

Human and Environmental Exposure Assessment for Nanomaterials

An Introduction to this Issue

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Determining whether a material or substance poses risk to human health depends on knowing not only the potential toxic characteristics of the material, but also the characteristics of exposure. To what concentrations are workers and general population exposed, for how long, and in what ways? Exposure assessment is particularly vital to answer the question of whether nanomaterials pose work-related health risks. Because of the relative newness of nanotechnology, as well as technical issues regarding metrics, availability of instrumentations, and questions about proprietary information, very little data on exposure to nanomaterials have been reported in the scientific literature. At this stage, measuring or determining risk becomes a little like trying to solve a mystery when major clues are missing. Scientists and engineers face this challenge even as the market for nanotechnology grows, and at the same time, there is increasing demand from diverse parties for guidance to underpin its responsible development.

This Special Issue on Human and Environmental Exposure Assessment for Nanomaterials aims at describing the state of the science in this research area. It originates from presentations and discussions which took place during the US National Nanotechnology Initiative workshop on Human and Environmental Exposure Assessment held on February 24–25, 2009 in Bethesda, MD (<http://www.nano.gov/html/meetings/exposure/index.html>), and aims at providing a peer-

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review platform for papers based on workshop presentations and other submissions from international experts.

Planning for the Human and Environmental Exposure Assessment Workshop began in February 2008 by the interagency Nanotechnology Environmental and Health Implications (NEHI) workgroup. The workgroup operates under the auspices of the US Nanoscale Science, Engineering, and Technology Subcommittee (NSET) and includes the US National Institute for Occupational Safety and Health (NIOSH) as a member. It was established informally in 2003, and formalized in 2005. One of the main tasks of the group was to develop strategy in close consultation with the public. Toward this end, the group released three documents for public review. The first NEHI document, *Environmental, Health, and Safety Research Needs for Engineered Nanoscale Materials* was released in 2006 and provided an evaluation of the science, grouped research into five categories (Instrumentation, Metrology and Analytical Methods; Nanomaterials and Human Health; Nanomaterials and the Environment; Human and Environmental Exposure Assessment; and Risk Management Methods), and described research needs within each category.¹ The second document, *Prioritization of Environmental, Health, and Safety Research Needs For Engineered Nanoscale Materials: An Interim Document For Public Comment*, was released in 2007 to elicit comments from the public, the scientific community, and other stakeholders on the NSET plan for prioritization of environmental health and safety research needs.²

Stakeholder input was incorporated into the third document, *Strategy for Nanotechnology-Related Environmental, Health, and Safety Research* released in 2008.³

The strategy describes an adaptive management approach for interagency efforts addressing the implications of nanotechnology, including identification of priority needs, assessment of existing research, analysis of research strengths and weaknesses, and periodic updates and revision. The strategy includes the provision of information to agencies that conduct and fund research on nanotechnology, informing those agencies

on critical research needs and facilitating collaborative research activities to address them.

The strategy also focuses on the research necessary to conduct risk assessment and risk management of nanomaterials to meet the needs of agencies with regulatory and oversight responsibilities. As the needs of regulators change and as we learn more thorough basic research, the strategy should be updated. Therefore, the interagency group conducts periodic progress reviews and updates research needs and priorities, taking into consideration advances from private sector and international entities. This is accomplished in part through workshops for each of the research categories. The first round of workshops was organized by coordinating agencies and held in 2009 and 2010. In recognition of its leadership in conducting research on exposure assessment, NIOSH is a coordinating agency for the Exposure Assessment research category and played a leading role in organizing the Human and Environmental Exposure Assessment Workshop.

In collaboration with NIOSH, NSET co-sponsored this workshop as part of a national effort to stimulate new research and knowledge in this area. More than 165 scientists and other stakeholders from government, industry, labor and other sectors participated in person. An additional 25 viewers joined from other locations via the web-cast plenary session. The workshop focused on the research needed to characterize exposures to nanomaterials among workers, other populations, and environments by measuring and modeling exposure levels, and by monitoring indicators of biological responses through the product life of a nanomaterial. The objectives of NIOSH, NSET, and other partners were to review the state of the science, identify critical gaps, and inform further development and adaptation of the interagency research strategy as appropriate.

The Human and Environmental Exposure Assessment Workshop was organized around five plenary presentations which provided state-of-the-science overviews for five research needs in the exposure assessment category, including needs for closing critical gaps in information necessary to adequately manage risk of nanomaterials, and for identifying emerging trends. Specifically, five presentations focused on the following research needs:

- *Characterizing exposure among workers;*
- *Identifying population groups and environments exposed to engineered nanoscale materials;*
- *Characterizing exposure to the general population from industrial processes and industrial and consumer products containing nanomaterials;*

- *Characterizing health of exposed populations and environments;*
- *Understanding workplace processes and factors that determine exposure to nanomaterials.*

These presentations served as catalysts for general open-floor discussions by the workshop participants and for discussions during breakout sessions. A number of these presentations are included in this issue; the discussions and summaries of oral presentations will also be captured in a workshop report, which will be published by the interagency group on the Internet (www.nano.gov). All presentation slides and video recording have already been made available on the workshop website (<http://www.nano.gov/html/meetings/exposure/index.html>).

Outputs of the Human and Environmental Exposure Assessment workshop, including this special issue, and outputs of the other interagency workshops, are utilized by the NEHI interagency group to further the development and adaptation of the strategy for nanotechnology safety and health. An updated document is expected to be released by the end of 2010 and will appear on www.nano.gov.

The critical importance of exposure assessment as an integral component of nanomaterial risk assessment and management is widely recognized and is reflected in the interagency strategy through its elevation to the level of research category. I am confident that this issue will make a substantial contribution to the responsible introduction of nanomaterials in manufacturing and commerce by presenting data essential to risk management, by identifying critical research gaps, and by facilitating coordinated efforts to address the gaps.

References

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