GRADIENT | EH&S NANO NEWS

Volume 11, No. 2 • Summer 2016

In This Issue

RECENT GOVERNMENT BRIEFS

NIOSH Not Issuing New Recommended Exposure Limit for Nanosilver

Based on the comments it received on the draft document "Health Effects of Occupational Exposure to Silver Nanomaterials," the National Institute for Occupational Safety and Health (NIOSH) has decided it will not issue a specific recommended exposure limit (REL) for occupational exposures to nanosilver, due to insufficient data. According to the January 21, 2016, *Federal Register* notice, this document "contains a review and assessment of the currently available scientific literature on the toxicological effects of exposure to silver nanoparticles in experimental animal and cellular systems, and on the occupational exposures to silver dust and fume and the associated health effects." The comment period for the document ended on April 22, 2016.

Industry groups generally supported NIOSH's decision to not set a separate REL for nanosilver, because, according to the Silver Nanotechnology Working Group (SNWG), "nanoscale silver is not significantly different from conventional silver, and… nanosilver has a long record of safe use and regulatory oversight" (Reynolds, 2016). Industry groups also reiterated their support for using risk management practices to ensure that worker exposures do not exceed the current REL for all forms of silver.

Public health groups emphasized the need to strengthen the document's language. They also wanted the United States Environmental Protection Agency (US EPA) and the Food and Drug Administration (FDA) to require companies to submit data on worker exposures to nanosilver before products containing nanosilver are allowed into the marketplace. These groups also supported implementing controls to mitigate exposures (*e.g.*, eliminating exposure to nanosilver or using less-hazardous substances) and recommended that companies be required to submit safety data on potential risks to workers (*e.g.*, liver and lung effects). Specifically, these groups noted the need to address women's exposures to nanosilver (*e.g.*, for reproductive endpoints), because most occupational studies of this substance have focused on men.

Link to the Risk Policy Report, by Reynolds:
http://insideepa.com/risk-policy-report/niosh-forgoes-novel-limit-nanosilver-citing-insufficient-risk-data

The docket, including comments and supporting documentation, can be accessed here:
https://www.regulations.gov/#!docketDetail;D=CDC-2016-0001

NIOSH Releases Guide to Protect Nanotechnology Workforce

In March 2016, NIOSH released a document titled "Building a Safety Program to Protect the Nanotechnology Workforce: A Guide for Small to Medium-Sized Enterprises." The purpose of this guide is to provide business owners "with the tools necessary to develop and implement a written health and safety program to protect" their employees. The guide focuses on "considering and managing the potential, unintended consequences to human health and the environment that might accompany development and use of the technology." It outlines issues and strategies related to risk minimization, risk management, occupational hazards and controls, and federal and international regulations and compliance, among others.

The guide can be accessed here:
http://www.cdc.gov/niosh/docs/2016-102/pdfs/2016-102.pdf

Industry Calls for a Narrowed TSCA Reporting Rule

Industry representatives have repeated their call for US EPA to clarify and narrow the scope of its proposed Toxic Substances Control Act (TSCA) Section 8(a) reporting rule for nanoscale materials, which was published in the Federal Register on April 6, 2015. The Rule would require a one-time submission of data on a chemical's properties, as well as "require that companies that intend to manufacture reportable substances after the rule takes effect report to the agency at least 135 days before commencing manufacturing." Industry officials are urging US EPA to drop the future reporting requirement, "arguing the agency is exceeding its TSCA authority and has failed to justify certain provisions" (Reynolds, 2016). In a March 16, 2016, letter to US EPA, the NanoManufacturing Association contended that the current Proposed Rule would lead to "duplicative reporting" on existing products and delays in the commercialization of new products. US EPA intends to issue the final rule by October 2016.

Link to the Risk Policy Report, by Reynolds:
http://insideepa.com/daily-news/industry-reiterates-call-narrow-nano-rule-epa-seeks-further-clarity

US EPA's Proposed Rule can be accessed here:
https://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPPT-2010-0572

The April 6, 2015 Federal Register notice can be accessed here:
https://www.gpo.gov/fdsys/pkg/FR-2015-04-06/pdf/2015-07497.pdf

The letter from the NanoManufacturing Association can be accessed here:
http://insideepa.com/sites/insideepa.com/files/documents/mar2016/epa2016_0657a.pdf

US EPA's Spring 2016 Regulatory Agenda item can be viewed here:
http://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201604&RIN=2070-AJ54

US EPA Files Answering Brief in Response to Environmental Group Petitions

On March 8, 2016, US EPA filed an Answering Brief in response to petitions filed by the Natural Resources Defense Council, the Center for Food Safety, and the International Center for Technology Assessment. The groups' suit, on which we reported in our **spring issue**, objects to US EPA's approval of a conditional registration for NSPW-L30SS (formerly Nanosilva), a nanosilver antimicrobial/pesticide product. In its Answering Brief, US EPA argued that "it properly determined that Nanosilva had insufficient time to generate data," because the agency "imposed new data requirements on Nanosilva simultaneously with its grant of NSPW-L30SS's registration." US EPA further argued that the use of NSPW-L30SS nanosilver would reduce the environmental silver load, because the product is applied at much lower rates than conventional silver (also used in antimicrobial/pesticidal applications), has low mobility once applied, and leaches silver from the treated material "into the environment at levels below what measuring instruments can detect." US EPA also noted that the petitioners are not challenging US EPA's finding that the use of NSPW-L30SS "will not cause unreasonable adverse effects." US EPA has asked the court to deny the environmental groups' petitions.

Read more at:
http://nanotech.lawbc.com/2016/03/epa-defends-conditional-nanosilver-registration

US EPA's Answering Brief can be accessed here:
http://nanotech.lawbc.com/wp-content/uploads/sites/539/2016/03/00178682.pdf

Harmonization of Environmental Safety and Health Terminology

Different stakeholders, such as the scientific community, international bodies and government agencies, and industry groups, use different nano-related environmental health and safety terms. Because of this, NANoREG, a project under the European Union's 7th Framework Programme, decided to harmonize these terms. The Joint Research Centre (JRC), the European Commission's science and knowledge service, published "NANoREG Harmonised Terminology for Environmental Health and Safety Assessment of Nanomaterials" on April 12, 2016. This report is the result of the project's "attempt at bringing common understanding and consistency in the use of key terms in the environmental health and safety (EHS) assessment of nanomaterials." Specifically, all project partners have agreed upon the terminology they will use in their activi-

ties and documents. The report describes the methodology used to select the 43 key terms and their supporting definitions, as well as the information sources used.

The NANoREG report can be accessed here:
http://publications.jrc.ec.europa.eu/repository/bitstream/JRC100906/jrc%20technical%20report-nanoreg%20terminology%20ehs%20assessement%20nms.pdf

Nanoparticles Found in Baby Formula

In May 2016, the Friends of the Earth (FOE), an environmental non-profit group, released a document titled "Nanoparticles in Baby Formula: Tiny New Ingredients Are a Big Concern" that reports on detections of hydroxyapatite nanoparticles (nano-HA) in samples of popular brands of baby formula. Arizona State University, which FOE commissioned to analyze the formulas, also found possible nano-titanium dioxide (TiO_2) and nano-silicon dioxide (SiO_2) in the formulas, in addition to needle-like and non-needle–like nano-HA. HA is a naturally occurring mineral and is a source of calcium, which was likely why it was added to the baby formulas. Nano-HA has been used in various applications, such as a filler to replace amputated bone, as a coating for hip replacements, and in toothpastes (for repairing tooth enamel). However, FOE expressed concern about a wide range of potential health effects associated with the needle-like form of nano-HA. Because the European Union Scientific Committee on Consumer Safety determined that needle-like nano-HA should not be used in cosmetics, due to its potential toxicity, and because the intended use of the formula is for infants, FOE has called for additional regulation of baby formulas and for a recall of formulas containing nanomaterials.

The FOE report can be accessed here:
http://webiva-downton.s3.amazonaws.com/877/eb/2/8482/FOE_NanoBabyFormulaReport_13.pdf

The Arizona State University (Tempe) report can be accessed here:
http://webiva-downton.s3.amazonaws.com/877/90/d/8141/ASU_FOE_Baby_Formula_Report_May_4_2016_FINAL.pdf

OECD Issues New Publications in Its Safety of Manufactured Nanomaterials Series

In late 2015 and early 2016, the Organisation for Economic Co-operation and Development (OECD) released six additional papers (Nos. 62 through 67) in its Safety of Manufactured Nanomaterials series.

Considerations for Using Dissolution as a Function of Surface Chemistry to Evaluate Environmental Behaviour of Nanomaterials in Risk Assessment (No. 62). Because there are no standardized test methods for evaluating the dissolution of nanomaterials in various environmental and biological media, this project's purpose was to "identify an approach to help guide current regulatory environmental risk assessments when evaluating dissolution information using the current state-of-the-science; and extend, as far as possible using our current understanding from silver nanoparticles (the case-study) to other metal-based nanoparticles." The approach described in the report classifies dissolution values as high, moderate, low, or negligible, using nanosilver as a case study.

Physical-Chemical Parameters: Measurements and Methods Relevant for the Regulation of Nanomaterials (No. 63). This report summarizes a meeting of the Working Party on Manufactured Nanomaterials (WPMN), which assembled to discuss the applicability of the OECD Test Guidelines on the physicochemical properties of manufactured nanomaterials. The WPMN issued several recommendations, including developing a decision tree for particle size and guidance on various nanomaterial chemical-/structural-based categories.

Approaches on Nano Grouping/Equivalence/Read-Across Concepts Based on Physical-Chemical Properties (GERA-PC) for Regulatory Regimes (No. 64). This report summarizes the "information obtained from a questionnaire survey on approaches to develop or use concepts of grouping, equivalence and read-across based on physical-chemical properties (GERA-PC) of nanomaterials for their human health and ecosystem hazard assessment in regulatory regimes." The questionnaire was divided into three sections related to GERA-PC concepts: present use, research and development activities, and other information (*e.g.*, details, explanations, comments, limitations, and challenges). The report concluded that "[a]ll of the respondents believed that future regulatory regimes need to employ GERA-PC concepts for hazard assessment of nanomaterials but many of them pointed out that they were facing scientific, technical and implementation challenges for realising their positive prospects."

Physical-Chemical Properties of Nanomaterials: Evaluation of Methods Applied in the OECD-WPMN Testing Programme (No. 65). This report describes an initial detailed evaluation of the applicability of test methods that can be used, either alone or in conjunction with other applicable tests, to evaluate the physicochemical properties of different

types of nanomaterials. This evaluation was "prompted by the essential need for an adequate and complete characterisation of nanomaterials to enable a further evaluation of their (toxicological) properties." Table 2 of the report summarizes the methods that were determined to be suitable for evaluating the physicochemical properties of nanomaterials. The report authors recommend identifying reference materials from which to develop and validate standard test methods.

Categorisation of Manufactured Nanomaterials Workshop Report (No. 66). This report summarizes the work done in an OECD expert meeting convened "to develop and define categorisation of nanomaterials." The experts proposed grouping schemes for manufactured nanomaterials, which are similar to the categorization schemes used to assess chemicals. According to the report, "[t]he categorisation scheme would take into consideration the chemical composition and shape and properties such as surface charge of the chemicals. A categorisation scheme needs to be able to be used within a regulatory scheme."

Developments in Delegations on the Safety of Manufactured Nanomaterials – Tour de Table (No. 67). This report compiles information on current developments in the safety of manufactured nanomaterials collected during and after the November 2015 meeting of the WPMN. It provides background information on activities related to manufactured nanomaterials and other nanotechnology-related activities at the international level. Participating delegations included Australia, Austria, Belgium, Canada, Germany, Japan, Korea, The Netherlands, Switzerland, Turkey, the United Kingdom, the US, the European Commission, and other organizations.

The OECD Safety of Manufactured Nanomaterials series papers described above can be accessed here:

No. 62:
http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2015)44&doclanguage=en

No. 63:
http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2016)2&doclanguage=en

No. 64:
http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2016)3&doclanguage=en

No. 65:
http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2016)7&doclanguage=en

No. 66:
http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2016)9&doclanguage=en

No. 67:
http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono%282016%2911&doclanguage=en

Guidance on Hazard Assessment for Nanoforms

The European Chemicals Agency (ECHA), the Dutch National Institute for Public Health and the Environment (RIVM), and the Joint Research Centre (JRC) recently published a new guidance document, titled "Usage of (Eco)toxicological Data for Bridging Data Gaps Between and Grouping of Nanoforms of the Same Substance – Elements to Consider." Nanoforms fulfill the European Commission's definition of nanomaterials, meaning "a natural, incidental or manufactured material containing particles … [with] one or more external dimensions in the size range of 1 nm – 100nm." Several distinct nanoforms may share the same chemical identity, but differ in other relevant physical/chemical properties (*e.g.*, surface modification, size distribution, and particle shape). The document aims "to consolidate existing information and develop approaches that a registrant can use to scientifically justify that certain (eco)toxicological studies undertaken on one nanoform of a substance (or the non-nanoform) can be used to predict the hazard properties of (an)other form(s) of the same substance." This guidance is intended to outline how stakeholders can perform a hazard assessment of more than one nanoform of the same substance while minimizing the testing (*e.g.*, on animals), and therefore costs, yet still protecting human and environmental health. The approaches described in the guidance document are similar to those used in other Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) approaches that employ the grouping of substances and read-across between substances to fill data gaps.

The guidance document can be accessed here:
http://echa.europa.eu/documents/10162/13630/eco_toxicological_for_bridging_grouping_nanoforms_en.pdf

DEPA Publishes Additional Nanomaterial Document

The Danish Environmental Protection Agency (DEPA) recently released a new document that addresses environmental and human health risk assessment (HHRA) of nanomaterials: "Assessment of Nano-enabled Technologies in Cosmetics." The report represents "the culmination of a comprehensive review of the available literature on nano-enabled technologies for cosmetic products, specifically addressing soluble nano-transporters." After describing the methodology it used, DEPA summarizes the use of nano-transporters in different types of cosmetics and evaluates the evidence for dermal absorption/penetration of nano-transporters and the dermal toxicity of nano-transporters. The report is accompanied by a database that summarizes the supporting literature.

The DEPA report can be accessed here:
http://www2.mst.dk/Udgiv/publications/2016/01/978-87-93435-25-4.pdf

The accompanying database can be downloaded here:
http://mst.dk/service/publikationer/publikationsarkiv/2016/feb/assessment-of-nano-enabled-technologies-in-cosmetics

RIVM Describes Computer Program for Risk Assessment of Nanomaterials in Cosmetics

RIVM recently published a document titled, "Description of a NanoCosmetics Tool for Risk Assessment," which describes a computer program that could be developed for performing risk assessments of nanomaterials in cosmetics. The electronic tool would contain information on the physicochemical characterization of nanomaterials in cosmetics, estimate consumer exposure to and possible toxicity and hazards of nanomaterials, and present a risk assessment. For cases in which there are limited data on the nanomaterials in question, default values would be used, resulting in conservative outcomes. The document concludes that the "development of a risk assessment tool for cosmetic ingredients and products is feasible, although several challenges remain especially with regard to the foreseen lack of data."

This report can be accessed here:
http://www.rivm.nl/dsresource?objectid=rivmp:303296&type=org&disposition=inline&ns_nc=1

OECD: Urgent Research Needed to Assess Risks from Nanomaterials in the Waste Stream

In a February 22, 2016, press release, OECD asserted its belief that "[u]rgent research is needed to assess the possible risks to human health and ecosystems from the ever-increasing amounts of engineered nanomaterials (ENMs) going into household waste and ending up in the environment." This assertion is more thoroughly described in "Nanomaterials in Waste Streams: Current Knowledge on Risks and Impacts," also published by OECD on February 22 of this year. The report surveys the literature on waste treatment processes (*e.g.*, recycling, incineration, landfilling, wastewater treatment), providing a state-of-knowledge analysis of the fate and potential impacts of ENMs in these processes. According to the report, because landfill sites, incinerators, and wastewater treatment facilities are not designed to filter out nano-sized particles, ENMs are entering the environment *via* sewage sludge used as agricultural fertilizer as well as *via* sewage plant effluent that flows into water bodies. The report concludes that knowledge gaps remain for nanomaterials in waste streams, and, thus, additional research on this subject is needed.

Link to the OECD press release:
http://www.oecd.org/environment/urgent-research-needed-into-risks-from-nanomaterials-in-household-waste.htm

The associated report can be downloaded here:
http://www.oecd.org/environment/waste/nanomaterials-in-waste-streams-9789264249752-en.htm

HOT-OFF-THE-PRESSES: PEER-REVIEWED RESEARCH ARTICLES OF NOTE

Exposure

Eastlake, AC; Beaucham, C; Martinez, KF; Dahm, MM; Sparks, C; Hodson, LL; Geraci, CL. 2016. "Refinement of the Nanoparticle Emission Assessment Technique into the Nanomaterial Exposure Assessment Technique (NEAT 2.0)." *J. Occup. Environ. Hyg.* doi: 10.1080/15459624.2016.1167278.

This article presents an update to the Nanoparticle Emission Assessment Technique (NEAT), which was developed by researchers at NIOSH for investigating ENM emissions and airborne exposure levels at workplaces manufacturing, using, and handling ENMs. Termed "NEAT 2.0," this refined methodology builds upon NEAT to provide a more comprehensive approach for assessing worker and workplace exposures to ENMs. In contrast to the original NEAT methodology, which was heavily focused on characterizing ENM emission sources using direct-reading instrumentation, NEAT 2.0 incorporates additional time-integrated exposure sampling to allow for quantitative assessment of workers' personal breathing zone exposures (full shift and task-specific), including respirable fraction samples for comparison with existing NIOSH RELs (which are currently available for TiO_2 and carbon nanotubes) and open-faced filter samples for microscopic analysis. NEAT 2.0 continues to rely on portable direct-reading instruments (DRIs, *e.g.*, condensation particle counters, laser photometers) to supplement the data from time-integrated samplers, now recommending that DRIs be used in data-logging mode to allow for the identification of workplace tasks or practices that contribute to short-term peak mass or particle number concentrations of ENMs. NEAT 2.0 also calls for more robust background data collection, including the collection of real-time and time-integrated background data during the entire sampling period, to characterize background fluctuations and identify short-term elevations in particle mass or number concentrations that are due to other background sources rather than ENM-generating activities. NIOSH has already applied NEAT 2.0 at a variety of facilities that deal with different types of ENM, including for a published study of exposures to metal oxide nanoparticles at a semiconductor fabrication facility.

http://www.ncbi.nlm.nih.gov/pubmed/27027845

Hazard Screening

Wiemann, M; Vennemann, A; Sauer, MG; Wiench, K; Ma-Hock, L; Landsiedel, R. 2015. "An *in vitro* alveolar macrophage assay for predicting the short-term inhalation toxicity of nanomaterials." *J. Nanobiotechnology* 14:16. doi: 10.1186/s12951-016-0164-2.

A recent article by Wiemann *et al.* reported on the authors' development of a standardized *in vitro* assay that is suitable to use for routine regulatory testing of ENM inhalation toxicity. Data collected from such an *in vitro* screening assay would determine whether *in vivo* testing would be necessary for hazard assessment. The proposed *in vitro* assay utilizes a monoculture of alveolar macrophages derived from rat lung lavages, which are cells known to play a central role in the initial contact and clearance of ENMs deposited in the lungs following inhalation exposure. The assay includes the following endpoints:

- Lactate dehydrogenase (LDH), indicating membrane disruption (*i.e.*, cytotoxicity)
- β-glucuronidase (GLU), indicating macrophage activation and/or membrane damage
- Tumor necrosis factor-alpha (TNF-α), indicating a pro-inflammatory response
- Hydrogen peroxide (H_2O_2), indicating oxidative stress

Eighteen inorganic ENMs, including metal oxides and sulfates with and without surface functionalization (boehmite [ALOOH], barium sulfate [$BaSO_4$], cerium[IV] oxide [CeO_2, four variations], iron[III] oxide [Fe_2O_3], titanium dioxide [TiO_2], zinc oxide [ZnO], SiO_2 [six variations], and zirconium dioxide [ZrO_2, two variations]), graphene nanoplatelets, and two nano-sized organic pigments were all evaluated (20 test materials in total). Non-nano–sized aluminum oxide (Al_2O_3) and quartz DQ12 were tested as negative and positive benchmark controls, respectively.

The proposed *in vitro* assay was assessed for its ability to classify the test materials as either "active" (*i.e.,* bioactive) or "passive." (*i.e.,* relatively inert). The authors established a classification system based on a threshold lowest observed adverse effect concentration (LOAEC) in units of particle surface area per unit volume of exposure media applied to cells (6,000 mm^2/mL). ENMs exhibiting a LOAEC <6,000 mm^2/mL for at least two of the four endpoints were classified as "active," while particles with a LOAEC ≥6,000 mm^2/mL for at least three endpoints were classified as "passive." Based on the *in vitro* assay results, 10 test materials were classified as "active" – TiO_2, ZnO, CeO_2, Al-doped CeO_2, CeO_2 NM-211, CeO_2 NM-212, SiO_2-naked, SiO_2 NM-200, SiO_2 NM-203, and Pigment Blue 15:1. The remaining 10 materials were classified as "passive" – SiO_2-polyethylene glycol (PEG), SiO_2-amino, SiO_2-phosphate, AlOOH, $BaSO_4$, Fe_3O_3, ZrO_2–3,6,9-trioxadecanoic acid, ZrO_2-acrylate, Diketopyrrolopyrrole Orange N, and graphene nanoplatelets. The *in vitro* assay classifications were then compared to previously published classifications of these test materials based on *in vivo* short-term inhalation studies (STISs) with the same test materials. Nineteen of the twenty classifications were in agreement with those based on the *in vivo* STISs (Pigment Blue 15:1 was classified as "active" and "passive" by the *in vitro* and *in vivo* studies, respectively). Based on these comparisons, the *in vitro* assay demonstrated a specificity of 91% (true negatives), a sensitivity of 100% (true positives), and an overall accuracy of 95%.

The concordance between the *in vitro* and *in vivo* results suggests that this assay may be a useful tool for preliminary hazard

screening. However, there are a few limitations of the *in vitro* assay the authors propose; more research will be necessary to validate and standardize the assay. For example, the authors did not account for the impact of variability in particle settling rates on the accuracy of the LOAECs. Specifically, for SiO_2-amino and SiO_2-phosphate, the authors noted that "relevant proportions had not sedimented within 16 h [sic] and hence could not be taken up by the AMs [alveolar macrophages]." Accounting for the dose actually delivered to cells would reduce the LOAECs of these materials and could potentially change their classifications from "passive" to "active." These revised classifications would conflict with their "passive" classification based on the *in vivo* data and would reduce the overall accuracy of the *in vitro* assay from 95% to 85%. Furthermore, the authors note that the selected threshold LOAEC value of 6,000 mm^2/mL was derived from the value of 4,000 μm^3/cell, and state that this value is conservative, considering that it produced no false negative results. However, no further justification is provided for this threshold value. In spite of these limitations, this study demonstrates that there is relatively high concordance between the results of the authors' proposed *in vitro* assay and the *in vivo* results for a wide range of materials, and lays significant groundwork towards establishing an *in vitro* screening assay suitable for regulatory testing.

http://www.ncbi.nlm.nih.gov/pubmed/26944705

Toxicology

Labib, S; Williams, A; Yauk, CL; Nikota, JK; Wallin, H; Vogel, U; Halappanava, S. 2016. "Nano-risk science: Application of toxicogenomics in an adverse outcome pathway framework for risk assessment of multi-walled carbon nanotubes." *Part. Fibre. Toxicol.* 13:15. doi: 10.1186/s12989-016-0125-9.

Given the wide array of nanoparticles currently in use that lack sufficient hazard data, the application of high throughput, *in vitro* approaches for nanoparticle hazard characterization is desirable. Towards this end, Labib *et al.* used a toxicogenomic approach, in the framework of an adverse outcome pathway (AOP) for lung fibrosis, to derive benchmark doses (BMDs) for three different multi-walled carbon nanotubes (MWCNTs). These BMDs were then compared to a BMD for lung fibrosis based on an HHRA for MWCNTs conducted by NIOSH. For the toxicogenomic approach, mechanistic information regarding MWCNT-induced lung fibrosis, along with gene transcription data for mouse lungs exposed to MWCNTs, was organized in an AOP for lung fibrosis. The AOP consisted of a molecular initiating event (MIE), involving the initiation of pathways signaling tissue damage (*e.g.*, the toll-like receptor signaling pathway), five key events (KEs), and the apical outcome (AO), *i.e.*, lung fibrosis. The KEs, comprised of perturbed biological pathways involved in the progression from the MIE to the AO, were: KE1 – acute phase response/induction of inflammatory cytokines; KE2 – persistent inflammation due to "frustrated phagocytosis," with acute inflammation progressing to chronic inflammation; KE3 – activation of T helper (Th) 2 type cells, involving the release of macrophage-activating cytokines, and secretion of metalloproteinase inhibitors that impair remodeling/reabsorption of the extracellular matrix (ECM); KE4 – fibroblast/myofibroblast proliferation and loss of integrity of the alveolar capillary membrane; KE5 – excessive deposition of the ECM. Labib *et al.* found that the BMDs for KE3, which was considered to be the "point of no return" at which effects are irreversible, were comparable among the three different MWCNTs, and also comparable to the BMD based on the NIOSH HHRA for lung fibrosis. This study thus demonstrates that transcriptional data can be used to inform hazard assessments of MWCNTs in the absence of data for apical endpoints. Nonetheless, this type of approach requires validation using larger datasets of gene transcription for nanomaterials with diverse properties tested in different species at multiple exposure doses and post-exposure time points.

http://www.ncbi.nlm.nih.gov/pubmed/26979667

International Conference & Exhibition on Advanced & Nano Materials (ICANM 2016)

August 1-3, 2016
Montreal, Canada
http://icanm2016.iaemm.com/

The International Conference & Exhibition on Advanced & Nano Materials is to be held from August 1 to August 3 in Montreal, Canada. The main objective of this conference is to explore the innovations and latest accomplishments in the areas of advanced materials and nanomaterials, focusing on their processing and the latest developments in the field. Attendees will be able to network with some of the world's leading scientists. Presentation and poster sessions will cover a wide range of topics, such as nanomaterials and nanotechnology, the applications of nanomaterials, nanonuclear materials, and novel nanomanufacturing methods.

11th International Conference on the Environmental Effects of Nanoparticles and Nanomaterials (ICEENN)

August 14-18, 2016
Colorado School of Mines, Golden, Colorado
http://igwmc.mines.edu/ICEENN2016.html
The Integrated GroundWater Modeling Center (IGWMC) of the Colorado School of Mines invites researchers, regulators, and industry leaders to the 11th International Conference on the Environmental Effects of Nanoparticles and Nanomaterials (ICEENN). There will be presentation and poster sessions focusing on topics such as advancements in nanomaterial analysis methods, surface chemistry of nanomaterials in complex matrices, *in vivo* and *in vitro* toxicology of nanomaterials, and applications of nanomaterials in health and the environment. A two-day preconference workshop will be offered in which attendees can get hands-on experience in data collection and processing while working with industry and academic experts.

11th International Conference and Expo on Nanoscience and Molecular Nanotechnology

October 20-22, 2016
Rome, Italy
http://nanotechnology.omicsgroup.com/
Conference Series LLC invites participants across the globe to attend the 11th International Conference and Expo on Nanoscience and Molecular Nanotechnology in Rome, Italy. This year's theme – Taking Nanotechnology to New Heights Through Innovation and Collaboration – provides 20 different tracks. This conference is intended for nanotechnology researchers, manufacturers, entrepreneurs, and venture capitalists, as well as government officials who are interested in the development of the nanotechnology industry. Poster sessions and presentations will cover a broad spectrum of topics, such as nanofabrication, industrial nanotechnology, nanocomputational modeling, and nanobiotechnology.

5th Sustainable Nanotechnology Organization Conference

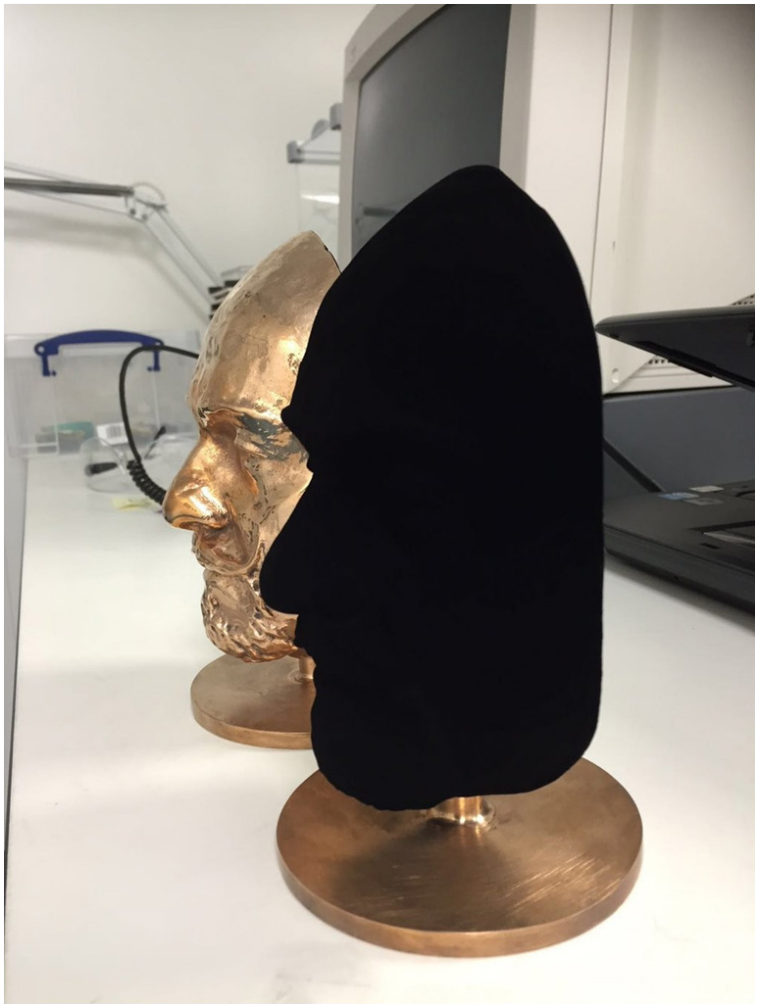
November 10-12, 2016
Orlando, Florida
http://www.susnano.org/SNO2016/conferenceOverview2016.html
The 2016 Sustainable Nanotechnology Organization (SNO) Conference will host a series of sessions organized around selected "systems" within which nanotechnology currently plays or has the potential to play a significant role (*e.g.*, air-water systems, energy systems, food agricultural systems, *etc.*). Scientists and researchers from across the globe will present on the applications and implications of nanotechnology across the respective life cycles of each system. Posters and presentations will aim to identify ways that nanotechnology can improve the sustainability of each system, highlight recent advancements in analytical methods and instrumentation, and integrate knowledge regarding the applications and environmental health and safety implications of nanotechnology.

Painting a Black Hole – Nano-Enhanced Super-Black Sprayable Paint Absorbs 99.8% of Light

Super-black coatings are used for a variety of light-sensitive applications. For example, a super-black surface can efficiently absorb stray radiation inside high-powered telescopes, reducing the amount of noise and increasing the telescopes' range and resolution. In 2014, Surrey NanoSystems released Vantablack, a super-black coating comprised of vertically aligned carbon nanotubes capable of absorbing 99.965% of light. The closely packed carbon nanotubes are extremely absorbent to most forms of radiation. Light photons striking the coating enter the tiny spaces between the vertically aligned nanotubes. The light is then rapidly absorbed as it "bounces" from tube to tube, and very little is able to actually escape from the surface. Vantablack reflects so little light that 3D objects appear to be 2D voids when coated with the product, creating a visual effect almost like one is staring into a black hole. As initially released, Vantablack requires a vapor deposition process in order to fully coat a surface. However, Surry NanoSystems has released a sprayable version, known as Vantablack S-VIS, which is capable of absorbing 99.8% of visible, ultraviolet, and infrared light. The application process requires several pre- and post-application steps to ensure high levels of adsorption, and the product is not as simple to apply as a typical spray paint, is heat-sensitive, and cannot withstand temperatures

greater than 100°C. However, the new sprayable form enables coating of larger and more complex objects. Interested parties can contact Surrey NanoSystems about having objects coated or about licensing the technology.

More information is available here:
https://www.surreynanosystems.com



Vantablack S-VIS Coating on a Three-Dimensional Sculpture of a Face. *Photo courtesy of Surrey NanoSystems.*

PUBLICATION STAFF

Editorial

Barbara D. Beck, Ph.D., DABT, FATS
Joel M. Cohen, Sc.D.
Anna Engel
Christopher M. Long, Sc.D., DABT
Mara Seeley, Ph.D., DABT
Laura E. Smith

Production

Aaron Bazzle
Lisa Edwards
Bethany Vasecka