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Gail Gallessich

First Comprehensive Survey of Nanotechnology Safety Practices, Conducted by UC Santa Barbara Researchers, Finds Industry Lacks Adequate Information on Safe Handling of Nanomaterials

The first comprehensive, international survey of workplace safety practices in the burgeoning nanotechnology industry finds that many nanotech companies and laboratories believe nanoparticles –– specks of matter that are smaller than living cells –– may pose specific environmental and health risks for workers. The study was carried out by researchers at the University of California, Santa Barbara.

"This is an important study because it reinforces the perspective that there needs to be more information regarding the toxicology of new nanomaterials and how they should be handled in the contexts of industry, consumers and the environment," said Patricia Holden, principal investigator for this project and associate professor at UCSB's Bren School of Environmental Science and Management. Holden co-advised four master's students in this research as part of their group thesis.

"Particles at the nanoscale take on entirely new physical properties, making their potential dangers to humans and the environment mostly unknown," said Holden.

The report, *A Survey of Current Practices in the Nanotechnology Workplace*, is available at http://icon.rice.edu. The survey and report were produced by a research team from UCSB that includes environmental scientists, sociologists, a corporate environmental management expert, and an anthropologist. The work was commissioned by the International Council on Nanotechnology (ICON), a coalition of academic, industrial, governmental and civil society organizations based at Rice University, following a competitive bidding process in which UCSB's proposal was chosen. ICON is administered by Rice University's Center for Biological and Environmental Nanotechnology (CBEN).

"The value of this study is that we brought together knowledge of academic and industry laboratory practices, toxicologic risk assessment, and social science approaches," said study co-principal investigator Barbara Herr Harthorn, who is co-director of the National Science Foundation's Center for Nanotechnology in Society at UCSB. "This allowed us to gather and analyze a unique set of detailed data from around the globe, establishing baseline data for future studies and a first step toward developing safe handling guidelines for nanomaterials."

The study found that companies are reporting that they are developing special programs and procedures for mitigating risks to workers and consumers. Yet, due in part to a lack of general information regarding nanomaterials risks, companies and labs have workers using conventional environmental, health and safety practices (EHS) when handling nanomaterials, even though the practices were developed to deal with bulk materials that can have markedly different chemical properties than their nano-sized counterparts.

"The use of conventional practices for handling nanomaterials appears to stem from a lack of information on the toxicological properties of nanomaterials, as well as nascent regulatory guidance regarding the proper environmental, health and safety practices that should be used with them," said Kristen M. Kulinowski, director of ICON.

Survey data were collected this summer from 64 organizations in North America, the European Union, Asia, and Australia. North American and Japanese respondents each represented 39 percent of those surveyed, with 17 percent from the European Union

and 5 percent from Australia. About 80 percent of responses were from private-sector companies, including for-profit entities that are developing or have developed at least one product containing nanomaterials.

"The National Institute of Occupational Safety and Health (NIOSH) is pleased to see the ICON report, which we will review with great interest in our ongoing efforts to further scientific research and provide interim recommendations on safe approaches to nanotechnology," said NIOSH Director Dr. John Howard. "We appreciate UCSB's partnership, early in their process, in inviting us to participate in the planning and design of the survey. This work will give researchers a better understanding of current work practices in the nanotechnology industry, and valuable insight into current information gaps that might exist in understanding and managing the occupational health implications of this revolutionary technology."

Workers occupy the frontiers of nanotechnology development. Engineered nanomaterials are intentionally designed to take advantage of properties that emerge at the nanoscale, and nanotech workers typically face the greatest exposure risks from engineered nanomaterials. For example, in products containing nanomaterials that are incorporated in a plastic composite or other solid matrix, risks to consumers are believed to be minimal because the materials are locked up tight. But workers who make the products, and who handle the nanomaterials in raw form, face more risk of exposure.

There exists little specific information about the potential harm workers face from most engineered nanomaterials. By attempting to understand how employers and workers are currently approaching the development and implementation of workplace safety practices, ICON and UCSB are taking an important step toward the development and global adoption of best practices to minimize exposure and hazard from engineered nanomaterials.

The survey and report were part of a two-phase project aimed at determining how industry is managing the occupational safety risks that may be posed by certain nanomaterials.

"When ICON began discussing the need for best-practices guidelines for handling nanomaterials, we quickly realized there was little documentation of *existing* workplace policies and practices," Kulinowski said. "It's hard to know where you need to go if you don't know where you are. With only limited anecdotal evidence of

EHS practices available, we decided that a more comprehensive evaluation was needed."

The first-phase report, *Current Knowledge and Practices regarding Environmental Health and Safety in the Nanotechnology Workplace*, was issued last month. It offered a review and analysis of existing efforts to develop "best practices" for workplace safety in the nascent nanotech industry. Today's second-phase report takes a snapshot of industry practices currently in use. Taken together, the two reports provide the first-ever overview of environmental health and safety in the nanotechnology workplace.

"It was a great experience to work with colleagues and students from both natural and social sciences," said Magali Delmas, co-principal investigator and associate professor of corporate environmental management at UCSB's Bren School. "It's a perfect example of the kind of interdisciplinary work we do here at the Bren School and at UCSB. Such collaboration allows us to address cutting-edge questions with the right combination of expertise."

Co-principal investigator Richard Applebaum, professor of sociology and global and international studies and Working Group co-leader in the Center for Nanotechnology in Society at UCSB, commented, "This report is an excellent example of the fruits of collaboration across the ‘cultural divide' that presumably separates social and physical scientists. Such collaborations, unfortunately, are all too rare in academia.

At UCSB's CNS, social scientists are working closely with physical scientists and engineers to address the societal impacts of nanotechnology.

The result is not only the deeper understanding that is reflected in this report, but a generation of young scholars who are far better equipped to hold thoughtful conversations across the divide, thereby contributing to a more enlightened debate over science policy."

ICON issued a call for proposals for the study in late 2005 and awarded the grant to the UCSB team in March. The UCSB team includes Bren School master's students Gina Gerritzen, Keith Killpack, Maria Mircheva and Leia Huang, and sociology doctoral candidate Joe Conti.

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