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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

Although nanotechnologies could have a tremendous positive impact on renewable energies and other environmentally benefial technologies, certain production and fabrication processes are anything but 'green'.

NANOTECHNOLOGY — NOT THAT GREEN?

There is a general perception that nanotechnologies will have a significant impact on developing 'green' and 'clean' technologies with considerable environmental benefits. The concepts are ranging from water treatment to energy breakthroughs and hydrogen applications. Renewable energy applications probably are the areas where nanotechnology will make its first large-scale commercial breakthroughs.

Conflicting with this positive message is the growing body of research that raises questions about the potentially negative effects of engineered nanoparticles on human health and the environment.

However, there is one area of nanotechnology that so far hasn't received the necessary attention: the actual processes of manufacturing nanomaterials and the environmental footprint they create, in absolute terms and in comparison with existing industrial manufacturing processes. Analogous to other industrial manufacturing processes, nanoproducts must proceed through various manufacturing stages to produce a material or device with nanoscale dimensions.

A recent overview article in the *Journal of Industrial Ecology,* written by three scientists at the University of Illinois at Chicago (UIC), explores manufacturing routes of nanoproducts, with special attention focused on attributes likely to have significant environmental implications ("Toward Sustainable Nanoproducts").

Apart from certain nanoparticles and carbon nanotubes, the volume of mass produced nanomaterials is relatively modest, especially when compared with the total output of chemicals. Nevertheless, a number of the materials used in nanoproducts are rare, with demand sometimes exceeding production.

The article takes a detailed look at the sources of environmental impacts of current production methods for nanomaterials and they evaluate both top-down and bottom-up nanomanufacturing methods.

There are a number of areas where the manufacture of nanomaterials has an environmental impact (as does all manufacturing). The question of course is if nanomaterial production leaves a larger or a smaller environmental footprint than the manufacture of traditional chemicals and products. Due to the scarcity of quantitative data with regard to energy and resource consumption as well as waste materials, this question cannot be answered conclusively. There is evidence, though, that some production processes have a considerable negative impact. Carbon nanoparticles, for instance, are found to be highly energy-intensive materials, on the order of 2 to 100 times more energy-intensive than aluminum, even with idealized production models ("Energy Requirements of Carbon Nanoparticle Production").

Or consider this: For certain one-dimensional nanoproducts, energy intensity (in terms of mass of fossil fuel use per product) is 400 times higher than that of a refrigerator and 700 times that of an automobile ("Environmental impacts of microchip manufacture").

The following is a summary of the sources of environmental impacts as identified and described by the UIC researchers.

Stricter Purity Requirements and Less Tolerance for Contamination During Processing Compared to Conventional Manufacturing Processes

Semiconductor devices as well as many nanomaterials require extraordinary levels of purity in terms of starting materials, water, and chemicals used during production, as well

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Adding yet another twist to the emerging debate about the potential risks of nanomaterials, researchers have demonstrated how difficult it is to map out the health effects of nanoparticles.

NANOTECHNOLOGY'S COMPLICATED RISK - BENEFIT DICHOTOMY

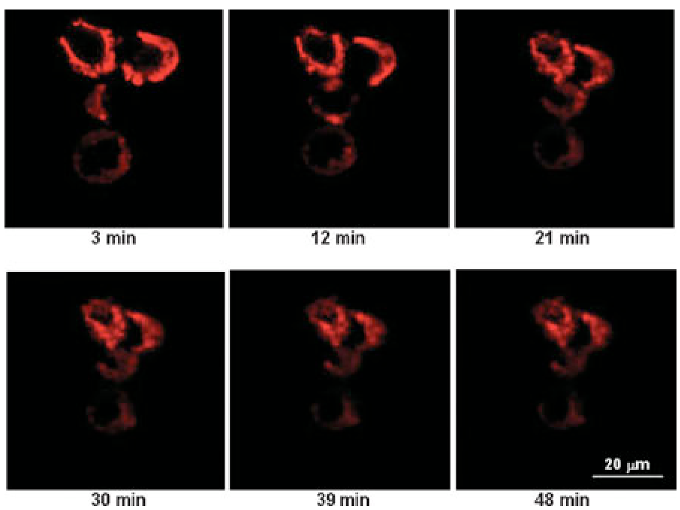
Researchers have shown that, even if a certain nanoparticle does not appear toxic by itself, the interaction between this nanoparticle and other common compounds in the human body may cause serious problems to cell functions. On one hand, this effect could be used to great advantage in nanomedicine for killing cancer cells. On the other hand, unfortunately, it is unknown at present whether the same effect could be observed with healthy cells as well. Since the number of possible combinations of nanoparticles and various biomolecules is immense, it is practically impossible to research them systematically. This latest example of the risk-benefit dichotomy of nanotechnology just shows how thin the line is between promising applications such as effective cancer killers and the unknown risks posed by unintentional effects of exactly the same applications.

"Our recent work with fullerenes provides two core findings," explains Dr. Emppu Salonen, a scientist at Helsinki University of Technology in Finland. "Firstly, fullerenes, which are inherently insoluble in water, can be efficiently solubilized a phenolic acid which is ubiquitous in plants and can be found for instance in tea, grapes, oak bark, and cosmetics products as an antioxidant. Secondly, when exposed to gallic-acid-solubilized fullerenes, human tumor cells were shown to contract rapidly within tens of minutes and subsequently die."

Salonen explains the significance of these two findings:

"The first finding touches two important topics. First, there is intensive ongoing research for finding good solubilizing agents for carbon nanomaterials in general, in view of their use in nanotechnology applications. Second, while the volume of nanoparticles produced and the number of consumer products containing nanoparticles are both increasing rapidly, we still do not know much about their environmental and biological effects. We do not know, for example, how nanoparticles might get discharged into the environment, whether they could be solubilized in soil and natural waters, and wether they could enter the food chain. To us, that is quite many important unknowns."

According to Salonen, the second finding has an interesting twist. Fullerenes are envisioned to be used in nanomedicine as drug delivery agents or even as the drugs themselves, for instance in therapies to fight cancer, HIV, Alzheimer's and Parkinson's diseases.



Real-time interaction of C70-gallic acid and HT-29 cells. The cell membranes were labeled with lipophilic DiIC18 and their cross sections appeared as red 'rings'. Over time the cells were mechanically contracted due to the mutual interactions between C70-gallic acid nanoparticles (weight ratio 1:5).

"Fullerenes are excellent antioxidants and have already shown great promise in in vitro experiments. Gallic acid is abundant in for instance tea, red wines, walnuts and is used in cosmetics products due to its known antioxidant properties. What our work shows is that when acting together, these a priori beneficial compounds induce a fast and dramatic death of tumor cells. What we do not know at present, though, is whether the same effect could be observed also with healthy cells."

Salonen is first author of a paper in *Small* that describes these findings ("Real-Time Translocation of Fullerene Reveals Cell Contraction"). He worked with the research groups of Ilpo Vattulainen at Tampere University of Technology in Finland and Pu-Chun Ke at Clemson University in South Carolina.

The main motivation for this study was to understand the fate of fullerenes discharged into the environment since, with the increasing industrial-scale production and envisioned application of fullerenes in consumer products, their eventual entry into the environment is unavoidable.

"The fact that nanoparticles are so small and highly reactive/adaptive makes determining their environmental impact much more challenging as compared to other, larger-size pollutants common today" says Salonen. "What we endorse — like many other researchers, governments and non-governmental organizations around the world — is proactive work on determining the biological and environmental effects of nanomaterials in general."

The Finnish-U.S. research team integrated results from both atomistic molecular dynamics simulations conducted by Salonen and Vattulainen at their labs in Finland, and experimental observations by Ke's lab at Clemson.

The toxicity of fullerenes is being intensively debated. The often conflicting research reports with regard to the toxicity of certain nanoparticles have to do with the different ways these particles are synthesized or characterized.

The scientists used a naturally occurring phenolic acid — which is ubiquitous in fruits and all plant ecological system — as their solubilizing agent. They found that cells exposed to fullerenes or gallic acid separately did not show any loss of viability. However, it was the interplay of fullerenes and gallic acid combined that resulted in the dramatic cell death

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University of Pittsburgh scientists demonstrate the natural biodegradation of single-walled carbon nanotubes through catalysis with a common enzyme found in horseradish.

Biodegradation of carbon nanotubes could mitigate potential toxic effects

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*.

Carbon nanotubes biodegrade over the course of several weeks

"While it has been shown that carbon nanotubes can indeed act as a means for drug delivery, negative effects such as unusual and robust inflammatory response, oxidative stress and formation of free radicals, and the accumulation of peroxidative products have also been found as a result of carbon nanotubes and their accumulated aggregates" Dr. Alexander Star tells us. "As a possible solution, we have provided compelling evidence of the biodegradation of carbon nanotubes by horseradish peroxidase and hydrogen peroxide over the period of several weeks. This marks a promising possibility for nanotubes to be degraded by horseradish peroxidase in environmentally relevant settings."

Star, an Assistant Professor in Advanced Functional Materials, Nanosensors, Physical Organic Chemistry at the University of Pittsburgh, together with Dr. Valerian Kagan and collaborators from Departments of Chemistry and Environmental & Occupational Health at the University of Pittsburgh, have demonstrated the natural biodegradation of single-walled carbon nanotubes through enzymatic catalysis. They have published their findings in *Nano Letters* ("Biodegradation of Single-Walled Carbon Nanotubes through Enzymatic Catalysis").

Researchers have been experimenting with ways to alleviate the potential negative side effects of carbon nanotubes either by functionalizing them to make them more biocompatible or by degrading them after their use. So far, methods for degrading nanotubes, or 'cutting' nanotubes, involved the use of a harsh solvent consisting of sulfuric acid and high concentrations of hydrogen peroxide.

"When dealing with environmental issues it is important not to introduce any contaminants harsher than what is being cleaned" says Star. "Our method provides a mild, natural approach for the safe removal of carbon nanotube material."

Natural and benign biodegradation through enzymatic catalysis

In their work, the University of Pittsburgh scientists show the natural biodegradation of single-walled carbon nanotubes through enzymatic catalysis.

"By incubating carbon nanotubes with a common enzyme, horseradish peroxidase and low levels of hydrogen peroxide under static conditions, these nanomaterials are oxidized" says Brett Allen, a chemistry Ph.D. candidate in Star's lab and first author of the report. "The formation of a highly oxidizing intermediate from this enzyme, known as Compound I, facilitates this biodegradation process. These results mark promising possibilities for nanotubes to be degraded in environmentally relevant settings."

In their 16-week experiment, the researchers started to observe a substantial decrease in the average nanotube length and the appearance of globular material after eight weeks. By the end of the incubation period after 16 weeks, they found that it had become difficult to account for any nanotube structure at all.

Allen says that examination of the samples at 12 weeks already revealed that the bulk of nanotubes were no longer present, and globular material had amassed.

Chemical spill kit

These findings could lead to the development of immobilized horseradish peroxidase/hydrogen peroxide mixtures into a chemical spill kit to clean up carbon nanotubes in environment, thus mitigating carbon nanotube toxicity.

"It is tempting to speculate that other peroxidases in plants and animals may be effective in oxidative degradation of carbon nanotubes" says Star. "If so, enhancement of these catalytic biodegradation pathways may be instrumental in avoiding their cytotoxicity in drug delivery, gene silencing, and tumor imaging."

He and Allen point out that, with further insight into this type of biodegradation process, it will be possible to engineer better, more efficient drug delivery platforms, where the patient need not worry about the injection of materials that could possibly accumulate causing cytotoxic effects.

"We are currently in collaborative efforts with Dr. Kagan to investigate the effects and degradation of carbon nanotubes using other relevant peroxidases" Star explains the team's current efforts. "Furthermore, we are at a need to understand the products of formation. While it appears that nanotubes are degraded, we have still not identified those products of degradation."

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as the frequent requirement for a clean room environment. The processes to achieve the required levels of purity are energy intensive. For instance, the energy intensity of a class 1 or 10 clean room is five times higher than a class 100,000 clean room.

Ultrapure water for processing requires an average of 1.4 to 1.6 gallons of potable water to obtain 1 gallon of ultrapure water. Subsequent recycling of ultrapure spent rinse water, which contains trace elements of metals, acids/bases, and solvents, poses several challenges.

Low Process Yields or Material Efficiencies

The authors write that, for many processes, only a small percentage of the starting materials is ultimately incorporated into final products, the rest accumulating on reactor walls (thus requiring frequent cleaning) or flowing to effluent waste streams. "Few systematic methods for recovering unused materials exist at present. Deposition, ion implantation, chamber cleaning, and dry etching techniques, for 1-D nanoproducts manufacturing, have low material or precursor utilization efficiencies, ranging from 3% to 10% for MBE and 1 to 20% for metal organic CVD."

Repeated Processing, Postprocessing, or Reprocessing Steps of a Single Product or Batch

One example of how high-repetition processing steps create large amounts of waste materials: "Nanoparticles extracted from solution by precipitation and centrifugation must be washed repeatedly with organic solvents and ultrapure water until the products are isolated from solvents, surfactants, or reagents. Liquid-phase synthesis techniques also require postannealing treatments to change the morphology of the products. As much as 15 liters of solvent per gram of product may be used."

Modern chip production technologies require numerous processing steps that involve a significant use of chemicals, surfactants and ultrapure water. The report notes that the lithography step is the most waste-producing process during wafer processing. It is a chemically intensive process that "is characterized by both significant energy consumption (excimer lasers) and the use of chemicals (coatings and photoresist mixtures), some of which are toxic and have to be disposed of as hazardous waste."

Use of Toxic, Basic, or Acidic Chemicals and Organic Solvents

According to the report, it is estimated that 99.9% of materials used to manufacture one-dimensional nanoproducts are not contained in the final products. Also, "despite major reductions in energy consumption and ultrapure water use, chemical use per product and chemical waste generation have been increasing in semiconductor facilities due to increasing wafer production and more complex processes."

In addition, life cycle impact analyses have not been done yet for many of the chemicals used in nanomanufacturing, so a total environmental footprint cannot be compiled yet.

Need for Moderate to High Vacuum and Other Specialized Environments

Many of the specialized nanomanufacturing processes are energy hogs due to demanding process requirements such as ultrahigh vacuums or high temperatures that can reach 1,000° C or more. Although deposition times during thin film production are actually quite short, deposition chambers have to be ramped up as long as 24 hours prior to deposition.

Use of or Generation of Greenhouse Gases

"Greenhouse gases emanate from two general sources: those generated upstream of nanostructure manufacturing (many processes have significant energy requirements, often in the form of high and/or prolonged heat), and those that are a direct result of manufacturing processes, such as the PFCs used for cleaning deposition chambers and as dry etching gases."

The authors conclude that, from an examination of the attributes of existing nanomanufacturing processes, a number of efficiency and toxicity problems exist and they will need to be addressed as the field matures. What cannot be answered fully yet is whether nanotechnology manufacturing processes are more or less sustainable than 'conventional' industrial methods because life cycle comparisons have not been done yet.

It also might be appropriate to look at the "Twelve Principles of Green Chemistry" that the U.S. Environmental Protection Agency has posted on its "Green Chemistry" website. Green chemistry, also known as sustainable chemistry, is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. The 12 principles can be fully applied to nanomanufacturing processes:

1. **Prevent waste:** Design chemical syntheses to prevent waste, leaving no waste to treat or clean up.

2. **Design safer chemicals and products:** Design chemical products to be fully effective, yet have little or no toxicity.

3. **Design less hazardous chemical syntheses:** Design syntheses to use and generate substances with little or no toxicity to humans and the environment.

4. **Use renewable feedstocks:** Use raw materials and feedstocks that are renewable rather than depleting. Renewable feedstocks are often made from agricultural products or are the wastes of other processes; depleting feedstocks are made from fossil fuels (petroleum, natural gas, or coal) or are mined.

5. **Use catalysts, not stoichiometric reagents:** Minimize waste by using catalytic reactions. Catalysts are used in small amounts and can carry out a single reaction many times. They are preferable to stoichiometric reagents, which are used in excess and work only once.

6. **Avoid chemical derivatives:** Avoid using blocking or protecting groups or any temporary modifications if possible. Derivatives use additional reagents and generate waste.

7. **Maximize atom economy:** Design syntheses so that

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the final product contains the maximum proportion of the starting materials. There should be few, if any, wasted atoms.

8. Use safer solvents and reaction conditions: Avoid using solvents, separation agents, or other auxiliary chemicals. If these chemicals are necessary, use innocuous chemicals.

9. Increase energy efficiency: Run chemical reactions at ambient temperature and pressure whenever possible.

10. Design chemicals and products to degrade after use: Design chemical products to break down to innocuous substances after use so that they do not accumulate in the environment.

11. Analyze in real time to prevent pollution: Include in-process real-time monitoring and control during syntheses to minimize or eliminate the formation of byproducts.

12. Minimize the potential for accidents: Design chemicals and their forms (solid, liquid, or gas) to minimize the potential for chemical accidents including explosions, fires. and releases to the environment.

Risk—Benefit Dichotomy...

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observed both as clear contraction of the cell plasma membranes in fluorescent measurements as well as directly in cell viability assays that provide information on the metabolism of cells.

Basically, the study tried to answer two questions: 1) can fullerenes discharged into the environment be solubilized by some naturally abundant compounds (answer: yes), and 2) what are the possible biological effects of such fullerene-solubilizing agent aggregates (answer: apart from the observed contraction of cell membranes, mostly unknown).

One area the scientists are already working on is studies to determine the effects of fullerene-gallic acid aggregates on cell plasma membranes, in order to provide an explanation for the cell death observed here.

The particularly pressing question how fullerenes solubilized by gallic acid can enter the food chain and eventually interact with animal cells, remains unanswered, although Ke's group has already carried out experimental work on this topic and also with other carbon nanomaterials and with other solubilizing agents.

Notwithstanding the potential negative effects, this research shows that gallic acid seems to be a very good compound for rendering fullerenes water soluble.

Salonen says that it should be noted that the cell lines which were exposed to fullerene-gallic acid aggregates in this study were human tumor cells (HT-29 cell line). "But while it sounds very promising that fullerene-gallic acid aggregates were so effective in killing tumor cells, we still have no idea whether these nano aggregates could also induce similar effects with healthy animal cells and bacteria" he says.

Salonen and his collaborators point out that the fact that gallic acid is such an efficient solubilizing agent of fullerenes raises an important question: Since gallic acid shares structural similarity with many components of natural organic matter (NOM) — a heterogeneous distribution of organic compounds found in soil and natural waters — it is valid to ask whether different chemical species in NOM can solubilize carbon nanomaterials as well. If so, what are the implications for environmental transport, bioavailability and physiological effects?

"Understanding these effects in all of their complexity is a daunting task for future research" says Salonen. "Only by understanding the fate of nanomaterials in biological organisms and in the environment can we guarantee a safe and transparent development of nanotechnology."

Upcoming Events
Looking At The Risky Side Of Nano

Nanotechnology and the law: The legal nitty-gritty for nano foods, nanocosmetics and nanomedicine
December 8-9, 2008, Leuven (Belgium)
A three-day seminar dealing with regulatory and legal aspects of nanotechnologies in food, cosmetics and medicine.

Nanomedicine Conference 2009
January 25-28, 2009, Bolans Village (Antigua and Barbados)
The conference will address progress and prospects for nanomedicine and nanotoxicology including, drug delivery, imaging and diagnostics, cancer, tissue engineering, interactions of nanomaterials with living tissue, and nanotoxicology.

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.

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.

European Commission Sees No Regulatory Void On Nanotechnology

While knowledge gaps remain regarding the potential risks of nanotechnologies, the European Commission again expressed confidence that existing EU regulation can be applied to this emerging sector, stressing that the challenge ahead lies in their implementation.

"We are not in a regulatory void," said Cornelis Brekelmans, an official in charge of regulatory aspects of nanotechnology at the European Commission.

Speaking at a conference on 2 October, Brekelmans said this was because EU rules impose a risk assessment on all products, adding that nanomaterials were no exception to this obligation.

"We may decide not to authorize a product," the official warned during the “Second Annual Nanotechnology Safety for Success” external dialogue workshop in Brussels. Depending on the outcome of such assessments, the authorities may review, modify or cancel authorizations, he explained.

According to the Commission official, "the real issue is implementation and enforcement". The basis on which a product can be banned must be better identified, he added, calling for enforcement capacities at national level to be strengthened in this respect.

The Commission, he said, remains "convinced that a lot of work still has to be done" on testing, standards and guidelines, while product authorizations must be conducted "on a case-by-case basis".

Positions

However, the European consumer organization (BEUC) argued that the EU's current approach was "not sufficient" due to a lack of clarity over how general safety requirements are to be applied to nanomaterials. The organization is also worried that regulatory measures might fail in member states due to the huge volume of work.

Cornelis Brekelmans, an official in charge of regulatory aspects of nanotechnology at the European Commission retorted that the absence of specific regulation on nanomaterial was "not really important," describing EU rules on product approvals as "technology neutral". If a specific regulation needed to be modified every time there was a new technology, it would mean we had failed, the official pointed out.

According to Brekelmans, EU regulations are "technology neutral and can cope with new developments". But this does not exclude the possibility of "specific rules on some things" and "we have to keep up-to-date with scientific information," he said, adding that if authorities find new evidence on something, "they might have to go back to what was already agreed upon".

As for the labeling of nanotech-based products, Brekelmans said current rules stated that if there was a risk, it should be indicated. "Whether we want to introduce a labeling on nano as such is a different issue," he said.

Brekelmans's view was challenged by Greens/EFA Group political advisor Axel Singhofen. Arguing that "the reality is not quite how you present it," Singhofen asked whether the Commission was ready to accept a shift to pre-market authorization for nanomaterials. This would mean that their safety would have to be proven before they could enter the market. However, Brekelmans said he did not believe that prior authorization was "the best way forward".

Laura Degallaix from BEUC gave a societal perspective on the issue, arguing that "applications coming to the market are often developed without much transparency despite limited understanding of the potential effects".

She outlined a number of points that BEUC hoped the Commission would take into account on nanotech regulation:

- Use every opportunity to update existing legislation (cf. reviews of cosmetics directive and novel foods).
- Introduce definitions for nanoparticles, refraining from limiting the size to 100 nm, for example.
- Allow changes to definitions at later stage.
- Seek international agreements for nanotech regulation.
- Apply the precautionary principle approach.
- Urge industry to produce data.
- Introduce strict and effective pre-market assessment and authorization processes.
- Consider nanoparticles as a "new" substances under EU rules.
- Ensure adequacy and harmonization of safety evaluation methodologies.
- Introduce post-market monitoring systems to assess efforts in the long term.
- Ensure transparent information and public engagement.

As for engaging the larger public, Degallaix said "communication on vague conceptions of nanotechnology will not be successful. Instead, adequate, understandable information on specific applications is needed".

Next steps

2008: The Commission and EU agencies will start to review existing documents that support implementation of the various directives with regard to their applicability and appropriateness to nanomaterials.

2009: The Commission will publish a second implementation report on nanotechnology.

2011: The Commission will issue a progress report on the implementation of existing regulations on nanomaterials.

Background

Industry is increasingly using nanotechnology in sectors such as healthcare (medicine), consumer products (food, electronics and cosmetics), information technology and the environment. However, a lack of knowledge and understanding of the health and environmental risks associated with nanomaterials highlights the need for more regulation of the sector.

According to the Commission's recent regulatory review on the issue, the current EU legislative framework "covers in principle the potential health, safety and environmental risks in relation to nanomaterials". The Communication on regulatory aspects of nanomaterials is covered under current EU laws on chemicals, consumer products and the environment.

In Short – Papers, Initiatives & Updates

STUDY: Removing high-polluting vehicles could reduce nanoparticle pollution by up to 48%

A study undertaken by researchers from the University of Alcalá (UAH) shows that if the "super-polluters", the high-polluting vehicles, such as certain buses and lorries in a poor condition, were removed, pollution from nanoparticles could be reduced by up to 25% and 48%, depending on the parameter analysed. These minute particles cause serious health problems. *DOI: 10.1016/j.atmosenv.2007.05.021*

FORUM: Intergovernmental Forum on Chemical Safety addresses nanotechnology

Every three years, exponents from policy, government, regulation, science, industry and public interest associations meet in order to discuss questions of chemical safety at the Intergovernmental Forum on Chemical Safety (IFCS) . This year's IFCS forum took place in Dakar, Senegal, from 15-19 of September, with participants from all over the world. Besides issues more specifically related to conventional chemicals, the forum also adopted the "Dakar Statement on Manufactured Nanomaterials", which includes ten general statements defining a common basis, and a list of 21 specific recommendations addressed to the participating governments, and the other organisations participating. Current activities and scientific data were presented at the forum. As a result, it was proposed that a precautionary approach should be applied to manage these risks. It was stated that the development of appropriate and effective regulatory standards is not able to keep pace with the rapid development of nanotechnologies. The insurance industry has recognized that where there is uncertainty about inherent, novel hazards of nanomaterials, a proactive and precautionary approach is needed on a case-by-case basis, for the purpose of comprehensive risk appraisals and regulatory adaptations. The full Forum report is available online (pdf download, 368 KB).

INITIATIVE: Russia introduces NANOCERTIFICA, its own nanotechnology certification system

The start of NANOCERTIFICA, the Russian Federation's first certification system for industrial nanotechnology production, was declared at a press conference on October 22, 2008 in Moscow. The Certification system is aimed at solving of the Corporation key tasks in the sphere of protection, standardization, certification and metrological provision of the nanoindustry. A system of voluntary certification will create a positive perception of nanoindustry products and their manufacturers on both foreign and domestic markets.

PAPER: Transport of Single-Walled Carbon Nanotubes in Porous Media: Filtration Mechanisms and Reversibility

Deposition of nanomaterials onto surfaces is a key process governing their transport, fate, and reactivity in aquatic systems. This report evaluats the transport and deposition behavior of carboxyl functionalized single-walled carbon nanotubes (SWNTs) in a well-defined porous medium composed of clean quartz sand over a range of solution chemistries. The results show that increasing solution ionic strength or addition of calcium ions result in increased SWNT deposition (filtration). *DOI: 10.1021/es801641v*

REPORT: Test reveals nanoparticles present in 80% of sunscreens, even when companies claim they are not

Consumers Union, nonprofit publisher of Consumer Reports, today released new product tests showing that 4 out of 5 sunscreens that claimed not to contain nanoparticles actually do contain them. Consumers Union urged the FDA to require a full safety assessment, stating that the nanoparticles appear widespread in mineral-based sunscreens and are difficult to avoid in these products. Sunscreen manufacturers use nano-size particles of these ingredients because they help make the products clear rather than opaque, something consumers may prefer. Tests Consumer Reports commissioned to an outside lab, released in 2007, found that 8 out of 8 sunscreens that included zinc oxide or titanium dioxide contained nanoparticles. Only one disclosed this fact on the label; the others said nothing about whether they contained the particles. A copy of the article can be found online on CU's website.

RESOURCE: Int.'l Council on Nanotechnology launches tool for EHS database analysis

Researchers can now do their own analysis of research on the risks of nanomaterials with a new tool unveiled today at the website of the International Council on Nanotechnology (ICON). The database analysis tool can be found at http://icon.rice.edu/report.cfm. The ICON EHS Database Analysis Tool offers a way for researchers at universities, nongovernmental organizations, government and industry worldwide to analyze ICON's database of citations to peer-reviewed publications addressing nanomaterials' environmental, health and safety impacts. The tool enables research comparisons, with every database entry assigned nine indices and each index including a trend across time.

PAPER: Fullerene Water Suspension Exerts Antibacterial Effects via ROS-Independent Protein Oxidation

Buckminsterfullerene can form water suspensions (nC60) that exert toxic effects. While reactive oxygen species (ROS) generation has been implicated as the mechanism for mammalian cytotoxicity, scientists propose that nC60 exerts ROS-independent oxidative stress in bacteria, with evidence of protein oxidation, changes in cell membrane potential, and interruption of cellular respiration. *DOI: 10.1021/es801869m*

FORUM: Food safety implications of nanotechnology on agenda of World Health Organization and FAO

The Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) have planned to convene a joint Expert Meeting which aims to identify knowledge gaps including issues on food safety, review current risk assessment procedures, consequently support further food safety research and develop global guidance on adequate and accurate methodologies to assess potential food safety risks that may arise from nanoparticles. Call for Experts and Call for Information are available here (pdf download, 60 KB).

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nano*RISK*

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

Optimizing The Benefits Of Nanotechnology While Minimizing And Controlling The Risks

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

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