



Incorporation of Nanotechnology in Textile Applications

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Nanotechnology is considered one of the most promising technologies for the 21st century. On the one hand there is the economical impact from new and optimised products. On the other hand one expects a strong contribution of nanotechnology in decreasing the ecological impact and consumption of natural resources. Nanotechnology has the potential to improve the effectiveness of a number of existing consumer and industrial products and is expected to have a substantial impact on the development of new applications.

What is nano?

The "nano" prefix denotes that at least one of the dimensions of these materials is in the order of 1-100 nanometer. A nanometer (nm) is a billionth of a meter, which is about 1/80000 of the diameter of a human hair, or 10 times the diameter of a hydrogen atom.

One refers to nanotechnology when either nanoscaled materials are produced (defined by e.g. their thickness, particle size or other structural features) or when the nature of a process involves the use of nanoscaled materials (e.g. sol-gel). Research and development in nanotechnology is directed toward understanding and creating improved materials, devices, and systems that exploit these new properties.

At nanoscale, the physical, chemical, and biological properties of materials differ in fundamental and valuable ways from the properties of individual atoms and molecules as well as bulk matter. For instance, ceramics, which normally are brittle, can easily be made deformable if the grain size is reduced to the nanometer range and thin films or fibres are produced. Another example is the fact that for nano-scaled particles the colour of the material becomes dependent on the particle size instead of its intrinsic properties, e.g. gold having a particle size of 1 nm shows a red colour. The ability to customize physical properties of materials gives nanotechnology a potential impact across a wide variety of disciplines.

Nanotechnology in textiles

The wave of nanotechnology has shown a huge potential in the textile and clothing industry which is normally very traditional. The future success of nanotechnology in textile applications lies in areas where new functionalities are combined into durable, multifunctional textile systems without compromising the inherent favourable textile properties, including processability, flexibility, washability and softness.

A whole variety of novel nanotech textiles are already on the market at this moment. Examples of industries where nanotech enhanced textiles are already seeing some applications include sporting industry, skincare, space technology

and clothing as well as materials technology for better protection in extreme environments. The use of nanotechnology allows textiles to become multifunctional and produce fabrics with special functions, including antibacterial, UV-protection, easy-clean, water- and stain repellent and anti-odour. In many cases also smaller amounts of the additive are required, saving on resources.

Perhaps one of the most widely recognized applications today is the shark-skin swimming suit in which the Olympic swimming champion Michael Phelps won several new world records. This suit contains a layer deposited by plasma coating to repel water molecules, designed to help the swimmer to glide through the water with minimum resistance.

One of the applications of nanotechnology in the textile industry is in polymeric materials for producing conventional fibres such as polyester, polyamide and polypropylene in nanoscale. Nanofibres have good properties such as high surface area, a small fibre diameter, good filtration properties and high permeability. Common production methods are electrospinning or bicomponent extrusion (islands in the sea technique).

Outlook

There is a significant potential for profitable applications of nanotechnology in textiles. Several applications of nanotechnology can be extended to attain the performance enhancement of textile manufacturing machines & processes. Nanotechnology overcomes the limitations of applying conventional methods to impart certain properties to textile materials. There is no doubt that in the next few years nanotechnology will penetrate into every area of the textile industry. However, there are still a lot of items to be taken in consideration before industrial commercialisation of the nano-products. First, there is the issue of costs, which in some cases is hampering the development of nanoparticle coatings and makes mass production economically less viable. Besides cost, a key point is the question of the impacts of uncontrolled release of nano-particles. Generally, the state of research into the health and environmental issues can be summed up as suggesting that the current results of studies on the impact are limited. In future, interdisciplinary research collaborations will lead to significant advancements in the desirable attributes of textile applications.

Further references on the application of nanotechnology in textile applications

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