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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

10 YEARS OF EUROPEAN NANOTECHNOLOGY RISK RESEARCH - A STATUS UPDATE

A group of experts from the chemical industry and various research laboratories in Germany have published a report on the current status of risk research on nanotechnology materials and applications. The report – 10 Years of Research: Risk Assessment, Human and Environmental Toxicology of Nanomaterials (pdf) – provides an overview of the current state of risk assessment and toxicological research into nanomaterials. It also lists and summarizes the national and European projects on toxicology on various nanomaterials.

In their report, the working group "Responsible Production and Use of Nanomaterials" from DECHEMA (Society for Chemical Engineering and Biotechnology) and VCI (German Association of the Chemical Industry) has drawn up a list of topics and priorities which need to be addressed; activities and projects which have already been carried out; are currently on-going; or are still at the planning stage. The main focus of our considerations is on Germany, with a wider outlook on papers and results at European level.

The report draws the following general conclusions from the projects carried out to date under realistic conditions:

- A risk assessment – where necessary in individual cases – should be performed on the basis of suitably modified and adapted OECD methods which have been validated and are internationally recognized. This confirms the OECD observation that the internationally recognized OECD methods and testing guidelines are suitable in principle for the testing of nanomaterials.
- The size label 'nano' does not also immediately mean "toxic", so it does not represent an intrinsic hazard characteristic.

The authors point out that, in terms of research into the safety of nanomaterials, academia and industry often address different aspects:

Research groups - especially university groups - tend to steer their projects towards research into more fundamental aspects, such as the fundamental principles of the action mechanisms involved in the interaction between nanomaterials and biological systems, and they develop fundamental methods for detection and characterization.

Industrial "Product Stewardship" programs assess the safety of products along their lifecycles, i.e. in manufacturing, further processing and in the planned applications. Consequently, these efforts are focused primarily on the products brought to market by the relevant companies.

Above and beyond these two aspects, joint consortia made up of representatives of industry and academia can systematically develop fundamental mechanisms on commercially relevant systems or systems which are close to real-life applications. In combination, these should yield coherent structure-activity relationships, which can play a supporting role in influencing future product developments in industry.

In order to ensure that "nano" based products are safe, basic risk assessments are required for them, both in terms of their intended applications and in relation to their full lifecycle along value creation chains. According to the opinions of the relevant experts of the Organisation for Economic Cooperation and Development (OECD) and the Scientific Committee on Emerging and Newly Identified Health Risks, (SCENIHR) of the European Commission, these risk assessments can, in principle, be carried out with suitably adapted, validated and internationally recognized (e.g. OECD) methods (see for instance the OECD Database on Research into Safety of

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Titanium Dioxide Nanoparticles Are Ubiquitous In Food Products

New research shows that consumers could be exposed to nanoparticles in food by a much larger degree than has been expected so far.

For a modern consumer it is hard to avoid titanium dioxide (TiO_2) – a widely used additive in food, personal care and other household products. Approximately 7 million tons of bulk TiO_2 are produced annually and used as white pigment in order to provide whiteness and opacity to products such as paints, coatings, plastics, papers, inks, foods, pills, as well as most toothpastes. In cosmetic and personal care products, it is used as a pigment, sunscreen and a thickener. TiO_2also is a photocatalyst; can oxidize oxygen or organic materials directly; and is superhydrophilic. You can therefore expect to see it increasingly used in paints, glass coatings, cement, tiles and ceramics, catalysts for air and water purification.

Due to increased performance (for instance better absorption and transparency of sun screens) and new uses (e.g. as nanocrystals in solar cells), the demand for TiO_2 nanomaterials is growing. Roughly 50,000 tons of TiO_2 nanoparticles were produced in 2010 and this amount is expected to grow to over 200,000 tons by 2015.

"Many applications of titanium dioxide would benefit from smaller primary particle sizes, and we can expect the percentage of TiO_2 that is produced in or near the nano range to increase," says Paul Westerhoff, a professor in the School of Sustainable Engineering and The Built Environment at Arizona State University and Senior Sustainability Scientist to the Global Institute of Sustainability. "TiO_2 nanomaterials in foods, consumer products, and household products are discharged as feces/urine, washed off of surfaces, or disposed of to sewage that enters wastewater treatment plants. While these plants capture most of the TiO_2, nanoparticles measuring between 4 and 30 nm were still found in the treated effluent. These nanomaterials are then released to surface waters, where they can interact with living organisms."

Westerhoff points out that, although the release of TiO_2 nanomaterials to the environment has been shown qualitatively, quantification of how much is released is difficult. That is why he and his team, together with collaborators from ETH Zurich and NTNU Trondheim, have started to fill the existing knowledge gaps that exist regarding commonly used sources of TiO_2 materials.

In a recent paper in *Environmental science & Technology* ("Titanium Dioxide Nanoparticles in Food and Personal Care Products"), the scientists quantify the amount of titanium in common food products, derive estimates of human exposure to dietary (nano-) TiO_2, and discuss the impact of the nanoscale fraction of TiO_2 entering the environment.

Specifically, the team analyzed titanium dioxide in foods and from food suppliers using advanced instrumentation to assess what fraction of the materials was less than 100 nm in size (whether it was aggregated or individual nanoparticles).

For their experiments, the researchers selected a wide range of white foods from grocery stores in the U.S. Some of the foods were labeled as containing TiO_2, and others were not but the primary product or surface coatings (e.g., icings) had a white color. All 89 foods were digested using microwave methods (in a beaker with hydrogen peroxide and hydrofluoric acid), and their titanium concentration was determined.

They found that roughly 36% of food-grade TiO_2 (E171) consists of particles which are less than 100 nm in at least one dimension and that it readily disperses in water as fairly stable colloids.

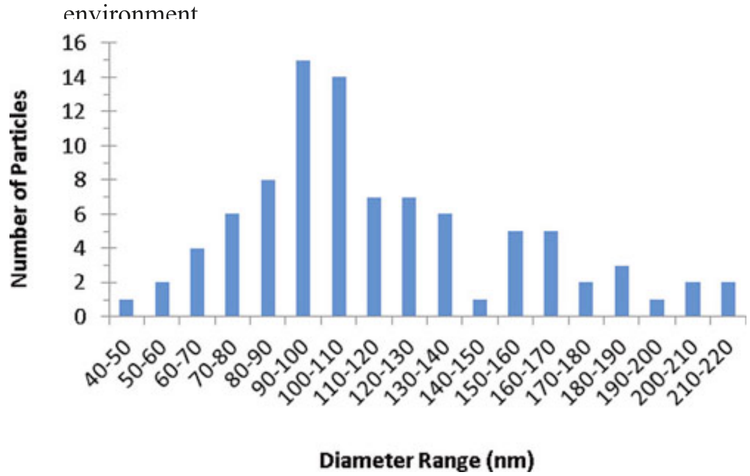
The scientists' simulated exposure to $TiO_2$for the U.S. population shows an average of 1-2 mg TiO_2per kilogram body weight per day for children under the age of 10 years and approximately 0.2-0.7 mg TiO_2/kgbw/ day for the other consumer age groups.

"Of course, exposure to titanium dioxide depends largely on dietary habits, and in special cases the exposure could be several hundreds of milligrams per day," says Westerhoff. "Because our measurements showed that roughly 36% of the particles in E171 may be in the nano range, we can presume a large exposure to nano- TiO_2."

The researchers' conclusion is that it appears that pigment TiO_2represents an enormous source of nanoscale TiO_2entering sewage systems, rivers, landfills, and other sensitive environmental compartments.

"It also appears that through surface modifications food-grade TiO_2 (E171) is more readily dispersed into water than other TiO_2nanomaterials – such as P25, which has been used in many environmental and toxicity studies – which potentially influences TiO_2fate, transport, and toxicity," Westerhoff notes. "Therefore, more environmental ecotoxicology and fate studies should use the fraction of smaller sized TiO_2in pigments because exposure to these materials is likely to be much higher and more representative than exposure to P25."

The research team suggests that future work should investigate other nanoscale food and personal care additives and that the research community should work towards understanding their surface chemistry and behavior in the environment.



Distribution of primary particle size of food grade titanium dioxide (E171). Analysis indicates that 36% of the particles were less than 100 nm in at least one dimension.

EUROPEAN NANOTECHNOLOGY RISK RESEARCH...

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Manufactured Nanomaterials). From these, it will then be possible to derive appropriate measures (e.g. safe limits for the workplace) which will enable safe production, further processing, usage and recycling/reuse in the relevant value creation chain.

The following varied factors and considerations must all form part of such a risk assessment: on the one hand, it needs to be investigated whether and, if applicable, to what level any release, i.e. emission of nanomaterials and/or nano-objects, is at all possible in an intended application. Furthermore, clarification needs to be sought whether the nanomaterials and/or nano-objects which may potentially be released can interact with surrounding biological systems, i.e. whether any exposure actually occurs in the relevant application.

On the other hand, the interactions of the nanomaterial under assessment and its effects on biological systems, i.e. humans and the environment, need to be examined and classified under defined conditions, e.g. via a range of different exposure routes (oral, dermal, by inhalation etc.) and at different doses, i.e. exposure levels. As a result, not only are the possible exposure scenarios in the application of the nanomaterial and/or nano-object and its biological effects examined in isolation, but in order to properly conduct a risk assessment of a material in an application, both factors also need to be combined with each other in order to allow a general risk assessment to be concluded. This means that, for example, the absence of a relevant exposure in an application and/or the absence of a negative biological interaction during an expected corresponding exposure would indicate the absence of any risk in a given application.

For relevant studies carried out for safety assessments, this therefore means that the biological effect (factor 1) needs to be systematically investigated under defined test conditions (defined test set-ups and comparison systems, characterized materials, defined exposure paths and exposure doses). In addition, realistic scenarios need to be drawn up for the relevant application and corresponding exposure doses (factor 2) and exposure paths.

By combining the mutually coordinated investigations into both factors, it will then be possible to perform a reliable risk assessment, from which it will also be possible to derive appropriate measures to minimize the risks associated with this application throughout the lifecycle.

A range of such studies designed to deliver safety-related data for nanomaterials has already been conducted or is currently in progress. Examples include a number of projects, such as the BMBF-funded (BMBF = German Federal Ministry of Education and Research) NanoCare project, in which nanomaterials which are relevant in terms of practical applications were examined under realistic and reproducible test conditions, from which concrete systematic data were then obtained.

In this context, the Nanoderm project funded by the European Commission is no doubt one of the most frequently cited projects, and it was able to show that nano-TiO2 does not penetrate through undamaged skin. In addition, the projects CarboSafe (since 2008) and CarboLifeCycle (since 2010) have also been set up and started as part of the Innovation Alliance Carbon Nanotubes (Inno.CNT). Here, environmental aspects as well as emission and exposure scenarios are investigated among other things for carbon nanotubes (CNTs).

The NanoCare and NanoNature projects tendered by BMBF, which look at issues relating to human toxicity and interactions between nanoparticles and the environment, have also recently started. In addition, there are numerous projects and activities at European level within the framework of the 6th (already completed) and 7th EU research framework program which have now started up or recently put out to tender again.

The results of the industrial safety research will particularly also serve as the basis for registrations under the REACH system at the European Chemicals Agency ECHA.

Even if the current data available on environmental and human toxicity of numerous nanomaterials is already starting to reach satisfactory levels, this data is set to grow in further efforts carried out jointly between research scientists from academia and industry.

Alongside the research work, the aspect of dialogue between stakeholders on the benefits and challenges of nanotechnology is unique to Germany. Here, the cross-disciplinary work carried out by the internationally unique "NanoKommission" of the German Federal Government as part of the "NanoDialog" deserves particular mention. The open dialogue about the new technologies and new materials and the associated direct feedback of the corresponding requirements and expectations between the different interest groups helps to communicate a mutual and deeper understanding for the different requirements. As a result, the various aspects – opportunities and challenges alike – of nanotechnology can already be assessed more realistically.

In addition to the stakeholder dialogue, it is also very important to ensure that the research into the safety of nanotechnology is made transparent to the general public by making available the relevant information in a manner which can be readily understood. Work on this aspect was started via an Internet platform conducted as part of the NanoCare project. This will now be intensively continued in the DaNa project with support from the BMBF. The DaNa project will compile existing knowledge and latest results from research projects into the safety of nanomaterials on its website. It will attempt to provide interested members of the general public with objective and easy to understand information on the subject and to engage the wider public in a factual and well-informed discussion.

Environmental Implications of Nanoparticle Ageing

Several studies in the literature have highlighted that as nanomaterials "age" they can undergo oxidation; sintering (coalescence); surface ligand displacement; smaller nanoparticle formation; and surface carbonate formation. Nevertheless, no studies are available on how these changes affect the physicochemical properties of the nanomaterials.

The aging of nanomaterials is expected to be rapid even under ambient environmental conditions. With the consequence that pristine, as synthesized materials – which are commonly used in nanotechnology-relevant environmental health and safety (EHS) studies – are never really encountered under natural environmental conditions. Which means that researchers who investigate the applications and implications of nanomaterials need to have a clear understanding of the aging process of these materials and need to take its effects into consideration.

"Most, if not all, nano EHS related research is conducted using freshly synthesized or newly purchased nanomaterials" says Vicki H. Grassian, F. Wendell Miller Professor in the Departments of Chemistry and Chemical and Biochemical Engineering, and Director of the Nanoscience and Nanotechnology Institute at the University of Iowa (UI). "However a number of publications over the recent years have indicated that these nanomaterials are highly dynamic in nature and change over time as they age under ambient conditions and in the environment. This results in changes in size, morphology, composition and surface functionality. Thus there can be significant deviations from the predicted behavior from the EHS studies conducted with fresh samples."

New research by Grassian's group ("Environmental Implications of Nanoparticle Aging in the Processing and Fate of Copper-Based Nanomaterials") shows clear differences between the aged and new copper nanoparticle processing under same environmental conditions which can lead to differences in their fate, transformation and toxicity.

The basic findings of this work is that copper-based nanoparticles age in the ambient environment and change over time. Furthermore, these aged nanoparticles show different behavior in aqueous suspensions with respect to dissolution.

"Our study highlights the important of oxidation and the thickness of the oxide layer on copper nanoparticles behavior," says Grassian. "These aged materials show different behavior when compared to metallic new (Cu) nanoparticles and fully oxidized copper oxide (CuO) nanoparticles. Although aged copper and copper oxide nanoparticles have the same surface composition the adsorption of organic acids showed distinct differences between the two samples indicating potential coupling of the surface with the underlying core."

She notes that in many nano EHS studies the samples are pretreated by sonication, dispersing in buffers and biological media. These can result in conditions which can either mitigate or enhance the aging process.

"In situations where the aging is enhanced, the responses obtained may arise not from the initially characterized materials but from the aged materials," says Grassian. "For example, our studies show that sonication of copper nanoparticle suspension the Cu_2O fraction of the sample and therefore the amount of copper in the Cu(I) oxidation state; which can play a role in the production of reactive oxygen species. Thus when considering the toxicological responses it will be important to account for this oxidized fraction as well."

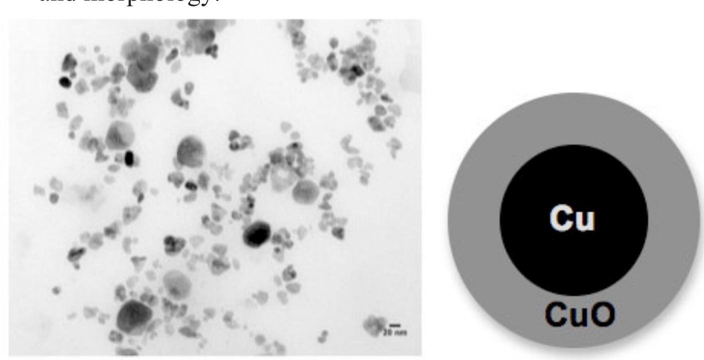
Furthermore, when a study is conducted over a long period of time aging of nanomaterials can result in inconsistent data from different laboratories or even the same laboratory. Thus, it is important to characterize these materials for each study conducted.

Copper and copper oxide nanoparticles have shown toxicological responses particularly in aquatic species and animal studies (see for instance: "Copper nanoparticles harm zebrafish"). That is why the UI team has undertaken a study of three different types of copper nanoparticles that differ in their level of oxidation.

As Grassian points out, a comparison of the aqueous behavior between newly purchased commercially manufactured copper nanoparticles to nanoparticles that were allowed to sit in the laboratory environment for several years under ambient conditions is particularly interesting as it probes potential effects of aging on environmental processing and the fate and transport of these materials.

"The aged materials exhibit differences in solubility, aggregation and reactivity that can affect the mobility and toxicity of these materials," she says. "Having a clear understanding of how these nanomaterials will change upon aging and consequent alterations in their physicochemical properties will enable establishing reliable structure-activity correlations. This is crucial in mitigating any unfavorable consequences of nanotechnology."

As this work clearly shows, EHS researchers need to conduct studies on understanding the thermodynamics and the kinetics of the aging process for nanomaterials. Aging is strongly affected by environmental conditions. Additionally, as with all the properties of nanoscale materials, the thermodynamic and kinetic behavior will depend on their size and morphology.



The figure above shows a transmission electron microscopy (TEM) image of aged copper nanoparticles.

NANOMATERIALS "JUST OUT OF REACH" OF EU REGULATIONS

REACH, the European Union's primary regulation on chemicals is failing to identify or control nanomaterials. That is the conclusion of "Just Out of REACH: How REACH is failing to regulate nanomaterials and how it can be fixed" (pdf), a new report by the nonprofit Center for International Environmental Law (CIEL). Nanomaterials, tiny manmade particles with extraordinary properties, are a fast-growing component of cosmetics, clothing, consumer electronics, and other products.

According to CIEL's David Azoulay, author of the report, "Three years ago, the Commission declared that REACH theoretically covered nanomaterials; but they continue to enter the EU market with little or no information on their potential risks, violating REACH's 'no data, no market' principle. The problem is that the regulation contains legal gaps and shortcomings that render it completely ineffective for nanomaterials."

The study documents four key gaps for nanomaterials in the registration phase of REACH, an essential step that requires chemical manufacturers and importers to provide key health and safety information.

- REACH does not define nanomaterials, and contains no nano-specific provisions;
- Most nanomaterials evade registration until 2018, yet they can still enter the EU market;
- REACH's schedule for registration hinges on the number of tonnes of a chemical, essentially missing all nanomaterials, which are generally produced in far smaller quantities; and
- REACH test guidelines fail to consider the special properties of nanomaterials.

"Just Out of REACH" also explores possible remedies to close these loopholes. Some have suggested renegotiating REACH to add specific provisions on nanotechnology. But this is politically impossible and could invite further weakening of the current regulation. Others have suggested changes to the technical guidance, but the study shows that these so-called solutions fall short of bridging the existing legal gaps.

Rather than re-opening REACH, the report proposes developing a stand-alone regulation, carefully aligned with the chemical rules, but specifically tailored to nanomaterials. According to Azoulay, "REACH could prove a useful instrument to better understand and regulate nanomaterials, provided it is coupled with a nano 'patch' that closes these inherent loopholes." Such a regulation would establish clear, legally binding provisions for nanomaterials and create a transparent and predictable legal environment for the safe production and use of nanomaterials in the EU.

This solution should be flexible and allow for future adjustments as nanomaterials are better understood, without requiring additional changes to REACH. "Flexibility must be a critical characteristic of any effort to regulate nanomaterials," says Azoulay. "Our understanding is still very limited; it will evolve, and our legal responses must be ready to do so as well. A "nano-patch" for REACH would provide that added flexibility."

DUST FROM INDUSTRIAL-SCALE PROCESSING OF NANOMATERIALS CARRIES HIGH EXPLOSION RISK

With expanded industrial-scale production of nanomaterials fast approaching, scientists are reporting indications that dust generated during processing of nanomaterials may explode more easily than dust from wheat flour, cornstarch and most other common dust explosion hazards.

Their article in ACS' journal *Industrial & Engineering Chemistry Research* ("Review of the Explosibility of Nontraditional Dusts") indicates that nanomaterial dust could explode due to a spark with only 1/30th the energy needed to ignite sugar dust — the cause of the 2008 Portwentworth, Georgia, explosion that killed 13 people, injured 42 people and destroyed a factory.

Paul Amyotte and colleagues explain that dust explosions are among the earliest recorded causes of industrial accidents — dating back to a 1785 flour warehouse disaster — and are still a constant threat at facilities that process fine particles of various materials.

Despite significant research, there is still much for scientists to learn about the risks of dust explosions in industry, especially of so-called "nontraditional" dusts (such as those made of nanomaterials), and a constant threat exists.

That's why the researchers decided to probe the explosibility of three types of nontraditional dusts: nanomaterials; flocculent (fibrous or fuzzy) materials used in various products, such as floor coverings; and hybrid mixtures of a dust and a flammable gas or vapor.

After reviewing results of studies that exist on the topic, the researchers concluded that the energy needed to ignite nanomaterials made of metals, such as aluminum, is less than 1 mJ, which is less than 1/30th the energy required to ignite sugar dust or less than 1/60th the energy required to set wheat dust aflame.

Flocking is often made with a process that generates static electricity, which could set off an explosion of flocculent dust, they point out. And the addition of a flammable gas or vapor to a dust as a hybrid mixture increases the chance that the dust will explode.

The researchers warn that precautions should be taken to prevent these materials from exposure to sparks, collisions or friction, which could fuel an explosion.

NEW MEASURING TECHNIQUES CAN IMPROVE SAFETY OF NANOPARTICLES

Using high-precision microscopy and X-ray scattering techniques, University of Oregon researchers have gained eye-opening insights into the process of applying green chemistry to nanotechnology that results in high yields, improves efficiency and dramatically reduces waste and potential negative exposure to human health or the environment.

University of Oregon chemist [James E. Hutchison] described his lab's recent efforts to monitor the dynamics of nanoparticles in an invited talk at the American Physical Society's March Meeting. It turns out, Hutchison said, that simply reducing the amount of gold -- the material used in his research -- in the initial stages of the process used to grow nanoparticles allows for better maintenance of the particle size.

That accomplishment, he said, has important implications. The use of lower concentrations of the precursor that forms the nanoparticles virtually eliminates the ability of nanoparticles to aggregate together and thus prevents variations of sizes of the desired end product.

"What we saw while observing the production process with small-angle X-ray scattering (SAXS) was amazing," Hutchison, said in an interview before his lecture. "We realized that it is possible to reduce the concentration of gold and allow the particles to still grow, but shutdown the coalescent, or aggregation, pathway."

He also summarized his lab's use of chemically modified grids (Smart Grids) in transmission electron microscopy to study how nanoparticles are shed from common objects such as silverware and copper jewelry -- findings that were detailed in the journal *ACS Nano*. They studied the transformation of silver nanoparticles coated on Smart Grids as well as the common objects and found that all forms produce smaller silver nanoparticles that could disperse into the environment, especially in humid air, water and light -- and likely have been doing that throughout time without any known health ramifications.

"There may be many beneficial applications to nanotechnology, but they are only beneficial if the net benefits outweigh the deleterious implications for human health and the environment," said Hutchison, who holds the Lokey-Harrington Chair in Chemistry at the University of Oregon.

These new monitoring and measuring techniques, he said, are vital to help understand what modifications are possible in the processes that grow nanoparticles for a desired product. Using green chemistry, he added, can help assure both efficiency and stability of a product, which, in turn, will lower the risk of unwanted environmental or harmful human-health consequences.

Hutchison is co-author of "Green Nanotechnology Challenges and Opportunities," a white paper published by the ACS' Green Chemistry Institute, and the National Research Council report, "A Research Strategy for Environmental, Health, and Safety Aspects of Engineered Nanomaterials." He also was the founding director of the Safer Nanomaterials and Nanomanufacturing Initiative (SSNI) of the Oregon Nanoscience and Microtechnologies Institute (ONAMI).

UPCOMING EVENTS
LOOKING AT THE RISKY SIDE OF NANO

Nanomedicine: Visions, risks, potential
April 19-20, 2012, Berlin (Germany)
This conference aims at discussing recent trends in the development of nanotechnological methods in medical applications with experts from different involved fields of research from an interdisciplinary perspective. There will be sessions on scientific and technical aspects of nanomedicine, on risk and other ethical issues as well as on the social impact of nanomedicine in the context of science, industry and the public.

Safety issues and regulatory challenges of nanomaterials
May 3-4, 2012, San Sebastian (Spain)
This event presents the latest results and progress of the European FP7 Projects: HINAMOX, NANOPOLYTOX, NEPHH and ENPRA as well as the state of the art and recent developments in the legislation and regulations in the EU and the world concerning nanomaterials.

7th International Conference on the Science of Exposure Assessment (X2012)
July 2-5, 2012, Edinburgh (UK)
X2012 will bring together the leading international experts and provide a platform for the exchange of knowledge and expertise in exposure assessment sciences. X2012 will contribute to the developments in state-of-the-art methodologies and practices in this field, and thereby improve our knowledge base to effectively control exposure to hazardous agents in the work environment, at home and elsewhere.

SENN2012 - International Congress on Safety of Engineered Nanoparticles and Nanotechnologies
October 28-31, 2012, Helsinki (Finland)
The goal is to summarize and share the latest knowledge on the safety of engineered nanomaterials and nano-related technologies. The emphasis is on producing solutions to the safety challenges related to engineered nanomaterials and nanotechnologies. Another aim is to enable commercial opportunities for the safe use of these materials and technologies.

The responsible development of nanotechnology: Challenges and perspectives
November 1-2, 2012, Montreal (Canada)
The **N**etwork on **e**thical, **e**nvironmental, **e**conomic, **l**egal and **s**ocial issues regarding nanotechnology development (Ne^3LS) is hosting an international conference to initiate thought-provoking discussion on the responsible development of nanotechnology.

NanoSafe 2012
November 13-15, 2012, Grenoble (France)
A multitude of topics relating to nanomaterials exposure assessment, detection, identification and toxicology.

In Short – Papers, Initiatives & Updates

STUDY: Plastic nanoparticles affect behavior and fat metabolism in fish

Nanoparticles have many useful applications, but also raise some potential health and ecological concerns. Now, new research shows that plastic nanoparticles are transported through the aquatic food chain and affect fish metabolism and behavior. The full report is published Feb. 22 in the open access journal *PLoS ONE* ("Food Chain Transport of Nanoparticles Affects Behaviour and Fat Metabolism in Fish"). Exposing fish to nanoparticles slowed their feeding behavior, and also affected metabolic parameters including weight loss and cholesterol levels and distribution. The authors, led by Tommy Cedervall, Lars-Anders Hansson and Sara Linse of Lund University in Sweden, suggest that their results could be useful for developing assays to test for nanoparticles and investigate potential biological risks associated with them.

PAPER: Silver nanoparticles and total aerosols emitted by nanotechnology-related consumer sprays

The objectives of this work were to characterize the emissions of airborne particles from consumer products that claim to contain silver nanoparticles or ions, determine the relationship between emissions and the products' liquid characteristics, and assess the potential for inhalation exposure to silver during product use. Three products were investigated: an antiodor spray for hunters, a surface disinfectant, and a throat spray. doi: 10.1021/es202770m

GOVERNMENT: Safe handling of carbon nanotubes in the workplace

Safe Work Australia released a new publication on the Safe Handling and Use of Carbon Nanotubes that addresses health concerns and offers information on how people can work safely with carbon nanotubes in the workplace. It suggests two risk management approaches that can be used separately or combined to inform a safe approach when using the material. Safe Work Australia commissioned the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to develop information on the safe handling and use of carbon nanotubes in the workplace.

PROJECT: The "Safe Implementation of Innovative Nanoscience and Nanotechnology" project's first call for proposals

The SIINN (Safe Implementation of Innovative Nanoscience and Nanotechnology) ERA-NET promotes the safe and rapid transfer of European research results in nanoscience and nanotechnology into industrial applications. National and regional resources will create a transnational programme of research. SIINN will bring together today's fragmented research activities on the potential risks of engineered nanomaterials for environment, human health, and safety. The first joint call for transnational projects of the SIINN initiative will open on March 20, 2012. The deadline for submitting proposals is June 5, 2012, 12:00 CET.

REPORT: Cytotoxic and genotoxic effects of silver nanoparticles in testicular cells

Silver nanoparticles cause more damage to testicular cells than titanium dioxide nanoparticles, according to a recent study by the Norwegian Institute of Public Health (see paper in *Toxicology*: "Cytotoxic and genotoxic effects of silver nanoparticles in testicular cells"). However, the use of both types may affect testicular cells with possible consequences for fertility. The researchers found that silver nanoparticles had a toxic effect on cells, suppressing cellular growth and multiplication and causing cell death depending on concentrations and duration of exposure. The effect was weaker for titanium dioxide nanoparticles, although both types did cause cell type-specific DNA damage, with possible implications on reproduction as well as human and environmental health.

STUDY: Making carbon nanotube nanoelectronics safe for the environment

The percentage of electronic waste occupying our landfills has grown at an alarming rate over the last decade, giving rise to concerns about the toxicity of components used in consumer electronics. Researchers at the University of Florida are looking for ways to minimize environmental hazards associated with a material likely to play an increasingly important role in the manufacture of these goods in the future. The results of their most recent studies are published in the March 2012 issue of *Nanotoxicology* ("Mitigation of the impact of single-walled carbon nanotubes on a freshwater green algae: Pseudokirchneriella subcapitata").

PAPER: Degradation products from consumer nanocomposites: A case study on quantum dot lighting

This article presents a case study on the end-of-life emission of a commercial prototype polymer/quantum-dot (QD) composite used in solid-state lighting for homes. We report the extent of cadmium release upon exposure to a series of environmental and biological simulant fluids, and track the loss of QD-characteristic fluorescence as a marker for chemical damage to the CdSe/ZnS nanoparticles.
doi: 10.1021/es204430f

GOVERNMENT: European Commission releases 2012 edition of the Compendium of Projects in the European NanoSafety Cluster

The European Commission has released the the third edition of the Nanosafety Cluster compendium (pdf). It documents the status of important projects on nanomaterial toxicity and exposure monitoring, integrated risk management, research infrastructure and coordination and support activities. The compendium is not intended to be a guidance document for human health and environmental safety management of nanotechnologies, as such guidance documents already exist and are widely available.

IN THIS ISSUE

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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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