

108.14 A case study on risk evaluation of printed electronics using nanosilver ink

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With the ever-increasing development of nanotechnology, our society is being surrounded by possible risks related to exposure to manufactured nanomaterials. The consumer market already includes many products that contain silver nanoparticles (AgNPs), including various household products, such as yoga mats, cutting boards, running shirts, and socks. Plus, there is a growing concern over the release of AgNPs in workplaces related to the manufacture and application of nanomaterials. Therefore, this study investigated the release of AgNPs during the operation of a printed electronics printer. Using an exposure simulation chamber, a nanoparticle collector, SMPS (scanning mobility particle sizer), CPC (condensation particle counter), dust monitor, and MCE (mixed cellulose esters) filters are all connected to measure the AgNP exposure levels when operating a printed electronics printer. As a result, a very small amount of AgNPs was released during the operation of the printed electronics printer, plus the number of AgNPs inside the exposure simulation chamber was lower than that outside. Plus, when evaluating the potential risks for consumers and workers using a margin of exposure (MOE) approach and target MOE of 1000, the operational results far exceeded the target MOE in this simulation study and in a previous workplace exposure study. Therefore, the overall results indicate a no-risk concern level in the case of printed electronics using nanosilver ink.

108.15 Evaluation of darkfield microscopy and hyperspectral imaging for analysis of airborne carbon nanotubes captured from occupational settings

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Current best-known methods for engineered nanomaterial (ENM) exposure assessment in occupational environments include the capture of airborne ENMs onto filter media. The standard method for the detection of ENMs captured onto filter media is direct visualization via transmission electron microscopy (TEM) for particle sizing, count, and morphology, coupled with compositional analysis, typically by energy-dispersive spectroscopy (EDS). This method is low-throughput, expensive, and time- and resource-intensive. Enhanced darkfield microscopy (EDFM) with hyperspectral imaging (HSI) analysis is being evaluated as a high-throughput screening technique to rapidly identify filter media samples that contain ENMs of interest that may then move on for further, more intensive TEM/EDS analysis. Building upon a preliminary study lead by NIOSH, we are further exploring the use of EDFM/HSI for the rapid visualization and identification of carbon nanotubes (CNTs) captured on mixed cellulose ester (MCE) filter media. We will compare the protocol we develop for EDFM/HSI of CNTs on MCE filter media to conventional TEM methods for accuracy, reliability, and precision of this new screening method. Future directions include expanding the EDFM/HSI protocol to other ENMs and to polycarbonate (PC) filter media samples.

108.16 Information resources for exposure assessment of engineered nanomaterials

M. D. Hoover

Nanoinformatics is the science and practice of determining which information is relevant to meeting the objectives of the nanoscale science and engineering community; and then developing and implementing effective mechanisms for collecting, validating, storing, sharing, analyzing, modeling, and applying that information; and then confirming that appropriate decisions were made and that desired mission outcomes were achieved as a result of that information; and finally conveying experience to the broader community, contributing to generalized knowledge, and updating standards and training. In our roles as information customers, creators, curators, and analysts, this definition should guide our collaborations to effectively assess and manage exposures to engineered nanomaterials. Key questions include: Is a hazard

present? Is there exposure to that hazard? What is the resulting risk? How can that risk be managed? and Is the risk management approach achieving the desired protection?

The development of information resources such as the Nanomaterial Registry⁴¹ has required our community to identify nanomaterial characteristics that are both meaningful and measurable and to validate reproducible protocols and practices for collecting information about those characteristics. The identification of key nanomaterial characteristics for exposure assessment is benefiting from a combination of field measurements⁴² to determine what is actually present across the nanomaterial life cycle, as well as laboratory investigations of how materials with those characteristics behave under environmentally, biologically, or industrially relevant conditions.

Collaborations such as the National Nanotechnology Initiative signature initiative on Nanotechnology Knowledge Infrastructure—Enabling National Leadership in Sustainable Design⁴³ are developing unifying concepts such as data-readiness levels and approaches for sharing and ensuring the reproducibility of data and experimental results. Community-based resources such as the GoodNanoGuide⁴⁴ are helping to share information in a manner that is relevant, reliable, and actionable. New generations of sensors will undoubtedly be needed to characterize nanomaterials efficiently and affordably and collaborations on that front are available through the signature initiative on Nanotechnology for Sensors and Sensors for Nanotechnology: Improving and Protecting Health, Safety, and the Environment.⁴³

The extensive list of links to information on the environmental health and toxicology of nanotechnology and human health at sis.nlm.nih.gov/enviro/nanotechnology.html illustrates both our current resources and our opportunities to improve our identification, creation, curation, analysis, and meaningful application of exposure assessment information in support of safe nanomaterial applications.

(The findings and conclusions in this abstract are those of the author and do not necessarily represent those of the National Institute for Occupational Safety and Health.)

108.17 Nanotechnology Knowledge Infrastructure (NKI): Enabling national leadership in sustainable design—Nanotechnology Signature Initiative [246]

S. Lehrman

The knowledge infrastructure has been identified by the Federal agencies participating in the National Nanotechnology Initiative as a focus area that may be more rapidly advanced through enhanced coordination and collaboration as a Nanotechnology Signature Initiative (NSI). The goal of the Nanotechnology Knowledge Infrastructure (NKI) Signature Initiative is to provide a community-based, solutions-oriented knowledge infrastructure to accelerate nanotechnology discovery and innovation. The NKI has four thrust areas that focus efforts on cooperative interdependent development of: (1) a diverse collaborative community; (2) an agile modeling network for multidisciplinary intellectual collaboration that effectively couples experimental basic research, modeling, and applications development; (3) a sustainable cyber-toolbox to enable effective application of models and knowledge to the design of nanomaterials; and (4) a robust digital nanotechnology data and information infrastructure to support effective data sharing, collaboration, and innovation across disciplines and applications. Agencies involved include Consumer Product Safety Commission, Department of Commerce (National Institute of Standards

⁴¹ nanomaterialregistry.org

⁴² e.g., cdc.gov/niosh/topics/nanotech/

⁴³ nano.gov/signatureinitiatives

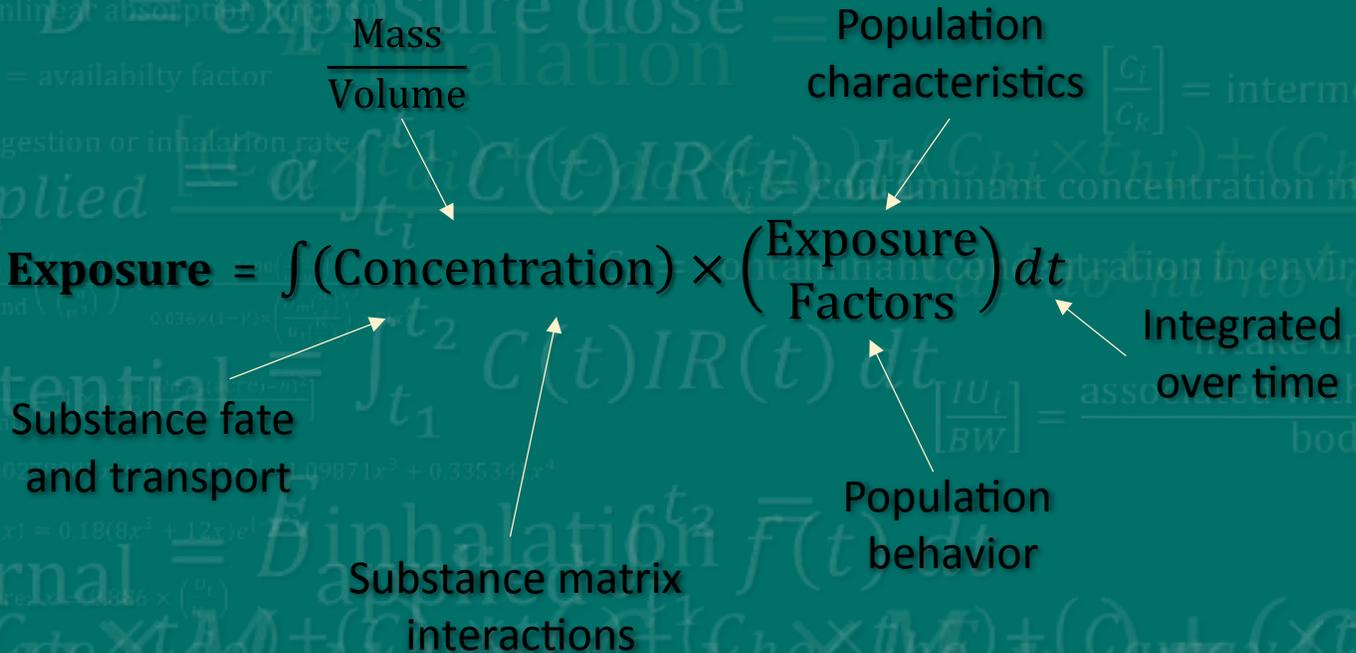
⁴⁴ nanohub.org/groups/gng

Quantifying Exposure to Engineered Nanomaterials (QEEN) from Manufactured Products

Addressing Environmental, Health, and Safety Implications

Workshop Proceedings
July 7–8, 2015

Sponsored by the
Consumer Product Safety Commission
in collaboration with the
National Nanotechnology Initiative



About the National Nanotechnology Initiative

The National Nanotechnology Initiative (NNI) is a U.S. Government research and development (R&D) initiative involving 20 Federal departments, independent agencies, and independent commissions working together toward the shared and challenging vision of a future in which the ability to understand and control matter at the nanoscale leads to a revolution in technology and industry that benefits society. The combined, coordinated efforts of these agencies have accelerated discovery, development, and deployment of nanotechnology to benefit agency missions in service of the broader national interest.

About the Nanoscale Science, Engineering, and Technology Subcommittee

The Nanoscale Science, Engineering, and Technology (NSET) Subcommittee is the interagency body responsible for coordinating, planning, implementing, and reviewing the NNI. NSET is a subcommittee of the Committee on Technology (CoT) of the National Science and Technology Council (NSTC), which is one of the principal means by which the President coordinates science and technology policies across the Federal Government. The National Nanotechnology Coordination Office (NNCO) provides technical and administrative support to the NSET Subcommittee and supports the Subcommittee in the preparation of multiagency planning, budget, and assessment documents, including this report. More information about the NSET Subcommittee, the NNI, and the NNCO can be found at nano.gov.

About the Nanotechnology Environmental and Health Implications Working Group

The NSET Subcommittee and its Nanotechnology Environmental and Health Implications (NEHI) Working Group provide leadership in establishing the NNI environmental, health, and safety (EHS) research agenda and in communicating data and information related to the EHS aspects of nanotechnology between NNI agencies and the public. Through the coordinated activities of the NSET and NEHI participating agencies, the NNI actively supports the development of the new tools and methods required for research that will enable risk analysis and assist in regulatory decision making.

About This Report

This document is the report from a workshop sponsored by the Consumer Product Safety Commission and co-hosted by the NNI that was held on July 7 and 8, 2015. The technical workshop was designed to bring together experts from Federal, regional, State, and local governmental and nongovernmental organizations to provide an assessment of the state of understanding in nanotechnology-related exposure science. The goal of this report is to provide an impactful document that will be useful in planning the future direction of exposure science and nanomaterials environmental, health, and safety research. This workshop is one of a series of technical workshops sponsored by the NSET Subcommittee to inform long-range planning efforts for the NNI and its EHS Research Strategy. This report is not a consensus document but rather a technical report with an aim to assess the state of exposure science and the tools and methods available to characterize and quantify exposure of people and the environment to engineered nanomaterials from manufactured products.

About the Report Cover and Book Design

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