

NANOMATERIALS AND PROTECTING HEALTH RISK

The tremendous growth prospects for the development and use of ultra strong, lightweight nanomaterials is both commercially promising and challenging from a regulatory perspective.

Federal health agencies, such as the U.S. Environmental Protection Agency (EPA) and National Institute for Occupational Safety and Health (NIOSH), are charged with protecting the safety of the American public and workers, respectively, and are beginning to take note of the potential health effects of

nanoscale and other ultrafine particles (UFP). This column briefly summarizes these regulatory initiatives.

Are There Health Risks?

Nanomaterials are a broad and diverse class of small-scale materials, generally defined to include particles of less than 100 nanometers (nm). Relatively little is known about how nanomaterials will affect human health and the environment, however, and the federal government is committed to ensuring all health and ecological

risks are defined and abated. The government shares the private sector's view that the ultimate success of nanotechnology is heavily dependant upon the ability to demonstrate that nanomaterials do not pose unreasonable adverse human or ecological effects. This is especially true with credible groups, such as the ETC Group (Action Group on Erosion, Technology and Concentration), calling for the removal from commerce of products that incorporate manufactured nanoparticles, and the banning



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of new products from commercialization "until such time as laboratory protocols and regulatory regimes are in place that take into account the special characteristics of these materials, and until they are shown to be safe."

Almost all of the current, modest body of research relates to naturally occurring UFPs rather than particles produced by nanotechnology. UFPs are ubiquitous in urban areas, in the form of combustion soot, diesel exhaust particles, and

products of gasoline exhaust and industrial processes. Research so far on health effects is limited. Some studies link UFPs with respiratory tract toxicity and indicate that UFPs pose a greater risk of producing an inflammatory response in the lungs than larger particles. These studies show the ability of UFPs to cross the blood-brain barrier, which has the potential to affect adversely the central nervous system. Most recently, on June 1, the American Heart Association issued a statement that exposure to

airborne particulate matter poses an increased risk of death due to heart disease. According to the statement, several studies link a greater incidence of heart disease with exposure to particulate pollution. Some experts say that such UFPs ultimately may present a far more substantial health threat than particulate byproducts of nanotechnology applications.

Regulatory Response

Researchers recommend undertaking inhalation studies to try to discover the operative toxicity mechanisms causing these adverse effects. The federal government agrees, and several federal agencies, including the National Institute for Occupational Safety and Health (NIOSH), the National Toxicology Program (NTP), EPA, and the Food and Drug Administration (FDA), are engaged in such research.

EPA has funded, through its National Center for Environ-

mental Research (NCER) and Science to Achieve Results (STAR), 32 research grants for more than \$11 million in the applications of nanotechnology to protect the environment.

Representative grants include: development of methods of removing toxic contaminants from surface water; new sensors that are more sensitive for measuring pollutants; development of green manufacturing materials; and development of more selective catalysts. EPA also is slated to initiate \$4 mil-

lion in research beginning in fiscal year 2004 to investigate the toxicology of certain manufactured nanomaterials. More information is available at <http://www.epa.gov/ncer>.

NTP

NTP's research focuses specifically on selected nanomaterials. For instance, NTP intends to evaluate in research animals the toxic and carcinogenic potential

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of inhalation exposure to quantum dots (tiny devices that contain a droplet of free electrons) and nanotubes. More information is available at <http://ntp-server.niehs.nih.gov/ntp/htdocs/liason/factsheets/nanoscalefacts.pdf>.

NIOSH

Occupational hazards are also a primary focus of current government concern. NIOSH has staked out nanotechnology as a key research area and is now

developing a National Nanotechnology Research Center to coordinate its research initiatives. NIOSH acknowledges that more research is necessary to understand the effects of exposure to nanoparticles. In 2005, NIOSH is expected to issue Current Intelligence Bulletins (CIBs) on titanium dioxide and nanotechnology.

Another area NIOSH has identified for further study is the potential toxicity of nanoparticles that contact skin. *In vitro*

assays have yielded strong evidence of oxidative stress and the destruction of dermal cell structure. Further research is needed to understand the relationship between nanoparticles and dermal sensitization or irritation. More information is available at <http://www.cdc.gov/niosh/topics/nanotech/>.

The research now underway will shed more light on the toxicity of UFPs and nanoparticles. Companies employing or planning to use nanotechnology should monitor these develop-



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law, chemical product litigation, and associated business issues.

About the Author

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Are we prepared to reap the benefits of this great revolution?

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