

Nanotechnology: The key to products of the future

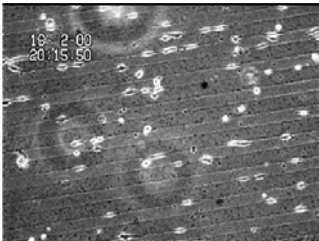
Nanotechnology is the application of science at the almost unimaginably small scale of atoms and molecules (one nanometer is a billionth of a meter; or about one eighty thousandth the width of a human hair). It is already affecting our lives, and its effects will shortly become even more dramatic.

We are all familiar with the consequences of miniaturisation - we have daily evidence of how small our telephones, computers and cameras have become. Nanotechnology already has some input here in the silicon chips which are the brains of these gadgets; and the application of nanotechnology is also in evidence in ink jet printers, CD's, security lights - to name but a few.

The excitement of nanotechnology is that the *properties* of substances can be altered, leading to a new world of product opportunities. These products will be cheaper, less wasteful of precious resources and non-polluting.

What about some of these new products? Let's just examine a few.

Take medical implants. In the US alone more than \$2 billion are spent yearly on hip and knee implants, plates and pins for broken bones, dental implants, and other reconstructions. An estimated 11 million people in the US have at least one such implant, and the number is growing as the population receiving implants increases. A critical problem is acceptance by the surrounding tissue. Specially developed coatings using nanoscale techniques and nano-textured surfaces create a cell-friendly environment which encourages tissue to bond to the implant, consequently the implant will last longer and feel more comfortable.



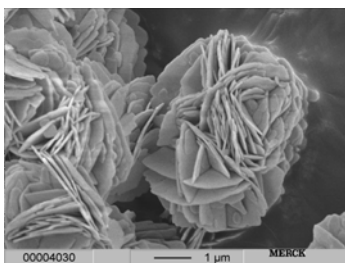
Cells aligning themselves along high adhesion nano-structured surface. Courtesy CRISMA, Glasgow University

How about crime prevention? Nanosized particles can be created that are smaller than the wavelength of visible light - therefore they cannot be seen. These are called quantum dots. The size of these particles can be controlled and solutions containing different sized nanoparticles can be made to fluoresce in different colours, when seen under light beyond the visible spectrum. The quantum dots are stable and invisible and do not influence the design of the surface on which they are applied. They can be 'printed' on to any substrate as apparently invisible 'bar codes' - until exposed to black light where they will fluoresce in a glorious range of colours. Uses include tagging of valuable property; for example, cars can have their full manufacturing history and even ownership printed on them, undetectable except under special lighting conditions. An owner's insurance, a thief's nightmare.



Different sized quantum dots of the same material in solution fluoresce in different colours. Courtesy Manchester Materials Science Centre.

Well, what about cosmetics? - given that the cosmetic industry has reputedly a larger turnover than even armaments. One of the world's major owners of nanotechnology patents is L'Oreal. Many cosmetics incorporate special nanoparticles that may be coated or uncoated and provide sunscreen, tactile, light scattering and matte effects for the wearer. In future, cosmetics will be marketed as 'holistic', that is, due to nanotechnology and the ability to design nanoparticles that can be absorbed through the skin, our makeup will deliver slow release vitamins giving the added benefit of feeling good on the inside as well as the outside.



Bismuthoxychloride (BiOCl) crystals, used as a mattening agent in cosmetics and also improves tactile properties. Courtesy Merck Speciality Chemicals

Implants, crime prevention and cosmetics - all money spinners. But that is only part of the story. Nanotechnology also promises 'paper quality' displays - lightweight, flexible, easy to read, and importantly, infinitely reusable. It offers a route to efficient and cheap solar cells and batteries, making truly portable technology a reality. Who wants their camera battery (or even their car, for that matter) to run out of power just at the crucial moment on safari when a pride of lions appears at the waterhole? And of course nanotechnology is revolutionising every aspect of information processing, whether it is the fast decipherment of our genetic 'fingerprint', to the rapid analysis of drug libraries.

Finally, are governments convinced that their economic future lies with nanotechnology? Well, most are. The UK has become one of the biggest investors in Europe this year, with £40 million funding going into nanofabrication technology. Most of the rest of Europe is active in funding research and development, led by the Germans, and closely followed by the French and Swiss. though the smaller Scandinavian countries such as Denmark, Sweden and Norway are punching well above their weight. The EU is also a powerful supporting nanotechnology. Out of a total proposed funding of 17.5 € billion for R&D over the next five years, 1.3 € billion are being devoted to research on nanotechnology, knowledge-based materials and new industrial processes.

For more information, consult the Institute of Nanotechnology's website. <http://www.nano.org.uk>, or contact Ottilia Saxl, CEO email o.saxl@nano.org.uk