

## NANO TECHNOLOGY AGE Safety Issues in our Libraries and B

By **Edith Arbuch**

**N**anotechnology is the set of theories and techniques allowing the production and manipulation of very tiny objects, the size of atoms. Nanoparticles, the building blocks of nanotechnology, have a size of 100 nanometres or less (a nanometer is one billionth of a metre). Nanoparticles are so tiny that they can be manipulated only by light, fluids, or chemical reactions.

In the last few years nanotechnology has expanded rapidly in all fields of research, including industry and medicine. Nanoparticles have been used in the production of more than 800 products such as iPods, iPhones, building materials, paints, medical instruments, drugs, clothing, detergents, sunscreens, cosmetics, toys, and home entertainment products. They are also used as food additives.

Libraries are not exempt from the nanotechnology invasion. Research on coating paper with zinc oxide (ZnO) nanoparticles for their antibacterial effects is now underway. It is expected that this technology will be applied in the papermaking industry in the next decade, therefore affecting all new print materials in libraries. In addition, nanoparticles are now being used in electronic inks and in the manufacturing of electronic papers, the main components of e-book readers. Nanochips are also being used in our desktop computers, and will soon be extensively used in almost all electronic and wireless equipment.

Questions about nanotechnology safety are everywhere. Because of their extremely small size, nanoparticles can go

into parts of the human body where other materials can't. Potential routes of exposure include inhalation, oral, and dermal.

Inhalation is the main hazard of nanoparticles exposure. Once inhaled, nanoparticles travel to the lungs, and from there to the circulatory system and other organs. Studies have demonstrated that inhaled nanoparticles cause platelet deposition in the arterial vessel walls leading to cardiovascular diseases. The size of nanoparticles plays an important role in their distribution in the circulatory system. Nanoparticles of 100 to 200 nm will localize in the inner regions of the blood vessels while 500 nm particles will migrate to the aorta, the main artery of the body. Inhaled nanoparticles can also migrate from the nose to the brain, thus affecting the central nervous system.

The unique properties of nanomaterials which make them attractive for industrial and medical applications are the same which make many of them hazardous. Some of these unique properties are the size, reactivity, shape, agglomeration, and solubility.

One of the most frequent questions in libraries is: What are the health concerns associated with nanoparticles?

When inhaled, ingested, or used on the skin at certain doses, nanoparticles have increased accumulation in the organism in comparison with larger particles; and once accumulated, they may not be cleared completely. Since

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nanoparticles are very reactive, they may react with the chemicals of the cells and alter DNA, causing mutations. Research on rodents has shown that carbon nanotubes, used in many nanotechnology products, can cause lung inflammation.

Toxicity of some nanomaterials is due to contaminants which adhere to their particles' surface during their transport or creation rather from the nanomaterials themselves. Engineered nanomaterials are now being coated to decrease contamination.

The environmental effects of nanoparticles receive special attention. While some non-biodegradable nanomaterials may accumulate in the environment, toxifying bacteria and aquatic species, others have the potential for pollution detection and reduction.

Development of new products using nanotechnology is growing at a much faster pace than research in the field of its safety, and nanotechnology advocates admit that some classes of nanomaterials can be hazardous under certain conditions.

So, nanotechnology is no different from any other technology where the benefits may outweigh the risks. It has unlimited promising applications, mainly in the fields of the environment and the treatment of deadly diseases. In the past we have worked with dangerous technologies such as those used in nuclear medicine, but until the haz-

ards of nanoparticles are well known, the utmost caution is critical.

Reliable information on nanotechnology for advanced researchers is available in specialized databases such as SciFinder Scholar, Medline, SCOPUS, and the Web of Science. For the general public and lower undergraduate students, reliable information on nanotechnology can be found at the following sites:

National Research Council Canada  
[nrc-cnrc.gc.ca/randd/areas/nanotechnology\\_e.html](http://nrc-cnrc.gc.ca/randd/areas/nanotechnology_e.html)  
Nanowerk  
[nanowerk.com/spotlight/spotid=984.php](http://nanowerk.com/spotlight/spotid=984.php)  
National Nanotechnology Initiative  
[nano.gov](http://nano.gov)  
Canadian NanoBusiness Alliance  
[nanotech-now.com/Time-for-Action.PDF](http://nanotech-now.com/Time-for-Action.PDF)

## Edith Arbuch

is a Science and Engineering Librarian at the Morisset Library, University of Ottawa. [earbuch@uottawa.ca](mailto:earbuch@uottawa.ca)