

## Nanotechnology:

# Does size really matter?

**Nanotechnology is providing society with endless exciting opportunities for the future but just how safe is it? How should the organic industry respond to it? Alasdair Smithson explores the nano-world, with special thanks to the Soil Association (UK) for information.**

## WHAT IS NANOTECHNOLOGY?

Nanotechnologies refer to technologies of the very small, with dimensions in the range of nanometers. A nanometer (nm) is a billionth of a metre — one-80,000th of the width of a human hair. For mathematicians, nano refers to the SI unit prefix for  $10^{-9}$  (= 0.000000001).

Its tiny measurement is used for measuring atoms and molecules. Nanotechnology is the production and application of material and devices at the nano scale (0.1nm to 100nm). At the nanoscale, quantum physics take over from classical physics and the physical properties of matter change.

For instance, carbon atoms that make up graphite or diamond can be rearranged into carbon nanotubes which are 100 times stronger and six times lighter than steel. The new properties of materials manufactured at the nanoscale have huge potential.

However, like many great technological discoveries, this is a double-edged sword. While nanotechnology offers promise for faster computers and communications, its application can also be applied to food and medicine.

This enormously extends a company's influence and offers huge possibility of financial reward, especially since it offers technological control at such a fundamental scale. Global investment in nanotech was US\$8.6 billion in 2004. It is predicted the industry will be worth US\$1 trillion globally by 2011.

The BFA has concerns related to synthetic or man-made nanomaterials and nanoparticles. We are not objecting to natural nanoparticles, which may be found in some soils, such as in or near volcanos.

It is also important to distinguish between natural nanoscale processes, such as cell division, and artificial ones. Our concerns relate to artificial nanoscale processes.

## IS IT LIKE GM?

As with genetic modification (GM), we have concerns that commercial aspects of nanotechnology have outstripped both public awareness (only 17% of people are aware of nanotechnology) and regulations, which are non-existent.

As with GM, there is a race to file nanotech patent applications — 80,000 every year placing this technology firmly in the hands of the world's wealthiest companies. There are about 50 companies in Australia involved with nanotechnology.

As with GM, the risks of nanotechnology are unknown, untested and unpredictable. Nanoparticles change in properties even with a tiny variation at nm size. Like GM, the risks are so great that some areas of nanotechnology may prove un-insurable.

Swiss Re, one of the world's largest reinsurance companies, says: "The danger is most probably not of an acute but chronic

nature and it could be some time before it manifests itself. This is where the real risk for insurers lies, and the comparison with asbestos should be seen in this light."

It recommends: "In view of the dangers to society that could arise out of the establishment of nanotechnology, and given the uncertainty currently prevailing in scientific circles, the precautionary principle should be applied whatever the difficulties."

## IS NANOTECH OUT THERE?

Nanotech products are already on the shelves, including anti-stain textiles for Gap trousers, Pilkington self-cleaning glass, Smith & Nephew bandages, L'Oreal face creams delivering Vitamin E in nano-capsules, while BASF's synthetic lycopene created in a nano form is used to improve the colour in many fruit juices and soft drinks.

A partial list of products using nanotechnology is available at <[www.etcgroup.org/documents/nanoproducts\\_EPA.pdf](http://www.etcgroup.org/documents/nanoproducts_EPA.pdf)>.

Many existing agricultural chemicals are being reformulated using nanotechnology. Another application is development of nano-sensors: networks of tiny nano-enabled sensors placed in crops relay information to the farmer, who then does not need to be out in the fields.

## UNKNOWN HEALTH, ENVIRONMENTAL RISKS

Because nanoparticles are so small, they can sometimes bypass the body's natural protective boundaries such as skin, or the blood-brain barrier.

Is it safe to apply sunscreen with nanoparticles of titanium dioxide or zinc oxide? We do not know. Industry and government are belatedly conducting safety tests that will take several years to reach firm conclusions.

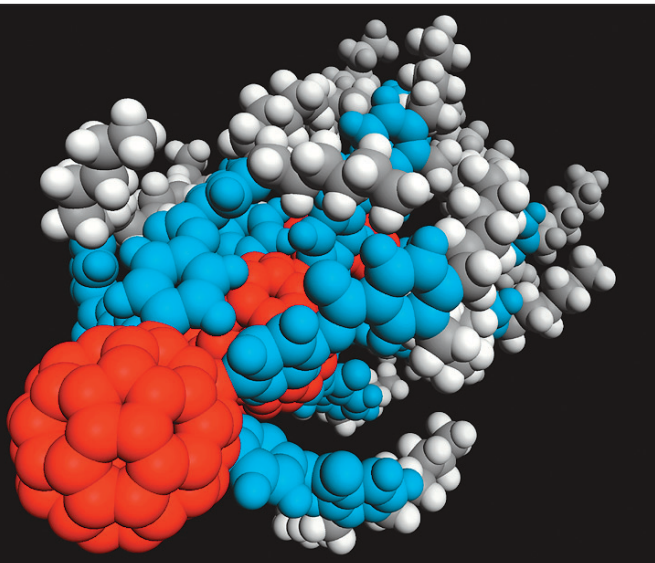
Particular impacts of nanomaterials are foreseen on the ecology of soils which often already contain and move around small particles. Nature reported in 2003 that 'nanoparticles could easily be absorbed by earthworms, possibly allowing them to move up the food chain and reach humans'.

In May 2005, The American Chemical Society reported the discovery that nano-buckyballs (carbon atoms rearranged into a 60-atom sphere) dissolved in water exerted a significant negative impact on common soil bacteria, potentially affecting soil health.

## WALKING WITH ROBOTS

While it may seem a little sci-fi and futuristic to think of self-replicating nano-robots taking over the world, there are some very real risks of nanobiotechnology for all of us.

Here, chemical and genetic engineering techniques are mixed to build designer DNA, atom by atom, into new life-forms or tiny, artificial structures using biology to carry this



**Nanotechnology: Molecular Shuttlecock (courtesy of Accelrys)**

out. Researchers aim to harness nature's ability to self-replicate so that a plant, for instance, could be commandeered to manufacture nanoscale structures.

A current example is work being carried out at the Scripps Institute in California, the United States, where nanotechnologists are genetically engineering a pea mosaic virus in order to grow nanowires for tiny computer chips.

## GOVERNMENT RESPONSE

The Australian Government is backing nanotechnology. Combined with State and Territory Governments and private entities, up to A\$100 million per annum is being invested for research and commercialisation purposes. (In comparison c. A\$300,000 gets put into research for Organic Farming.)

The British Government, in a conscious departure from its approach to GM, recognises the debate on an untested technology needs to take place sooner rather than later. For this reason, it commissioned a report by the Royal Society and

Royal Academy of Engineering. The 2004 report, *Nanosciences and Nanotechnologies: Opportunities and Uncertainties*, recommends "particles and nanotubes should be treated as new chemicals under UK and EU legislation, in order to trigger appropriate safety tests and clear labelling". It also recommends a ban on environmental uses of nanoparticles.

In February, the British Government responded to the report. It said: "The Government agrees that ingredients in the form of manufactured free nanoparticles should undergo a thorough safety assessment by the relevant scientific advisory body before they are used in consumer products. The Government believes in the consumer being able to make informed choices."

It also said: "As a precautionary measure, in the interim, exposure in the workplace and releases to the environment should be minimised until the possible risks posed by nanoparticles and nanotubes are better understood."

Despite this recognition, no new regulations have been proposed nor does it look likely for several years.

## THE BFA STANCE

The BFA is taking what it believes to be a proactive step in banning products or ingredients produced using nanotechnology. Organic farming methods are based on use of natural biological and ecological processes.

The use of synthetic nano-particles which would not exist in nature and whose basic physical structure has been modified at a very fundamental level are incompatible with this important organic principle.

Nanotechnology also contravenes the precautionary principle, another important organic principle because it entails unpredictable and unknown risks, and is unnecessary because safer alternatives exist.

Nanotechnology can be applied to food, agriculture, fertilisers, medicines (for both humans and animals), cosmetics, textiles and packaging as well as many other things and is banned for use in any product certified with ACO or registered/approved by BFA.

We welcome your feedback and comments on this hot topic. Please let us know what you think by emailing me at <alasdair@bfa.com.au>; phone (07) 3350 5706; or by writing to Alasdair Smithson at BFA, PO Box 530, Chermside, Qld 4032. ■

## REFERENCES, FURTHER READING AND SUPPORTING EVIDENCE

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