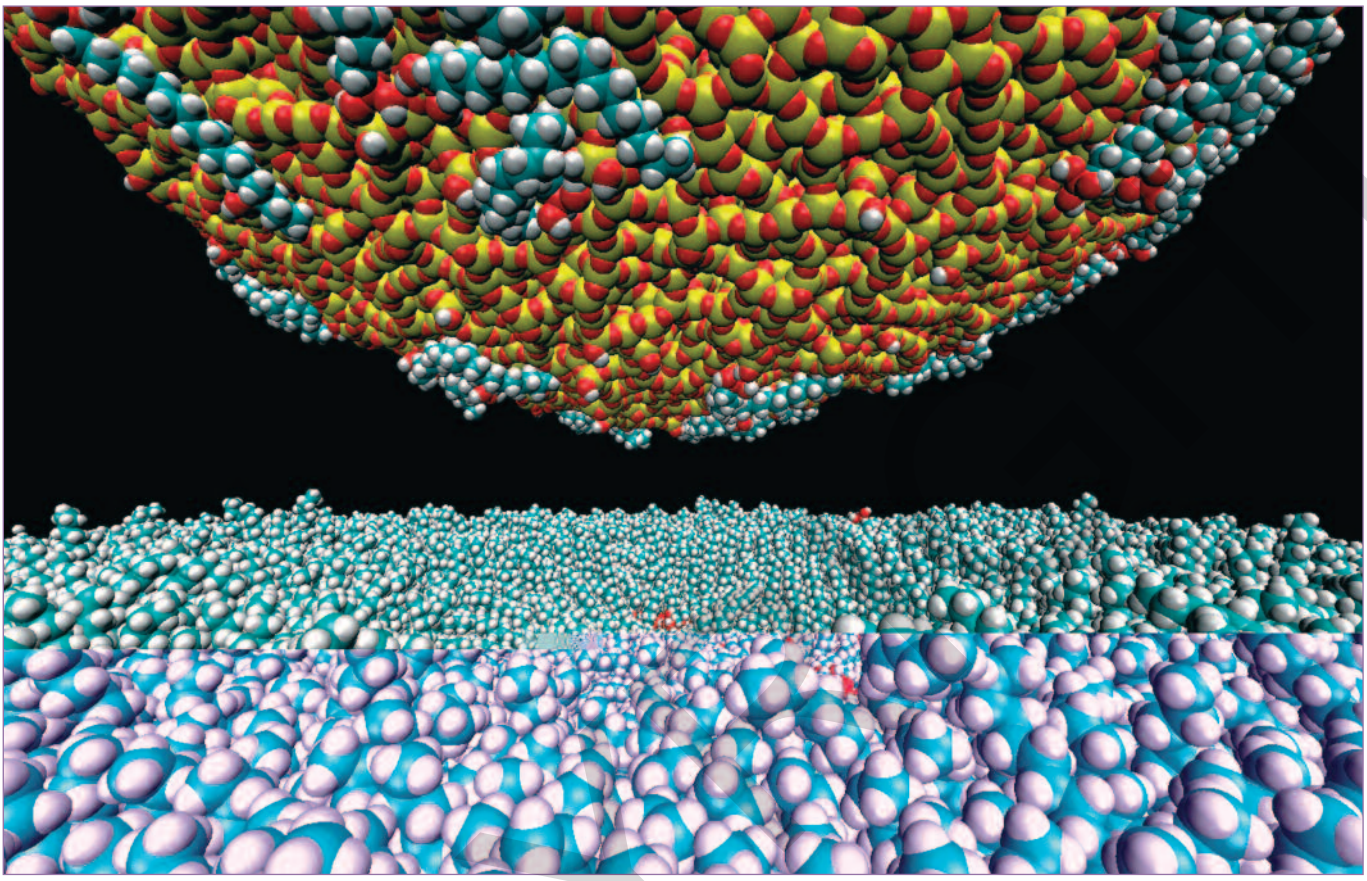
Scottish nanotechnology portal Nanoposts has issued a new report on the impact the technology is making on the textile industry. Nanoposts expects that 24.6% of all textile products available in 2015 will incorporate some form of nanotechnology and that the market by then will be worth almost $3 billion.



Bright future for nanotechnology in textiles

News items on nanotechnology always get extra large numbers of hits on *sportstextiles.com*, which is an unscientific way for us to gauge that interest in this subject is exceptionally high. And no wonder, if a new report from Nanoposts is to be believed.

Nanoposts may be a new name to many. It's an information and technology transfer portal, spun off from the Institute of Nanotechnology at the University of Stirling in Scotland. A report it issued at the start of 2009, Nanoscale Technologies for the Textile Market, made the news on sportstextiles.com in December, when its imminent publication was first announced, and turned heads with the suggestion that nanotechnology in textiles will be a market worth $2.9 billion by 2015. Nanoposts also expects that 24.6% of all textile products available in 2015 will have some form of nanotechnology—nanofibres and nanotubes, coatings, or smart materials and sensors— in them.

Since then, the organisation has been kind enough to let *WSA* see a draft copy of the report, which is greatly detailed and offers a wealth of reasons to support the interest our readers show in nanotechnology.

Numbers game

Numbers are always difficult to project six years ahead, but the important point, according to the report, is that nanoscale technologies—manipulating the attributes of matter at the

Nanoposts's new report describes nanoscale technologies as manipulating the attributes of matter at the nanoscale to create products with new functionalities at the macroscale.

Sandia National Laboratories

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nanoscale to create products with new functionalities at the macroscale— have real commercial potential for the textile industry. Nanoposts's confidence about this stems from the fact that conventional methods for imparting different properties to fabrics often offer only temporary effects, and lose their functions after washing or wearing.

Many companies in the fibre-fabric-finished goods supply chain are aware of this and are working to engineer in functionality such as hygroscopic qualities, or protection against odour or ultraviolet (UV) radiation from the sun at fibre level. Nanotechnology is already a popular way of doing this; it can provide high durability for fabrics because nanoparticles have a large surface area-to-volume ratio and high surface energy, leading to an increase in durability of the function. In addition, a coating of nanoparticles on fabrics will not affect their breathability or hand, crucially important factors in trying to convince brands and finished-garment manufacturers that the technology is worth investing in.

The Stirling-based outfit recognises that the main drivers for the uptake of nanoscale technologies in the textile industry have been in critical applications (such as in healthcare or emergency services contexts), and in luxury applications (with niche consumer markets). On the other hand, the main inhibitors it has identified are cost and a lack of standards, both of which will be familiar objections that nanotechnology enthusiasts will have heard in response to boardroom presentations on the subject in textile companies around the world.

Early adopters

Current applications for fibres and textiles incorporating nanomaterials include stain-resistance, anti-odour, anti-microbial functionality in apparel (including sports apparel), conductive cloth, and water-repellent fabrics and textiles. It is also entirely feasible, Nanoposts points out, to combine different functionalities in the same fibres, although this needs considerable further development.

It is less bullish about the present state of the commercial market for nanotechnology in textiles than some other research organisations. The report quotes a study by Massachusetts-based VDC Research, which claims that the market was worth $720 million in 2008. Nanoposts describes this figure as "extremely optimistic". Nevertheless, it pays careful attention to many of the applications that have begun to enjoy commercial success.

One of the most important examples for the sports and outdoor market is UV protection. The UV-blocking property of any fabric can be enhanced when a dye, pigment, delustrant, or ultraviolet absorber finish is present to soak up radiation and stop so much of it getting through to the skin. The report points out that organic compounds that absorb in the UV range, or inorganic metal oxides such as titanium dioxide, are being applied for UV protection in textiles at the moment. Titanium dioxide, and many other oxides in colloidal form, have produced what it calls "excellent results". Application is often by plasma or by electronic beam processing (e-beam), which allow for "polymerisation in situ". The new report goes on to say that nanoscale titanium dioxide and zinc oxide are more efficient at absorbing and scattering UV radiation than the conventional size of applications of these compounds; they are better able to block UV because nanoparticles have a larger surface area per unit mass and volume than conventional materials.

The report also talks in detail about hydrophilicity—the process through which other substances attach themselves to water—pointing out that, in textiles, this functionality is important for comfort and for dyeability. Nanoposts highlights the importance of this for use in breathable waterproof garments for example. Hydrophilic and anti-microbial nanoparticles have also been developed to stop bacteria from growing on textile surfaces. It mentions specifically the work that UK-based companies P2i and Surface Innovations have done to exploit technology in this area.

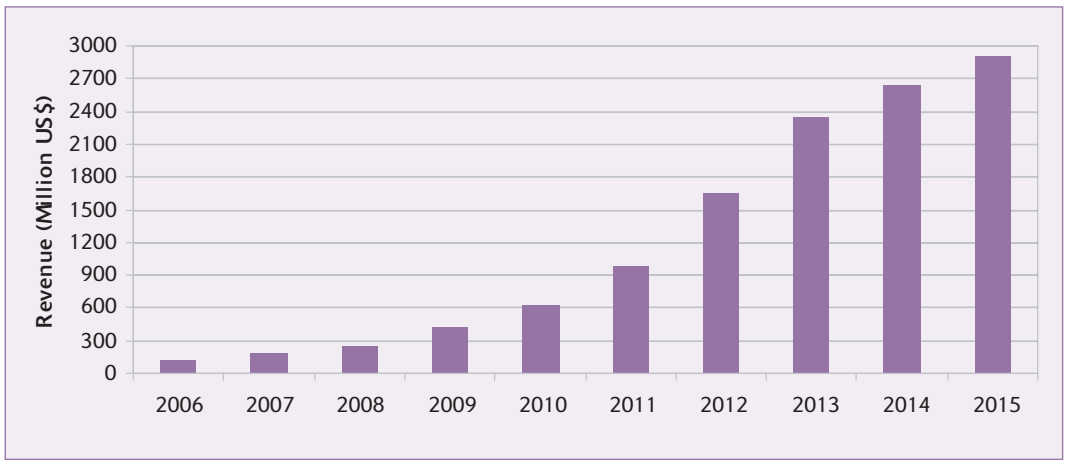
In contrast to this, water and oil repellence applications also feature, with mentions of the 'lotus effect', a biomimetic approach to making ultra-hydrophobic fibres that repel dirt, making it possible to offer outdoor products such as tents



Last year Hi-Tec in collaboration with P2i launched its V-Lite Altitude Ultra WPi boot deploying ion-mask hydro management nanotechnology.

Hi-Tec

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Textiles nanotechnology implementation market: revenue forecasts (world), million US$, 2006-2015.

Nanoposts

that are self-cleaning. "Because lotus-like coatings will affect only the surface of fibres, these can be applied to any commercial textile materials without altering their bulk properties," the report says. Other possible applications include fabrics that are sweat-resistant and anti-stain. However, Nanoposts warns that most of these applications require the use of fluorocarbons at present. As mentioned above, the alternative is to assemble the polymer directly on the textile surface with plasma or by e-beam, offering advantages, not least in terms of environmental impact.

The report offers the example of US company Nano-Tex, which has worked to improve the water-repellent property of fabric by creating 'nano-whiskers', hydrocarbons that are 1,000 times smaller than a typical cotton fibre. The whiskers create a peach-fuzz effect on the surface of the fabric without compromising tensile strength or breathability. The spaces between the whiskers are smaller than the typical drop of water, but still larger than water molecules; water thus remains on the top of the whiskers and above the surface of the fabric. However, liquid can still pass through the fabric, if pressure is applied.

Another example of nanotechnology with a commercial presence is NanoSphere from Swiss textile technology company Schoeller. NanoSphere impregnation involves a three-dimensional surface structure with gel-forming additives that repel water and prevent dirt particles from attaching themselves in a mechanism similar to the lotus effect.

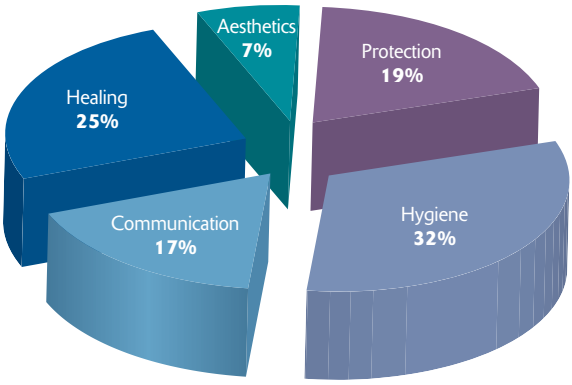
The shape of things to come

The Nanoposts report goes on to highlight ceramic particles as ideal for thermal comfort and shape-memory applications. "Many silicon compounds possess a great thermal capacity and the mineral montmorillonite has performed well under application," it says. "Shape memory alloys (SMAs) are another area under investigation for incorporation into textiles for adaptive thermal comfort, the reversible form changing due to heating and cooling. They would allow for heat storing and evolving materials, with variable porosity and water vapour permeability. Shape memory alloys have the ability to change their shape in response to conditions of heat or cold. Nitinol—an alloy of nickel and titanium—is the most common SMA. Other examples include gold-cadmium, copper-tin-zinc, copper-aluminium-nickel, silver-cadmium, and copper-zinc-aluminium." Interestingly, montmorillonite 'nanoclays' are also of great interest in the field of flame-retardant fabrics.

In its projection for the use of nanotechnology in textiles between now and 2015, the report says the breakdown of applications will be as follows: hygiene 32%; health 25%; protection 19%; communication 17%, and aesthetics 7%, suggesting there is great scope for outdoor and sports brands to claim an important share of what will then be a $3 billion market.

Part of this prediction is that nanotechnology-based applications, such as self-cleaning textiles, will start to make a major impact from 2011, with "good prospects for significant revenue growth" from then onwards.

With in-depth insight into the different ways in which nanoparticles can be applied to fibres, fabrics or garments, plus details of current research projects and a list of all the companies active in this area already, Nanoscale Technologies for the Textile Market should make interesting reading for players right across the sports and outdoor industry.



The projected percentage breakdown by application area based on nanotechnology by 2015 in the textiles sector. The main percentage of revenue will be generated by coatings for hygiene and healing (wound care), and protection (fire and ballistic).

Nanoposts

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