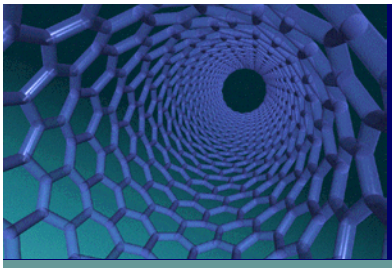

Gradient CORPORATION
EH&S Nano News

Volume 2, No. 02 www.ehsnanonews.com February 2007

Editor: Barbara D. Beck, Ph.D., DABT
Dr. Beck directs Gradient's nanotechnology, toxicology, and risk assessment practices.

In This Issue

Recent Government Briefs

(NANOFORUMEULA) Over the next year and a half, the EU will be funding collaboration between European and Latin American nanotech researchers. This new project, known as Nano Forum EU Latin America, was initiated in order to include Latin American researchers in international nanotech R&D efforts. Two workshops and 'fact finding missions' in Mexico and Brazil are currently being planned. Visit: http://www.malsch.demon.nl/nanoforumeulastarts051206.htm

(ISO TC-229) In early January, the International Organization for Standardization's Technical Committee 229 on Nanotechnologies (ISO TC-229) announced that it has identified over 100 projects it plans to work on, with certain key topics receiving priority. The committee is comprised of 28 member countries and is generally aimed at standardizing various aspects of nanotechnology, including classification, nomenclature, calibration, and certification. In the January presentation at a public meeting held by the National Nanotechnology Initiative, a member of the group said that one of the most pressing needs is to develop standards to rapidly screen nanomaterials for their impact on human and environmental health. Longer-term priorities were also set for the following few years and the immediate next step is for proposal development of the short-term goals.

Visit: http://www.iso.org/iso/en/stdsdevelopment/tc/tclist/TechnicalCommitteeDetailPage.TechnicalCommitteeDetail?COMMID=5932

Press Release: http://www.nano.gov/html/news/EHS_Pub_Mtg_1_8_07.html

Reports, Reviews, White Papers, and Books

Nanotechnology: Don't Delay Liability Risk Assessments and Solutions

By George J. Mannina, Jr.; Washington Legal Foundation
http://www.wlf.org/upload/120806lbmannina.pdf

In this article published by the Washington Legal Foundation, Mr. Mannina, an attorney with O'Connor & Hannan LLP, calls for the development of a Nanotechnology Insurance Fund ("NIF"). The author begins the article by comparing the excitement around nanotech to that of asbestos and PCBs when these materials were first introduced. The key difference is that it was not until asbestos and PCBs had been used for years that health concerns arose—or were even considered. The author says that although there is great potential for nanomaterials and products, recent studies at least suggest cause for concern around human and environmental health risks of nanomaterials. It is in this context that the author proposes the NIF, with two key purposes: to provide compensation for injury to consumers or workers, and to pay for any necessary environmental clean-up. However, a recent commentary on this article in the Nanotechnology Law Report calls this proposal premature, laying out multiple points of contention with such a plan, and instead asserts that individual manufacturers must be responsible for the potential EH&S impacts of their products.

Upcoming Meetings and Conferences

NanoTech Insight

Luxor, Egypt, March 10-17, 2007
http://www.nanoinsight.net/in/07/view/index/index.cfm

With reports on cutting edge developments in nanotech and an emphasis on networking, this conference in Luxor is relevant for all in the field of nano: from ethicists and investors to biologists, chemists, and those in technology transfer. The meeting's program is wide-ranging, with sessions on topics such as environmental risks/benefits, fabrication, medical applications, and renewable energy. However, the underlying focus is on international involvement and dialogue in order to develop nanotech in a sustainable way—bridging the gap between the industrial and developing worlds.

International Symposium on Nanotechnology in Environmental Protection and Pollution (ISNEPP) 2007

Fort Lauderdale, Florida, Dec. 10-12, 2007
http://www.isnepp.org/ISNEPP07/front1.htm
This conference is about nanotechnology in the context of environmental protection and remediation, public health, energy resources and production, and standards and regulation. Recent research developments, as well as outstanding data and research needs, will be highlighted and discussed in the symposia, round tables, and panel sessions. The program is still in the planning stages, but the abstract submission deadline is not far off (May 10).

Hot-off-the-Presses Peer-Reviewed Research Articles of Note

Warheit *et al.*, 2007. "Pulmonary bioassay studies with nanoscale and fine-quartz particles in rats: Toxicity is not dependent upon particle size but on surface characteristics" Toxicological Sciences 95(1): 270-280.

Abstract: http://toxsci.oxfordjournals.org/cgi/content/abstract/95/1/270

Synopsis:

- In general, pulmonary toxicity studies in rats have shown that nano-sized particles are more toxic than chemically similar fine-sized particles. Attention has also focused on surface area as playing a significant role in the toxicity of nanoparticles. However, Warheit and colleagues explain that no studies of this sort have looked at cytotoxic particles—previous studies on pulmonary inflammation and nanoparticles have instead always evaluated low solubility/low toxicity particles. The authors therefore sought to evaluate the role of particle size, surface area, and surface activity of α-quartz particles of various sizes.
- Two bioassays were conducted, each with five rats per group per dose per time point (24 h, 1 week, 1 month, 3 months); all α-quartz particles used were analyzed for average particle size, size range, surface area measurements, crystal structure, and purity. In the first experiment, bronchoalveolar lavage (BAL) was used to evaluate the pulmonary inflammatory and cytotoxic effects of intratracheally instilled nanoquartz (50 nm) *vs.* Min-U-Sil (534 nm), a standard reference α-quartz particle.
- In the second experiment, BAL and lung tissue evaluations were compared for animals intratracheally instilled with 1 or 5 mg/kg of either carbonyl iron (CI) particles (negative control), nanoquartz (12 nm), Min-U-Sil (534 nm), or fine-quartz particles (300nm) (four additional rats per group were added to the low and high dose groups—per time point and for the first two time points, respectively).
- Briefly, the results included the following: CI particles and PBS solution (vehicle) yielded short-term, reversible lung inflammation, likely due to the instillation procedure; exposures to all α-quartz particles, regardless of size, resulted in significant pulmonary inflammation and cytotoxicity (via BAL fluid and cell proliferation measurements) and foamy macrophage accumulation and fibrosis (via histopathology); the different types of α-quartz particles did, however, yield varying degrees of pulmonary effects that did not correlate to particle size.
- The authors explain that "the toxicity range of lung inflammation/cytotoxicity/cell proliferation and histopathological response were, in descending order, nanoscale quartz II [12nm] = Min-U-Sil quartz [534 nm] > fine quartz [300 nm] > nanoscale quartz I [50nm] > CI particles." Although the effects were qualitatively similar, they had different potencies. Importantly, the toxicity range of the particles were directly correlated with the hemolytic potential of the particles (as measured by hemoglobin supernatant concentrations of human red blood cells treated with the various α-quartz particles), suggesting the surface activity of the particles dictates pulmonary toxicity.

Implications:

- This study is in direct contrast with earlier studies that have attributed pulmonary toxicity to particle size or surface area. While all of the α-quartz particles caused continuing inflammation and adverse effects in the lungs of the exposed rats, the surface activity of the particles, as measured by *in vitro* RBC hemolysis experiments, was associated with the potency of the toxicity.
- The authors explain that their findings are in agreement with an earlier study by Clouter *et al.* (2001), which showed that hemolytic activity was the best *in vitro* predictor of *in vivo* activity of standard experimental quartz particles.
- Nanotech researchers and toxicologists are actively seeking *in vitro* screening techniques that can predict nanoparticles toxicity—the results of this hemolytic study are likely to play a key role in the planning of future studies in this field.

Phenrat *et al.*, 2007. "Aggregation and sedimentation of aqueous nanoscale zerovalent iron dispersions" Environmental Science and Technology 41(1): 284-290.

Abstract: http://pubs.acs.org/cgi-bin/abstract.cgi/esthag/2007/41/i01/abs/es061349a.html

Synopsis:

- Nanoscale zerovalent iron (NZVI) is highly efficient and effective at dechlorinating chlorinated organics (*e.g.*, remediation of TCE-contaminated groundwater) and immobilizing heavy metals in groundwater (*e.g.*, arsenic). Field demonstrations and bench-top experiments have yielded exciting results relevant to *in situ* groundwater remediation, but aggregation of the particles—to sizes on the micrometer scale—has been shown to cause limited mobility—and therefore decreased efficacy—of the NZVI. The magnetic properties of NZVI are thought to contribute

to aggregation as well as gelation, the formation of fractal networks by chain-like aggregates of NZVI. In turn, gelation is thought to contribute to the sedimentation of NZVI, which will further decrease the mobility of the NZVI.

- Commercially available reactive nanoscale iron particles (RNIP; average diameter of 40 nm) were used in this study, as well as magnetite and hematite as comparison materials for the experiments that evaluated the role magnetic forces play in aggregation. Phenrat and colleagues investigated the aggregation of the nanoparticles via dynamic light scattering and used optical microscopy and sedimentation measurements to analyze the size of the fractals that ultimately formed.
- The authors found that NZVI aggregates in two phases. First, micrometer-sized aggregates are formed, and then those aggregates that formed in the first 20-30 minutes link together to form chains; sedimentation then occurs quickly. As particle concentration and saturation magnetization ("the maximum intrinsic magnetic moment") increased, the rate of aggregation also increased.

Implications:

- Several studies have been published over the last couple of years have been focused on various 'additives' that might be used to prevent aggregation during groundwater remediation employing NZVI. This study emphasizes the need for work in this field if NZVI is to be used to any extent in environmental remediation.
- Phenrat and colleagues note that it may be more appropriate to consider aggregate size when estimating mobility of NZVI. Further, efforts should be made to find ways to decrease the magnetization of the NZVI particles since that property also plays a role in maintaining dispersed NZVI.
- This study ultimately adds to the growing literature on the use of NZVI in groundwater remediation which continues to demonstrate that although the application is promising, substantial optimization of the technique is still required.

Guest Contributor

Nanotechnology and the Public Sphere

Michael D. Mehta, Ph.D

"Nanotechnology" is a word that has come a long way in the past few years. Until recently most people associated nanotechnology with science fiction-based accounts which tended to focus on fantastical devices and applications. Due to recent developments in nanoscience (*e.g.*, greater control over atomic structure and relatively better predictability of nano-scale properties), nanotechnology has entered the commercial realm, and has simultaneously begun the journey of finding its space within the social imaginary.

To become a mature and sustainable technology, nanotechnology must have general support by users of nano-based products and by the public at-large. Since much of the early discussion on nanotechnology focuses on how to frame benefits and control risks, it is important to examine the social and ethical impacts of nanotechnology, and the specific challenges arising from the use of this suite of technologies in medicine, industrial processes and products, and food.

As in the case of previous technologies, nanotechnology is outpacing our collective ability to understand and direct its course (Hunt and Mehta, 2006). If we consider developments in nuclear technology, information technology, and biotechnology, there appears to be a fairly consistent pattern of development, use, social concern, regulation, and ultimately some form of resolution. All modern technologies, and perhaps even non-modern ones, move through such a series of stages. This said, it is worth noting that not all technologies survive these transitions. Some technologies like civilian nuclear power (especially in the United States, Canada, and the UK) and agricultural biotechnology (so-called GM foods) stall in their tracks, and represent case-studies for people in business schools on the topic of commercial failure. With nanotechnology, much is at stake. Since nanotechnology crosses over into so many disciplines, potential and actual business ventures, and is converging strongly with biotechnology in particular, a range of challenges and opportunities emerge.

Scientists have opened up the "black box" of nanotechnology, and as a result have unleashed a transformative (or disruptive) suite of technologies on the world. Nanotechnology is disruptive in so far as it puts pressure on other products or processes to re-align themselves around its introduction. More importantly, nanotechnology is transformative in the sense that it has the potential, at least in theory, to transform social relations, labor, international economies, and to affect a range of institutions. When we opened up this black box, we ushered in a "nanotechnological" way of seeing the world (Milburn, 2002). Consequently, the very existence of nanotechnology plays a role in shaping how we understand the fundamental nature of matter and ultimately affects how we re-design our regulatory, legal, social, and ethical frameworks.

It is crucial to recognize that the success or failure of nanotechnology is contingent on the degree of support it receives from the public. This support can be nurtured by a thorough discussion of the risks and benefits, by encouraging the development of an appropriately constituted regulatory system that can deal with issues like convergence and novelty, and by fostering an environment that seeks public input early and often (Mehta, 2005). In short, nanotechnology has moved from the laboratories of the world into the public sphere. Its future depends heavily on how it, and its proponents, navigate and negotiate the world of the social.

References

Geoffrey Hunt and Michael Mehta (eds) (2006)
Nanotechnology: Risk, Ethics and Law. London: Earthscan.

Michael Mehta (2005)
"Regulating biotechnology and nanotechnology in Canada: A post-normal science approach for inclusion of the fourth helix." International Journal of Contemporary Sociology. 42(1): 107-120.

Colin Milburn (2002)
"Nanotechnology in the age of posthuman engineering: Science fiction as science." Configurations, 10: 261-295.

Michael D. Mehta, Ph.D, is Professor of Sociology at the Univesity of Saskatchewan (Canada). His website is www.policynut.com.

Anouncement

The *Journal of Industrial Ecology* is currently accepting article submissions for their upcoming issue on industrial ecology and nanotechnology. The deadline for submission is March 1, 2007; further detail can be found at : http://www.yale.edu/jie/cfpnano.htm.

Coming Next Month

- Findings of cellular toxicity of carbon-based nanomaterials
- Applying expert judgment to the health risk assessment of nanoparticles

Publication Staff

Editorial

Barbara D. Beck, Ph.D., DABT
Christopher M. Long, Sc.D.
Noelle M. Cocoros, M.P.H.

Production

Melissa Motta
Elizabeth Allen
Ruth Buchman

Contact Us:

Gradient Corporation
20 University Rd
Cambridge, MA 02138

t: 617.395.5000
f: 617.395.5001

email: ehsnanonews@gradientcorp.com
website: www.gradientcorp.com

Gradient
CORPORATION

Science and Strategies for Safe Environments
www.gradientcorp.com