Nanoprotections for nanotechnology?

Noreen Parks

Nanotechnology – the development and use of materials whose building blocks measure billionths of a meter – is being hailed as the new industrial revolution. Hundreds of commercial products, from cosmetics and medicines to electronics and automobiles, already contain nanomaterials. Countless other uses, including new cancer therapies, pollution-gobbling compounds, and more efficient solar cells, are on the drawing board. While potential benefits are enormous, cautionary notes are ringing out from many scientists and watchdog groups on the potential risks of this revolutionary class of materials.

On September 25, the National Academy of Sciences (NAS) released its first review of the National Nanotechnology Initiative (NNI), a consortium of 20 federal agencies whose investments in nanotech activities totaled roughly $1.1 billion for 2006. The report concluded that research on environmental, health, and safety (EHS) aspects of nanotechnology – which amounted to only $38.5 million, or 3.7%, of the NNI's budget – is inconclusive to date, and knowledge and data to assess risks incomplete.

The report highlighted two key attributes of nanomaterials that underscore the need for increased research: their particle size allows for inhalation or absorption, and their structures can promote specific biological activities. While this has implications for consumer product safety and the environment at large, NAS review chair Jim Williams, (Ohio State University-Columbus, OH) sees the protection of workers involved in manufacturing nanomaterials as of paramount concern. From the relatively few such studies assessing the toxicity of nanomaterials, there has been evidence of adverse effects on cell cultures and lab animals. In view of such findings, the report deemed it "prudent to employ some precautionary measures" for EHS protections, but, says Williams, there is not enough data to make specific recommendations.

Gaps in regulatory laws and agency powers raise additional concerns. For instance, the 1976 US Toxic Substances Control Act doesn't distinguish between chemicals of identical composition but differing structural properties – a critical factor for nanomaterials. And the US Food and Drug Administration has only limited authority over potentially high-risk products, such as cosmetics.

Andrew Maynard of the Woodrow Wilson International Center for Scholars (Washington, DC) believes that, given the rapid pace of new product introductions, it is critical to formulate the right research questions and implement sound science to find answers. "Many of the potential impacts are hypothetical at the moment", he says, "but clearly we can't treat this as just another class of conventional materials, or we run the risk of missing critically important issues". ■

Chinese fireworks spark pollution controversy

Leslie Bienen

Researchers have studied fireworks' contribution to air pollution in a few cities in the USA, Europe, and India, but only rarely in the fireworks capital of the world, China. Now, Guoshun Zhuang (Fudan University, Shanghai, China) and colleagues have monitored air quality over a 4-day period in Beijing during the lantern festival (*Atmos Environ* in press). In 2006, in response to public pressure, the Chinese Government eased up on an official 13-year ban and allowed fireworks to be set off at certain times and places. In addition to many known pollutants associated with firework detonation, colored fireworks generate ozone, a harmful oxidizing agent.

Says Zhuang, "Fireworks are an essential part of Chinese festivities and were traditionally thought to scare off evil spirits. However, they can increase air and noise pollution and contribute to respiratory diseases, so there's a conflict between health issues and tradition." The researchers found that various fine metals were emitted in very high quantities on festival night, while coarse particle formation of chemicals such as nitrate, sulfate, oxalate, and others, occurred secondarily, after the festival.

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Fireworks, a beautiful source of pollution.

There are two problems to overcome in assessing the effects of fireworks on ambient air quality. The researchers solved the first, identifying the pollution products, by using correlation analysis. "Our results suggested that metals in fireworks were mainly in the form of chloride salts", explains Zhuang, "while potassium chlorates or perchlorates were the main oxidizers". Secondly, some of these compounds are present in everyday air pollution, so the contribution of fireworks must be separated out. "We addressed that problem by using potassium as a tracer, and found that about 97.8% of lead in the air, 43.1% of total carbon, and 27.5% of zinc, as well as many other pollutants, were derived from fireworks."

These results show that firework combustion, particularly the resulting fine particulates, truly is dangerous to the environment and human health. Zhuang believes that, especially in the context of China's existing air pollution problems, "a combination of political will and public support to limit health and environmental hazards while maintaining China's traditions", is necessary. ■