

Nanoparticles and nanosafety: The big picture

February 6 2014, by Maxine Mccall



Nanotechnology research. Credit: Flickr/Brookhaven National Laboratory

Nanoparticles—or nanomaterials, as they are often called—are [chemical objects](#) with dimensions in the range of 1-100 nanometres (nm).

Particles this tiny are hard to imagine, but it may help to think that a 1nm nanoparticle could fit up to 80,000 times across a human hair.

Nanoparticles occur naturally in the environment, such as in clay, milk, and in [volcanic ash and sea spray](#).

Manufacturers also make nanoparticles for use in a range of everyday products.

- The surfaces of your fridge may hold silver nanoparticles to stop bacteria growing
- Sunscreen applied as a clear film to your skin may contain [zinc oxide](#) or [titanium dioxide](#) nanoparticles to provide broad-spectrum sun protection
- The frame of your new bicycle may even contain carbon nanotubes to make it stronger and lighter than older bikes.

Nanoparticles are intriguing to scientists because the [properties](#) of a chemical—such as [silver](#) or [zinc oxide](#)—in nano form can be very different to a larger particle of the same chemical.

This is because surface properties dominate in the nano form (due to higher surface area). It's the internal composition that defines the properties of larger particles. This difference opens up a range of new uses for that chemical.


What are the benefits of nanomaterials?

The prevalence of manufactured nanoparticles is increasing.

New developments have led to significant advances across a broad range of [electronic](#), [medical](#) and [environmental](#) applications (among others).

Nanoparticles may be more conductive, stronger or more chemically reactive than larger particles of the same substance.

This means smaller amounts of the chemical in nano form can achieve the same effects, making a product cheaper – or the same quantities may be used to create an enhanced product.

Nanosafety: the big picture 

WHAT ARE NANOPARTICLES?

- Chemicals or objects that are 1-100 nanometers
- That's about as 8,000th of a human hair in width
- They have unique characteristics

NANOPARTICLES OCCUR NATURALLY IN OUR ENVIRONMENT

- Clay
- Volcanic ash
- Milk
- Ocean spray

THEY ARE ALSO MANUFACTURED FOR USE IN EVERYDAY PRODUCTS

- Next-gen computer chips
- Medical implants
- Sunscreens & cosmetics
- Sporting equipment

WHY DO WE NEED TO RESEARCH NANOSAFETY?

- Nanoparticles can be more conductive, stronger or chemically reactive than larger particles of the same substance.
- The properties that make nanomaterials promising for manufacturing, could also present new unknown risks.
- Our research seeks to find out what potential effects nanoparticles have in the workplace, on human health and on the world.
- This research helps to inform Australian Government policy and regulators.

OUR GOAL: TO DEVELOP NOVEL NANOMATERIALS WITH SAFETY IN MIND

WWW.CSIRO.AU/NANOSAFETYTHEBIGPICTURE

Credit: CSIRO

What are the potential risks?

The same properties that make nanoparticles promising for new manufacturing opportunities may also present new risks to us and our natural environment.

Normally, new chemicals and their commercial use would be assessed by one or more of a number of regulatory bodies within Australia. But if a chemical in traditional form has already been assessed, it [may not](#) require further scrutiny by regulators if it is made in nano form. That's the case even though the two forms of the same chemical may have quite different properties.

It is this "[slipping through the cracks](#)" that has raised some concerns in the community about the large-scale use of untested [nanomaterials](#).

Assessing the risks associated with manufactured nanomaterials is never easy or straightforward. Unlike traditional chemicals, the classification of the properties and [potential risks](#) of nanomaterials is not based on composition alone.

Rather, it is a [complex function](#) of a number of properties, including particle size, shape, surface area, surface coating and even how tightly the particles are clumped together.

Adding to the challenge, many of these properties can change with time and through use as the nanomaterials move through a complex system, such as our own bodies or a waste-treatment plant.

What safety research is being done?

In 2007 the Working Party for Manufactured Nanomaterials, in the Organisation for Economic Cooperation and Development ([OECD](#)), launched an international programme to test 13 different types of manufactured nanomaterials that were in the early stages of

commercialisation.

OECD member countries were invited to comprehensively test these nanomaterials for their physical and chemical properties, their fate and transport in the environment, and their potential toxicities in a range of biological systems.

Australia [took part](#) and tested a number of zinc oxide, cerium dioxide and [silver nanoparticles](#). The CSIRO was a major contributor to the Australian effort.

This international effort gave clarity on the types of nanomaterial properties needed for toxicity assessments, and developments on how to make those measurements. While these are important steps forward, more work still needs to be done before such measurements will be routine.

The timeline to achieve this is tight, especially for Australian companies that export internationally. [New regulations](#) will be in force this year in Europe that require mandatory labelling of certain nano-containing products.

This is by no means a simple task. It is not easy to find—let alone count and measure sizes of—these very tiny particles in complex products. This makes it tricky to determine whether they are even captured by the definition of "nano" and hence require labelling.

At present, CSIRO's nanosafety team is [investigating](#)

- nanoparticles in sunscreens
- the environmental effects of nanoparticles added to fuels for combustion engines
- whether nanoparticles eaten by freshwater animals are excreted

- or retained and then transported up the food chain
- whether [nanoparticles](#) are produced in bush fires.

Ongoing research in this area is both relevant and vital to the future of Australian manufacturing.

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