Nano4Life 2011 is the annual conference for the NanoKTN's Healthcare & Life Sciences theme, now in its third year, and examines the convergence on nanotechnology and healthcare.

Working Safely With Nanomaterials
March 24, 2011, Glasgow (UK)
This conference will look at the current research using nanomaterials, identify the gaps in information and guidance and address questions pertinent to nanotechnology workers.

5th Annual Nanotechnology Safety for Success Dialogue Workshop
March 29-30, 2011, Brussels (Belgium)
The European Commission is convening this international conference to take stock of the fast advancing science needed for appropriate and effective policies; and to analyze how these advances allow progress with respect to intelligence gathering, risk assessment, risk management, and safe design.

Risks Associated With Nanoparticles And Nanomaterials
April 5-7, 2011, Nancy (France)
Organized by the Institut National de Recherche et de Sécurité in association with the Partnership for European Research in Occupational Safety and Health, this conference will be the first of the INRS Occupational Health Research Conference new series and is addressing in 2011 the occupational risks associated to nanoparticles and nanomaterials.

EuroNanoForum
May 30 – June 1, 2011, Budapest (Hungary)
EuroNanoForum is a biannual event supported by the European Commission. One of the topical areas of this conference is "Society, taking a holistic approach to address societal benefits and risks".

Nanotech Conference & Expo 2011
June 13-16, 2011, Boston, MA (USA)
Nanotech 2011 is the world's largest annual nanotechnology conference and expo. The "Energy & Environment" track deals with environment, health and safety issues as well as cleantech and greentech issues.

In Short – Papers, Initiatives & Updates

GRANTS: New funding competition for nanotechnology EHS aspects

The Technology Strategy Board and the Engineering and Physical Sciences Research Council have jointly allocated up to £400,000 to stimulate innovation with technologies that can address the potential environmental, health and safety (EHS) aspects of the development of nanoscale technologies, either by offering an innovative EHS product or by solving EHS issues with nanotechnology enabled products and processes. For full information please visit:
http://www.innovateuk.org/content/competition/feasibility-studies-for-responsible-development-of.ashx.

GOVERNMENT: California chemical information call-in: Nanometals, nanometal oxides, and quantum dots

Pursuant to Health and Safety Code section 57019(d), the Department of Toxic Substances Control (DTSC) formally announces this request for information regarding analytical test methods, and other relevant information, from manufacturers of the following nanomaterials: Nano Silver, Nano Zero Valent Iron, Nano Titanium Dioxide, Nano Zinc Oxide, Nano Cerium Oxide, Quantum Dots. Formal Request Letter (pdf)

PAPER: 120 Years of nanosilver history: implications for policy makers

Nanosilver is one nanomaterial that is currently under a lot of scrutiny. Much of the discussion is based on the assumption that nanosilver is something new that has not been seen until recently and that the advances in nanotechnology opened completely new application areas for silver. However, this analysis shows that nanosilver in the form of colloidal silver has been used for more than 100 years and has been registered as a biocidal material in the United States since 1954. Fifty-three percent of the EPA-registered biocidal silver products likely contain nanosilver. The implications of this analysis for policy of nanosilver is that it would be a mistake for regulators to ignore the accumulated knowledge of our scientific and regulatory heritage in a bid to declare nanosilvermaterials as new chemicals, with unknown properties and automatically harmful simply on the basis of a change in nomenclature to the term “nano”. doi: 10.1021/es103316q

PAPER: Trafficking and subcellular localization of multiwalled carbon nanotubes in plant cells

Researchers have investigated the capability of multiwalled carbon nanotubes (MWCNTs) to penetrate the cell membrane of plant protoplasts (plant cells made devoid of their cell walls *via* enzymatic treatment) and studied their internalization mechanism *via* confocal imaging and TEM techniques. Their results indentified an endosome-escaping uptake mode of MWCNTs by plant protoplasts. Moreover, short MWCNTs (<100 nm) were observed to target specific cellular substructures including the nucleus, plastids, and vacuoles. These findings are expected to have a significant impact on plant cell biology and transformation technologies.
doi: 10.1021/nn102344t

STUDY: Researcher warns of health risks with carbon nanotubes

Carbon nanotubes, which are extremely small fibers used in many new light and strong materials, may present health risks if inhaled, in the worst case leading to cancer, according to new research from Lulea University of Technology. A new doctoral dissertation ("Modeling Nanofiber Transport and Deposition in Human Airways"; pdf) shows that extremely small fibers such as carbon nanotubes can make their way far into the lungs, which in the worst case can present an increased risk of developing cancer.

INITIATIVE: UK, US to analyze environment and health risks of manufactured nanomaterials

Scientists from both sides of the Atlantic are joining forces to discover what these risks might be, and provide the scientific evidence base needed to inform government and industry policies. In phase 2 of the Environmental Nanoscience Initiative (ENI), which was first launched in 2006 and includes funding from BBSRC among others, scientists from the UK and USA will collaborate on three major research projects. The ENI's UK partners and the US Environmental Protection Agency have jointly invested more than £7M (over US$ 11M) in this research. More information on the initiative and the projects being funded in Phase II can be found at: www.nerc.ac.uk/research/programmes/nanoscience.

GOVERNMENT: Australia issues guidance on new chemical requirements for notification of industrial nanomaterials

Australia's National Industrial Notification and Assessment Scheme (NICNAS) has issued guidance on new chemical requirements for the notification of industrial nanomaterials. The notification and assessment process comes in effect on January 1, 2011. Download the notice (pdf).

PAPER: Surface charge-dependent toxicity of silver nanoparticles

This study investigates the toxicity of four silver nanoparticles representing various surface charging scenarios ranging from highly negative to highly positive. The results clearly demonstrate that the AgNPs exhibited surface charge-dependent toxicity on the *bacillus* species investigated.
doi: 10.1021/es1034188

PAPER: Size-dependent uptake and toxicity of TiO2 nanoparticles in living lung epithelial cells

The cellular uptake and distribution of five types of well-characterized anatase and rutile TiO 2 nanoparticles (NPs) in A549 lung epithelial cells is reported. NP uptake is found to be kinetically activated and strongly dependent on the hard agglomeration size—not the primary particle size—which quantitatively agrees with the measured intracellular oxidative stress. Pro-inflammatory responses are also found to be sensitive to primary particle size.
doi: 10.1002/smll.201001832

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nano*RISK*

Nanowerk LLC
700 Bishop Street, Suite 1700
Honolulu, HI 96813, USA
Tel: +1 408 540-6512
Fax: +1 808 524-8081
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 www.nanorisk.org.

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