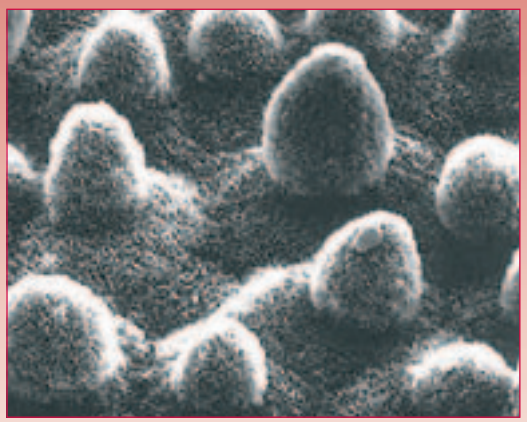
Assuming the lotus position

The lotus leaf is very clever. But then you should have known that: after all it has been around for a long time and still looks good.

It was back in 2001 when Dong Yongrong told the Xinhua News Agency that the company of which he was general manager was starting to make ties (neck-ties might be a better description of this increasingly discarded accessory) with nano-technology stolen from the lotus leaf. One can be quite sure that the poor little leaf has no idea that it has been leading the charge in molecular scale engineering, nor does it receive any royalties. It—the tie—just has a fuzzy surface that holds in air so that water or oil falling on the tie floats over the surface and on down to the floor. The fuzzy surface mimics the structure on the lotus leaf and it is structured to reduce the contact area and thus the adhesion. Consequently, the oil or water cannot spread out and rolls around as droplets, dropping off the surface and taking dirt with it.

Mr Yongrong's technique was developed at the Chinese Academy of Sciences (CAS) and has become know as the "nano-necktie". He liked the technique since, when put on natural materials such as silk, wool or cotton, it left them feeling soft, when more traditional waterproofing made the silk feel rough.

Last November researchers from the Clemson University, South Carolina, announced that they had patented a similar approach. According to Phil Brown, a research team member, they are developing a highly water-repellent coating made of silver nano-particles that can be incorporated into suits and other clothing items, offering better resistance to dirt as well as water, and requiring less cleaning than conventional fabrics. The coating is a polymer film (polyglycidyl methacrylate) and, researchers say, will be easily integrated into any common fabric, including silk, polyester and cotton.



Magnified surface of the lotus leaf.

The Woolmark Company

The simple lotus plant has not only given us a neat surface coating concept, but has created a whole new concept: "self cleaning clothes".

Nanotechnology is all about playing with things of molecular size, or a few atoms and above. Technically it is for things between 1 and 100 nanometres. The CAS particles on Mr Yongrong's ties were all below 100 nanometres. Clemson University and the CAS have promised us all sorts of amazing possibilities. At CAS they have already developed another process that greatly improves the ability of artificial textiles to absorb water, prevents woollen cloth from shrinking and protects silk from discoloration.

In Japan we have seen companies such as Kanebo, Teijin and Shikibo become involved. Teijin has impregnated textiles with amino acids to give a softer feel and help the skin hold moisture, and Shikibo supposedly helps to keep the skin white by additives that control the melanin associated with the darkening of skin in sunlight.

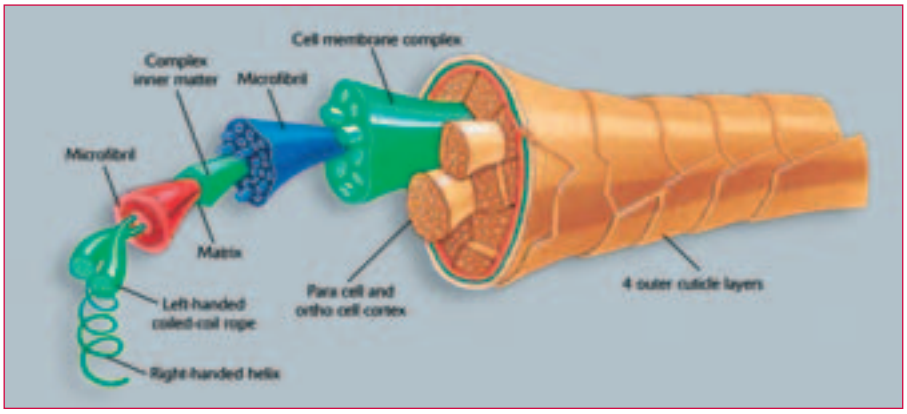
Hans-Jürgen Hübner, CEO, Schoeller Textil AG, told the Volvo Conference at ispo in 2004 that clothing of the future could become the "Pharmacy in the Wardrobe" when he discussed his company's NanoSphere - which is the name of its development based on nano-particles. Even ketchup, honey, coffee, red wine and many other substances simply run off the nano-structured surface which also makes textiles robust, abrasion-proof and longer-lasting. In the event that the substance fails to run off of its own accord, simply rinse it off with water – and the garment is clean again, according to Mr. Hübner. The outdoor industry was sufficiently impressed with this development to award the company its European Outdoor Award for its NanoSphere finish technology. Companies such as Raichle, Mammut, The North Face and Berghaus have already taken up the new development.

The CAS expects all this to go much further with clothes that can sense the surrounding changes of light, sound, temperature, humidity, radiation, and fluctuations in body temperature.

For Malcolm Campbell, commercial director of the Woolmark Company, this excitement only goes to reinforce the original nano-level smartness of natural wool as a textile. From his perspective we do not have to copy the lotus leaf in our fibres, as we have nano-technology already within wool as a natural high performance fibre. Talking at a nano-technology conference at the end of 2004 he noted how, in the winter the relative humidity indoors, is lower than outdoors and this conditions the wool garment so that when the user goes outdoors and the garment gathers a little moisture it immediately begins to produce heat, buffering the wearer against the sudden temperature drop.

This arises because wool is so much better than synthetic fibres or even cotton at absorbing moisture vapour. He also argues that Woolscience, as he now defines it, manages to increase comfort in all temperatures from zero to 40°C, is flame retardant, and helps to keep you dreaming contentedly when in bed.

He then went on to describe what is happening with nano-technology, starting with Sensory Perception Technology (SPT). In this he discussed mainly micro-encapsulation technology which has been most pronounced in sports and military wear when related to phase change technology and the associated control of temperature. But in addition to this we can have anti-cellulite treatment in hosiery, clothing that can repel insects; curtains that have an added freshness and can hide tobacco smells; clothes with aroma therapy; and chairs to focus the mind.



Wool is the most complex of fibres.
The Woolmark Company

Campbell also looked at odour control using silver ions and titanium dioxide, which is a strong photocatalyst, working in sunlight to break down and remove organic compounds which come in contact with it. These are broken down with UV light using the metal oxide as a catalyst, and removed from the garment as carbon dioxide and water.

All this underlines the fact that biomimicry or nanotechnology is not just for synthetic fibres but is vitally important for natural fibres such as wool. Woolscience is involved in ongoing research to look at new finishes, fibre blends, technical chemical applications on wool to add value and exceed the requirements of the military, corporate, institutional and industrial user. In particular work is ongoing with the Australian Defence Force to improve the protection aspects of wool while maintaining comfort.

One of the reasons that nano-particles are particularly useful, according to Dr Raymond Mathis at Cognis, is that they are not visible to the human eye. Because of this, quite large quantities can be loaded onto a structure without it altering the look, whereas if larger particles were used it would look grey. Dr Mathis notes that the term has become very inclusive and includes much organic chemistry which is not really true nanochemistry. "True nanochemistry is about introducing nano-sized particles and keeping them from agglomerating."

For Cognis, its Cyclofresh range fits into the nanotechnology category and is designed to use natural means to prevent unpleasant odours arising from garments. The material recognises sweat when it arises and catches it, and there is a more active version which even releases freshness as soon as you start to get sticky. Cyclodextrins – sugar molecules derived from starch – are the natural and safe basis of this technology and can be added to cotton, linen, wool, viscose and polyester type fabrics. The cyclodextrins become active as soon as they come into contact with moisture, and they then release what are called "guest" molecules stored in their cup-like structure. These guest molecules can have various fragrances and the space they vacate is filled with the body perspiration. Cognis is continuing to work on new concepts such as anti-sun, anti-allergy, and anti-flammatory areas.

According to Bruce Mehlman, Assistant Secretary of Technology Policy at the US Department of Commerce, "nanoscience and nanotechnology stand as the next great frontiers for exploration and conquest – perhaps the greatest frontiers we've ever faced. The ability to manipulate matter at the atomic level – to build new materials and devices molecule-by-molecule – promises more change in the next 30 years than we saw in all of the 20th century.

"Imagine programmable machines that travel through your bloodstream, supplementing your immune system or performing genetic surgery, or artificial red blood cells that permit scuba diving without oxygen tanks or keep your organs safely oxygenated four hours after your heart stops beating. Imagine having your clothes respond and adjust to changing weather conditions, monitoring your vital signs, and protecting wounds."

One way or the other, whatever the definition of nano, it is a concept we can expect to hear a lot more of in the coming years.

NO SUB-HEADINGS