Nanotechnology and Lifestyle

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INTRODUCTION

Perhaps surprisingly the earliest commercialized applications of nanotechnology are seen in lifestyle applications. Textile and cosmetics are among the first products to use nanomaterials. This overview discusses these and other examples of nanotechnology materials and technologies in lifestyle applications.

TEXTILE APPLICATIONS OF NANOTECHNOLOGY

Treating textiles with nanotechnology materials is a method to improve the properties of the textile, making it longer durable, have nicer colours etc. Nanotechnology can also be used to add new functionalities like energy storage and communications. The next figures show some of the opportunities offered by nanotechnology to improve the functionality of textiles.

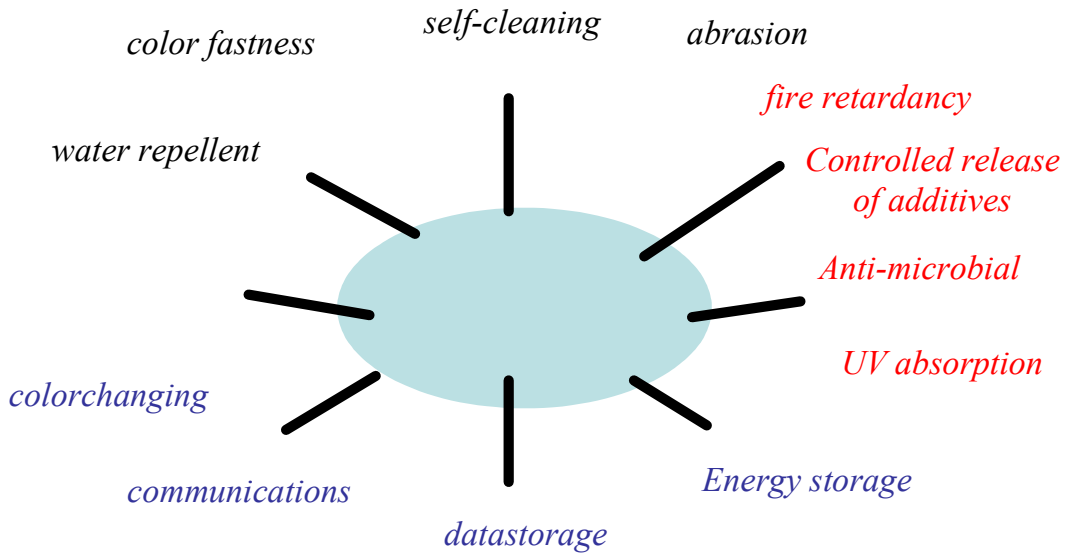

Figure 1: Improved and New Functionalities of Textile by Nanotechnology.

Some interesting examples of nano improved textiles currently on the market are:

- Stain repellent and wrinkle-resistant threads woven in textiles.
- A product soon to be introduced, contains molecular-scale sponges that soak up and neutralize stinky-odour-causing hydrocarbons and release them only when washed.

van Heeren, H. (2005) Nanotechnology and Lifestyle. In *Nanotechnology Aerospace Applications* (pp. 4-1 – 4-4). Educational Notes RTO-EN-AVT-129, Paper 4. Neuilly-sur-Seine, France: RTO. Available from: http://www.rto.nato.int/abstracts.asp.

- Bodywarmers use Phase Change Materials (PCMs) responding to changing body temperatures. The fabric coating consists of the materials encapsulated into small spheres. As the body warms up, the PCM melts, drawing the heat away. When cooling off, the PCM freezes again, in turn releasing its stored heat.
- Nanosocks treated with silver nanoparticles. The silver acts against infection and odour.

Bulletproof vests are another item profiting from nanotechnology. Nanotube fibers are used to make a material seventeen times tougher than the Kevlar.

Future developments are to use nanotechnology to create Smart and Interactive Textiles (SMIT) that can sense electrical, thermal, chemical, magnetic, or other stimuli. Currently however, the major part of advanced textiles are relative low tech products like photochromic t-shirts.

COSMETIC APPLICATIONS OF NANOTECHNOLOGY

At the forefront of nanotechnology in cosmetics we see companies like l'Oreal, producing anti-wrinkle cream containing nanocapsules, which help active ingredients get to the skin's deeper layers. By reducing the active ingredients to a very small size and coating them with a biodegradable polymer, the company found the nanocapsules were small enough to pierce through the first layers of the skin and release the active ingredients below, in the lower layers of the skin.

Anti dry skin crèmes use oxide powder with nanosized silica powder. Zinc oxide nanoparticles scatter the light, thereby protecting the skin. Besides that, ultra-fine titanium dioxide with the inclusion of a small amount (<1%) of manganese can catalyse free radicals that have been generated by other sunscreen components into harmless chemical species.

SELF CLEANING AND USER ADAPTABLE SURFACES

The leaves of certain plants and the wings of insects always stay clean because dirt and water cannot adhere to their structured surface. The lightest rainfall can therefore clean the surface. Learning from that observation. several nanostructured top layers have been proposed and are applied to create self cleaning surfaces.

Electro-chromic materials, another example, are able to change between a transparent and an absorbing state through the application of a low voltage (only a few volts). A foil consisting of thin oxide layers is laminated between two flexible polymer sheets. The foils are first coated with a transparent electrically conducting layer and then by active electro-chromic layers. The user can easily control the transparency using an electronic control unit. The visor changes between dark and light conditions in a few seconds.

Nanocoatings can even be used as ski-wax. The ultra thin coating changes according to the temperature and adapts to the surface and snow-crystals. The surface structure remains completely free of wax enabling optimum gliding.

Other examples of nano surface coatings are:

- Titanium dioxide (TiO2) crystals, only 40 nanometers in size, formed to a layer and acting as a powerful oxidizing agent, destroying airborne germs and pollutants.
- An aqueous suspension, applied via roll (or dip, or spray) coating process onto a substrate forms a tortuous path for molecules such as oxygen and aromatics. This increases the barrier properties of the substrate and makes the materials more air thigh. Is being now introduced in tennisballs.

NANOBASED SYSTEMS

Smart, small systems and sensors are other applications where nanotechnology will boost performance:

- High-precision scanning systems enable personal projection displays for a broad range of military, medical, industrial, professional and consumer products. Service information and complex instructions can be viewed at their point of task, head-up and hands-free.
- Smart Dust Millimeter-scale self-contained MEMS and nano devices that include sensors, computational ability, bi-directional wireless communications technology and a power supply. As tiny as dust particles, smart dust motes can be spread throughout buildings or into the atmosphere to collect and monitor data. Smart dust devices have applications in everything from military to meteorological to medical fields.
- Nanosensors are especially suitable to detect small concentrations in applications as environmental, healthcare and the detection of chemical or bio hazards.