



# Safety and nanotechnology

Nanotechnology is the exciting new science that lies at the root of so many recent innovations, but is there a darker side to nano? Are unknown dangers lurking in these little particles or are scare stories just that? Should we be worried?

Sometimes it seems like every week there is a story in the media telling us that a product we considered quite harmless might actually be a risk factor for cancer or some equally dreadful disease. And then the next week we hear that eating it in certain quantities could possibly help prevent that disease... Take coffee. It's been in and out of favour like a yoyo. The mixed messages are confusing, and the result is normally that people just tune out.

But every now and then a scare story pops up that makes us take notice - and nanotechnology is often the subject.

Why? Well, partly because nanotechnology is new and exciting and there are still a lot of unknowns, and also because the news stories play on our instinctive unease at the thought of these tiny little particles running around inside us causing who knows what kind of havoc. Nanotechnology in cosmetics

being absorbed through our skin? Nanotechnology in food? If you are a fan of science fiction, the wondrous and terrifying possibilities of nano have been a recurring theme in books and TV shows for many years now - anyone remember what the nanobots did to *Red Dwarf*?

But how worried should we be? Nanotechnology is being applied with increasing frequency to textiles, particularly on the more technical side of the industry in everything from sportswear to body armour, and these fabrics are finding their way into corporatewear and workwear in various guises - nano stain resistance, nano waterproofing, nano hygiene coatings. In the latter case, nano-silver is finding increasing favour as an anti-microbial, and not just in textiles. It is also turning up in washing machines, fridges, deodorants - all kinds of consumer products that are easily available on the high street. Should we take this as proof that they are safe, or is

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there something to the nano scares that periodically hit the headlines?

The problem with any assessment of this kind is, firstly, what is actually being assessed? The safety of nanotechnology? People might use the term and think they know what they mean by it, but this is a very broad field of science, points out Mark Brutton from US firm Nanotex, which develops fabric treatments based on nanotechnology. 'It's like asking, "is chemistry safe?" It is very difficult to make generalisations because nanotechnology covers so many different things.'

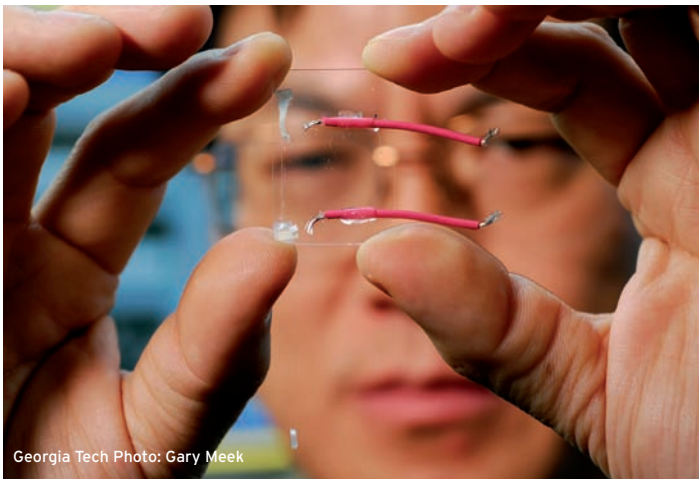
You only have to look at the range of products that result from it to see the truth of that - cosmetics, sunscreens, textiles, electronics, pharmaceutical products, etc. Now you might think that's missing the point and it's not the product itself but the nano-sized things that go into it that are up for discussion, but what this illustrates - and one of the reasons why it is so hard to define nanotechnology for the purposes of safety - is that the chemistry, form, size and use of nano anything is so varied that it cannot be lumped together under one heading if you want to determine how safe, or unsafe, it is.

What we are left with is looking at applications of nanotechnology on

an individual basis - is that particle, in this form, used like so and in this concentration, harmful or not? But even that isn't easy, as current research does not have all the answers and what research there is tends to focus on a specific set of conditions and cannot always be applied to broader usage.

Then there is the nano aspect of nanotechnology. The reason that materials are reduced to a nano-scale is because at this very small size they exhibit different properties, and it is those different properties that make them useful for a particular application. The question being asked is what else about them is changed at a nano-scale? Can something that is harmless to us in its non-nano form become harmful when reduced to a nano-scale, and if it gets into the body in this form, what does it do?

Take silver as an example. This is currently one of the more controversial nanomaterials in use. Silver has been used for centuries for its anti-bacterial properties and is not toxic to humans. But what about nano particles of silver? There are concerns that these nano particles could enter the waste stream through the washing of garments, for example. 'There are two issues here,' explains Mark. 'One is that when in the waste stream the silver particles could kill necessary bacteria in waste treatment facilities and inhibit the ability to clean our water - but exactly what kind of concentration of silver particles would be required to have a real effect? The other is that there have been studies showing that high concentrations of silver



Georgia Tech Photo: Gary Meek

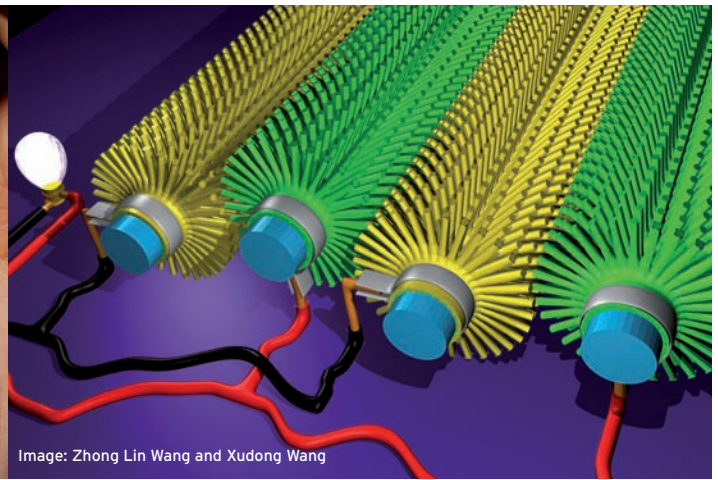


Image: Zhong Lin Wang and Xudong Wang

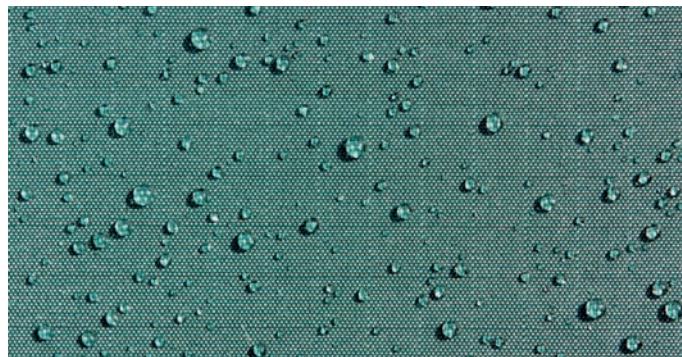
**Top left: Researchers at the Georgia Institute of Technology led by professor Zhong Lin Wang (pictured) used textile fibres covered with zinc oxide nanowires (top right) to develop the 'power shirt'. The fibres generate electrical current using the piezoelectric effect, and combining current flow from many fibre pairs woven into a shirt or jacket could allow the wearer's body movement to power a range of portable electronic devices. Below: nanotechnology is also used to develop waterproof fabric treatments.**

nano particles can be toxic to fish and other organisms. There is no indication that this is the same for humans, but silver remains one of the biggest unknowns and concerns for nano particles.'

The German Federal Institute for Risk Assessment certainly believes so. As recently as last month it published an opinion to the effect that, until more is known about the changes to the behaviour and toxicity of nanosilver particles, manufacturers should refrain from using them in consumer products such as food, cosmetics and textiles.

On the other hand, there is no definitive evidence that nanosilver particles do pose a risk to our health, nor is the risk to the environment universally agreed upon. The University of Exeter just published the results of a study that exposed rainbow trout to commercial nanosilver particles of various sizes in an attempt to discover whether silver is more toxic to fish at a nano-scale. The results showed that the uptake of the particles was much lower than expected and appeared to cause only minor levels of stress to the fish. However, since this tested only specific particles, its results cannot be applied to all the nanosilver particles that are used in commercial products.

The use of silver in anti-microbial fabrics has been well documented in the uniform market, particularly for healthcare, but you have to remember that not all of these use nanotechnology at all. Some use silver thread. Nothing nano about that. And, says Mark, not everything nano-sized is a nano particle. There isn't a nano particle in sight in any of Nanotex's various nano fabric treatments, for instance. And even



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with nano particles, the concern is around 'free particles'. If your nano particle is permanently bonded to the fabric, it's not getting loose to get into the water system or through your skin. The only way it will get loose is when the fabric sheds fibre, and even then it is permanently attached to something too big to be bio absorbable.

Terminology is clearly important here, so if you are concerned, ask questions. For example, if it is a coating, does it contain nano particles? If so, how are these bonded? And, more importantly, don't panic about it.

'You have to look at the bigger picture,' says Del Stark from the Institute of Nanotechnology. 'The media tends to whip up scare stories, particularly for anything that goes in the mouth or on the skin, but there is a lot of ongoing research by universities and independent bodies, and in general

terms there has been nothing so far to give regulators any reason to impose new legislation.'

And the nanotechnology uses the corporatewear industry is likely to come up against are relatively small scale. Stain resistant fabrics are very useful, but nothing compared with some of the products in development. 'The US army's soldier of the future initiative at MIT is looking at the use of nanotechnology combined with integrated electronics to create a uniform that will know when a soldier has been wounded and is able to apply pressure to the wound or release anticoagulants. Or, if the soldier is hit with a biological weapon, the uniform could detect it and administer the antidote.'

On a slightly less futuristic level, there is also research being carried out into energy harvesting using nanotechnology. For example, sports bras with a mechanism in the lining to capture kinetic energy and use it to power an iPod or other electronic device. This is also being looked at for things like running shoes.

Yes, there are unanswered questions about the various uses and forms of nanotechnology, and a lot more research that needs to

be done, but nanotechnology is also a new field of science with huge potential. If you think not having to wash your clothes so often is very nice and convenient, how much better would something be that could actually save a life?

This is not to say you should embrace anything nano with open arms - it is a new science, so of course there will be risks. As with any other type of technology there will be good products and bad ones, and the same criteria apply as to the selection of any technical garment or fabric - check out its credentials.

However, refusing to have anything to do with anything nano on the basis that it might be dangerous seems a little extreme, especially when you consider everything else we do, drink, eat and smoke that could be or definitely is harmful. This is not to say we should ignore the risk, merely that a balanced view is appropriate. Take sunscreen, for example. This frequently contains nano particles of titanium dioxide or zinc oxide, about the safety of which there is some debate. Which risk would you rather take? The theoretical risk posed by these nanomaterials, or the very real risk of unprotected exposure to the sun? One might be dangerous; we know the other can be deadly.

Decisions about individual products need to be taken at an individual level. Pretty much everything we do carries some sort of risk, and in the end maybe it is not so much about whether nanotechnology or anything else is safe or unsafe, but a question of degrees. After all, a little sunshine is good for both body and soul; it's only too much that's bad for you. ■