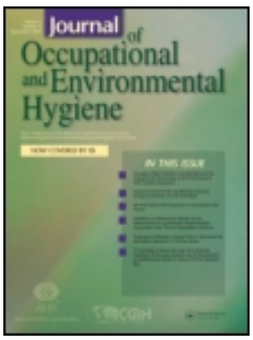

Journal of Occupational and Environmental Hygiene

ISSN: 1545-9624 (Print) 1545-9632 (Online) Journal homepage: http://www.tandfonline.com/loi/uoeh20

The Nanoparticle Information Library (NIL): A Prototype for Linking and Sharing Emerging Data

Arthur L. Miller , Mark D. Hoover , David M. Mitchell & Brian P. Stapleton

To cite this article: Arthur L. Miller , Mark D. Hoover , David M. Mitchell & Brian P. Stapleton (2007) The Nanoparticle Information Library (NIL): A Prototype for Linking and Sharing Emerging Data, Journal of Occupational and Environmental Hygiene, 4:12, D131-D134, DOI: 10.1080/15459620701683947

To link to this article: https://doi.org/10.1080/15459620701683947

Published online: 07 Nov 2007.

Journal of Occupational and Environmental Hygiene, 4: D131–D134
ISSN: 1545-9624 print / 1545-9632 online
DOI: 10.1080/15459620701683947

Commentary
The Nanoparticle Information Library (NIL): A Prototype for Linking and Sharing Emerging Data

Arthur L. Miller,[1] Mark D. Hoover,[2] David M. Mitchell,[3] and Brian P. Stapleton[1]

[1]National Institute for Occupational Safety and Health, Spokane, Washington
[2]National Institute for Occupational Safety and Health, Morgantown, West Virginia
[3]Interactive Consulting, Spokane, Washington

INTRODUCTION

Industrial hygienists and other health protection professionals face significant challenges in understanding and controlling a myriad of potential factors that may influence the toxicity, exposure, and ultimately the health risks of producing, handling, and using engineered nanomaterials. As an early step to foster information exchange and understanding nanoparticles and their properties, the National Institute for Occupational Safety and Health (NIOSH) has created an Internet- based Nanoparticle Information Library (NIL). The NIL supports the NIOSH mission to identify and prevent potential adverse effects from nanoparticles by communicating information about health and safety issues that may be associated with nanoparticle manufacturing, handling, or exposure. The current prototype version of the NIL can be accessed at www.cdc.gov/niosh/topics/nanotech.

As illustrated in a representative view of the NIL homepage (Figure 1), the NIL is part of the broader, Internet-based NIOSH Safety and Health Topic page on nanotechnology. The topic page includes information on NIOSH research for nanotechnology safety and health, as well as documents for public comment such as *Approaches to Safe Nanotechnology: A Dialogue with NIOSH*.

As described in the following paragraphs, the NIL provides an online forum for contributing nanoparticle information; access to profiles of the scientists, engineers, and researchers who have contributed information to the NIL; search capabilities for nanoparticle properties and information; access to health and safety information from complimentary databases; a news and information feature that highlights current NIL progress and future developments; and opportunities to provide constructive feedback and comments.

CONTRIBUTOR SECTION

The contributor section of the NIL homepage provides researchers, developers, nanoparticle manufacturers, and others with the ability to make online submissions of nanoparticle information. Contributors have the option of filling out a professional contact data form and providing particle images, physicochemical properties, and any available toxicology data directly online or contacting the NIL support team for guidance in compiling and submitting their data package. To the fullest extent possible, contributions are based on peer reviewed publications that are either voluntarily submitted by contributors or are solicited from published authors by the NIOSH NIL scientists. Submissions are reviewed by NIOSH NIL scientists prior to posting.

The contributor section also provides NIL users with access to detailed profiles that document the source of each contribution, including information about the primary researchers who are developing the nanoparticles; related publications; address, telephone, and e-mail contact information; and a link or links to contributor-related websites. The full list of contributor profiles can be browsed, a quick search feature can be used to search for specific contributors, and a "Featured Contributor" block highlights a recent or especially active contributor. The intent is to encourage awareness, communication, and collaboration among contributors and users.

SEARCH CAPABILITIES FOR NANOPARTICLE PROPERTIES AND INFORMATION

The basic content of each nanoparticle properties and information profile includes:

- a representative image or images of the nanoparticle (e.g., an atomic force, scanning, or transmission electron micrograph or, in some cases, an illustration);
- primary elemental composition of the nanoparticle (a required selection from a drop-down list of periodic chart elements);
- origin or synthesis method of the nanoparticle (e.g., flame, plasma, etc.);

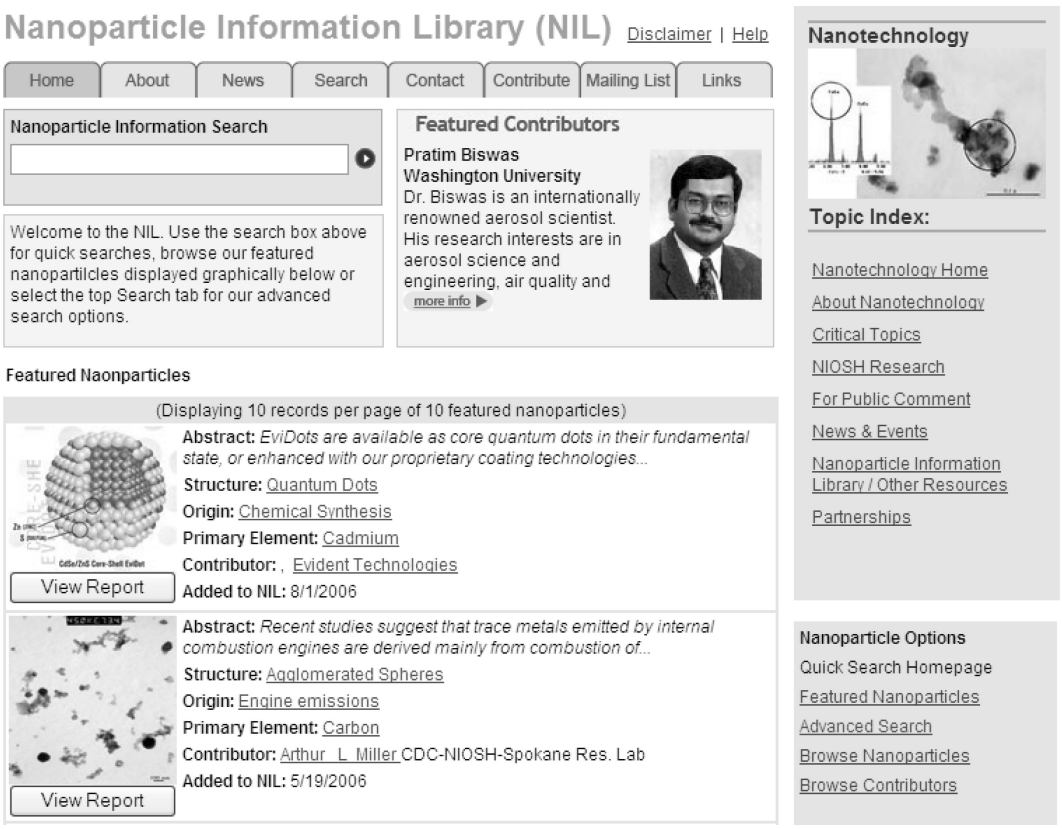

FIGURE 1. Representative snapshot of the Nanoparticle Information Library (NIL) homepage

- information on the physical properties, including properties potentially relevant to occupational safety and health studies, such as size, shape, structure, surface characteristics, and chemical properties;
- research abstracts or summaries;
- contributor information; and
- links to available health and safety information.

HEALTH AND SAFETY INFORMATION

The health and safety feature of the NIL is an initial attempt to provide access to specific information on health and safety issues related to each type of nanoparticle. Because the current availability of nanomaterial-specific information is quite limited, the majority of element- or compound-specific information is associated with studies involving larger particles or bulk materials. However, the body of knowledge from new research is growing rapidly, and the links in this section of the NIL to health and safety information from complimentary databases are also designed to provide users with ready access to a variety of new nanomaterial-specific information. The following sections describe the current main sources of health and safety information made available through links from the NIL.

ICON Environmental, Health and Safety (EHS) Bibliography

The International Council on Nanotechnology (ICON) Environmental, Health and Safety (EHS) database is a searchable bibliographic resource of occupational safety and health publications, documents, grant reports, and journal articles. As noted on the home website of the database at Rice University (http://icon.rice.edu/research.cfm), the database was initially developed by Dr. Tim Borges and Ms. LeeAnn Wilson at Oak Ridge National Laboratory to catalog abstracts and citations for research papers related to the EHS implications of nanoscale materials. Some entries have links to full papers, although site registration or payment may be required to access the full content of other articles directly from the journal publisher. ICON is continually updating the EHS database and has collaborated to provide direct links between the database and the NIL.

Woodrow Wilson Center for Scholars (WWCS) Databases

The Woodrow Wilson Center for Scholars (WWCS) has collaborated with the NIL to provide links between the NIL and databases developed by the WWCS Project on Emerging Nanotechnologies. The WWCS inventory of current research

catalogs global government-funded research into the human health, safety and environmental implications of nanotechnology. As noted on the home website for the WWCS Project (http://nanotechproject.org), the inventory, while not comprehensive, is designed to serve as a resource for researchers, policymakers, and others engaged in ensuring the success of nanotechnologies through understanding and reducing potential risks. The inventory also includes some research projects supported by industry, foundations, and others.

The inventory lists projects, including summaries, duration, funding sources, budgets, and, if available, results. The research is categorized on multiple levels. The first layer of categorization analyzes each research project by its relevance to the implications of nanotechnology, whether the nanomaterials under investigation are intentionally manufactured, incidental, or naturally occurring, and whether the primary focus is on human health, environment, or safety impacts. A second layer of categorization classifies the research according to its focus within a simplified risk analysis framework. Finally, provision is made for a more detailed, third layer of classification according to a range of searchable keywords and phrases.

The WWCS has also built a complimentary database of consumer goods that describes nanotechnology products that are currently available on the consumer market. That database is a dynamic inventory of Internet-available information that includes items that are identified as nano-based by the manufacturer or another source and have nano-based claims for the product that appear reasonable. Hyperlinks are also provided to the manufacturer's website. Consideration is being given to how specific products might be linked to related nanomaterials in the NIL.

The InterNano Online Information Clearinghouse

The InterNano online digital information clearinghouse has been developed by the National Science Foundation's National Nanomanufacturing Network to collect, organize, and distribute information for the benefit of academic, industrial, and government sectors trying to make nanotechnology commercially useful to society. The objective is to provide directories and databases of nanomanufacturing processes and nanostructured materials properties; offer a standardized vocabulary for new materials; provide timely availability of educational materials, workshop reports, and nanomanufacturing events information; facilitate networking and information exchange between nanomanufacturing community members; increase the availability of scientific literature on nanomanufacturing; aggregate publicly available information; and curate collections of material-specific products, including images.

The links between NIL and InterNano are designed to help occupational health professionals understand the manufacturing processes that create specific nanomaterials and to help nanomanufacturing professionals catalog and understand the physical, chemical, and biologically relevant properties of materials created by specific nanomanufacturing processes.

Nanomaterial-Biological Interactions (NBI) Knowledgebase

Researchers from the Environmental Health Sciences Center (EHSC) at Oregon State University and the Safer Nanomaterials and Nanomanufacturing Initiative of the Oregon Nanoscience and Microtechnologies Institute (ONMI) have collaborated with the NIL to provide links between the NIL and the Nanomaterial-Biological Interactions (NBI) knowledgebase.

The NBI was developed by the EHSC and ONMI to function as a data warehouse and data integration/interpretation center for investigations on the biological effects of nanomaterial exposure. Computational models (e.g., scenario-based exposure-to-dose, physiologically based pharmacokinetic/pharmacodynamic, molecular dynamics and structure-activity relationship) included in the NBI knowledgebase provide a framework to conduct species, route, dose and scenario extrapolations. Features of the NBI knowledge base allow for unbiased interpretations of nanoparticle-biological interactions, discovery of unique structural characteristics that govern nanomaterial-biology interactions, identification of the experimental platforms/methods most predictive of nanoparticle-biological interactions, and determination of critical data required to predict effects from nanomaterial exposure.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS (NPG) DATABASE

The *NIOSH Pocket Guide to Chemical Hazards* (NPG) (www.cdc.gov/niosh/npg) is a source of general industrial hygiene information on several hundred chemicals/classes of material for workers, employers, and occupational health professionals. Information found in the NPG is designed to help users recognize and control occupational bulk chemical hazards and does not contain information specific to nanomaterials. The NIL has links to the NPG based on the element(s) or compound(s) in the nanomaterial, as a helpful resource to NIL users. The NPG does not contain an analysis of all pertinent data, rather it presents key information and data in abbreviated or tabular form for chemicals or substance groupings (e.g., cyanides, fluorides, manganese compounds) that are found in the work environment.

REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATABASE

The Registry of Toxic Effects of Chemical Substances (RTECS) (www.cdc.gov/niosh/rtecs) is a compendium of data extracted by NIOSH researchers from the open scientific literature. The data are arranged in alphabetical order by prime chemical name and recorded in a format developed by the RTECS staff. The NIL uses its links to the NIOSH Pocket Guide to access information in RTECS based on the element(s) or compound(s) in the nanomaterial. Six types of toxicity data are included in RTECS: (1) primary irritation, (2) mutagenic effects, (3) reproductive effects, (4) tumorigenic effects, (5) acute toxicity, and (6) other multiple dose toxicity. Specific

numeric toxicity values are noted, as well as the species studied and route of administration used. For each citation, the bibliographic source is listed, thereby enabling the user to access the actual studies cited. RTECS notes that no attempt has been made to evaluate the studies cited and that the user has the responsibility of making such assessments.

OTHER NIL FEATURES

The links section provides convenient access to national and international nanotechnology web resources that collectively provide an expanded knowledge base. The news and information feature highlights NIL developments and provides convenient links to a number of comprehensive national and international sources of current events and advances in nanotechnology. A mailing list feature enables interested users to receive NIL information and updates through periodic email messages. A contact feature allows NIL users to pose questions and provide feedback to the NIL administrators.

FUTURE OPPORTUNITIES

The real-life examples of nanomaterials and their associated origins, properties, and applications in the NIL can support development of a number of needed environmental health and safety tools, training aides, guidelines and standards by:

- providing meaningful examples of the differences in nanomaterial properties that can potentially influence toxicity or the efficacy of control;
- providing practical examples of nanomaterials and nanomaterial-associated properties to illustrate and support proposed or internationally agreed upon terminology and nomenclature, in particular, the terminology and nomenclature development initiatives of the International Standards Organization Technical Committee 229 on Nanotechnologies (www.iso.org);
- supporting the development of technically defensible strategies for grouping nanomaterials into property-based categories for designing and applying controls;
- providing catalogs of comprehensive and cost-effective measurement and assay methods for characterizing, classifying, and conducting exposure assessment for nanomaterials;
- assembling comprehensive suites of reference materials that span the range of nanomaterials actually being used, or likely to be used in commerce, or can respond to specific needs for calibration of instruments or methods or for the conduct of meaningful and intercomparable toxicology studies;
- providing validated examples of effective control technologies for material-specific and process-specific applications; and
- fostering insights and strategies to ensure the adequate anticipation, recognition, evaluation, and control of existing and emerging nanomaterial environmental health and safety risks.

SUMMARY

National and international collaboration on knowledge-management systems such as the NIL are essential to ensuring that health and safety advances can occur in conjunction with technological advances. Every day, scientists and engineers are finding new ways to create and apply particles at the nanoscale for better-performing materials; electronic miniaturization; medical delivery and absorption systems; and innovative approaches to protecting workers, the public, and the environment. Nanotechnology experts, users, and health protection professionals are encouraged to become engaged in sharing and applying our collective knowledge by contributing to the NIL initiative, providing frequent and constructive feedback, and helping to develop and achieve its future opportunities.

ACKNOWLEDGMENTS

This work would not have been possible without the encouragement, support, feedback, and cooperation of many individuals both inside and outside of NIOSH and its Nanotechnology Research Center, including John Howard, Paul Schulte, George Conway, Lani Boldt, Gordon Anderson, Chuck Geraci, Mary Lynn Woebkenberg, Andrew Maynard, Kenneth Linch, Fred Blosser, Max Lum, Aleks Stefaniak, Pratim Biswas, Mike Roco, all of the nanoparticle profile contributors, the interactive database link collaborators including the NIOSH Web Team, Rice University and the International Council on Nanotechnology, Oregon State University, and the Woodrow Wilson Center for Scholars.