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Author: Dawson, Natalie G.

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Sweating the Small Stuff: Environmental Risk and Nanotechnology

NATALIE G. DAWSON

Nanoscience, or nanotechnology, is science or technology that creates functional materials from atomic particles. Once considered to be little more than science fiction, nanotechnology is now a well-established field, as evidenced by various new journals and federally funded research programs, as well as myriad new products ranging from industrial materials to cosmetics. According to the Woodrow Wilson Center's Project on Emerging Nanotechnologies (PEN), more than $60 billion in nanorelated products were sold in 2007, and this number could more than double by the end of 2008. Estimates are that by 2014, more than 15 percent of all products on the global market will have some kind of nanotechnology incorporated into their manufacturing process. This technology boom raises an important question: what is being done to address the environmental risks associated with nanotechnology?

As companies, federal laboratories, and international unions call for more research funding for nanotechnology, emerging scientific investigations into the effects of nanorelated materials on the environment and human health reveal potential problems with the new, largely unregulated technology. Anthropogenically manipulated nanoparticles, the basic unit for many advancing technologies, are deemed "more chemically reactive than their ordinary-sized counterparts," according to PEN. Scientists at the University of Florida have identified potential pathways for engineered nanoparticles that carry mercury into natural systems, and a recent review of potential environmental risks associated with emerging nanotechnologies (*Journal of Environmental Monitoring* 10: 291–300, 2008) pointed to the potential bioaccumulation of particles in natural systems via wastewater and runoff. In April, the Department of Defense released a memorandum to its researchers that voiced the agency's concerns regarding nanotechnology, "especially while no current set of standards exists to fully evaluate the environment, safety and occupational health risks." A May 2008 study published in *Nature Nanotechnology* examined carbon nanotubes, one of the first usable nanotechnologies, and found their structure to be similar to that of asbestos—a known carcinogen.

Federal oversight of nanotechnology is minimal. Individual cities, states, and companies within the United States have begun to regulate nanotech operations in the absence of federal oversight. Berkeley, California, now requires all nanotech companies and university laboratories to report how they are dealing with waste products from their activities. California, Massachusettes, and Wisconsin are working to establish voluntary registry programs for organizations that work with nanotechnology. DuPont has teamed with the Environmental Defense Fund to establish standards in nanotechnology that minimize environmental and human health risks. In a recent report dealing with these "bottom-up" approaches, PEN director David Rejeski stated: "In the absence of substantial and timely federal government activity in this area, industry is left without clear guidance and exposed to downstream liabilities and potential public backlash. State and local governments can fill this gap." Many entities hope that such bottom-up approaches will spur more comprehensive federal action and, as the PEN report states, "pave the way for more effective federal oversight."

Federal funding requests for specific research projects to analyze nanotechnology and potential environmental consequences have been sluggish and few. Moreover, some federal funds that were intended for environmental assessments of nanotechnology have been reprogrammed for other programs, according to a Government Accountability Office report.

The Environmental Protection Agency (EPA) is hosting a conference in October to explore international nanotechnology issues as part of a strategic plan developed by EPA's Office of Research and Development, National Center for Environmental Research, and the Ecological Exposure Research Division to "address potential gaps in research and international collaborations," said Nora Savage, the lead in the EPA's internal effort to develop a nanotech research strategy. Although the US Geological Survey (USGS) has individual research projects involving nanotechnology, it has not yet made formal requests to Congress for funding for nanotech risk-assessment research. "But there are many programs interested in these research questions," noted Sarah Gerould, program coordinator for the USGS Contaminant Biology Program, and "unfortunately, many of these programs are seeing funding cuts. Our program has lost about half of its spending power over the last eight years."

In response to these concerns, the National Nanotechnology Initiative (NNI) Amendments Act (HR 5940) was introduced in the House of Representatives in May 2008. The legislation is intended to direct more funding under nanotechnology programs for environmental, health, and safety research, as well as to require regulatory agencies such as the EPA to assist in reviewing and recommending actions regarding nanotechnology. The NNI would receive $1.49 billion for additional research and development in the proposed fiscal 2009 budget, of which $76 million is directed toward environmental, health, and safety research.

Natalie G. Dawson (e-mail: ndawson@unm.edu), a freelance writer, is a doctoral student at the University of New Mexico.

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