

Tiny roots of great genius

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By **Annabelle Filer**

Nanotechnology is coming to the fore to create pioneering materials that may revolutionise industry, architecture and product design

As architects and designers we really are entering that brave new world. One technological advance to creative freedom is through nanotechnology, essentially the creation of very small particles and the relationship they have with one another.

Nanotechnology is not a new, yet as science continues to explore and develop its possibilities are genuinely pioneering. Imagine, for example, a fusion of technology with organic living systems. This may prompt an ethical argument but, in the right context, is inspiring and hugely positive.

It could have profound effects on household goods, the automotive and airline industries and medicine. Nanotechnology should become an important ally to the construction industry, enabling us to build more cheaply, quickly and safely by making nano changes to some of the core materials. New coatings are being introduced for self cleaning fire protection, blocking UV and solar-heat gain. Nanotechnology is key driver in the reduction of our environmental footprint from the material viewpoint.

Currently we have two particular nanosized particles to thank: titanium dioxide and carbon nanotubes. These punch well above their weight as the selection on these pages, a number of which are still in development, clearly demonstrates.

Electricity generating fabric

It stands to reason that we should find a way of converting our own low-frequency, mechanical motion into electrical power, and this is exactly what scientists led by Professor Wang at the Georgia Institute of Technology are doing. It is known as the Piezoelectric effect, and the institute's team is using a Kevlar-type fabric for harvesting this energy.

The smart fabric in development may detect and convert the vibrations from a footstep or a heartbeat into a small electrical charge. While this may seem an interesting idea and offering the opportunity for generating our own power to use our mobile phone or iPod, it is the potential that is more interesting. Imagine generating power through sails, canopies or tents. The technology is based on zinc oxide nanowires, arranged like bristles on a bottle brush, which connect with each another through movement and rub together generating electricity. Power dressing at its most literal.

Similar work is being developed elsewhere. In Japan, for example, mats are being tested at station turnstiles to harness energy from commuters' footsteps.

Product information:

- Research: US based
- Size: Fabric unknown
- Colour and range: unknown
- Applications: Architectural fabrics using vibrations, fashion and military
- Other: Estimated viable and scalable product 2-3 years away

www.nanoscience.gatech.edu

Nansulate

This clever little awardwinning coating has the potential to save 20-40 per cent of residential and 10-25 per cent of industrial energy consumption, simply by applying a liquid coat to a surface. Nansulate was created with the intention of becoming the world's leading insulation, thanks to the use of the nano particle hydro-NM-oxide. It is difficult to write great prose about its impeccable resistance to corrosion and mold and lead encapsulation, so I won't try.

Through maintenance and regulation of surface temperatures, Nansulate reduces condensation and the problems arising from that. It also manages to reduce one of the most costly industrial problems, maintenance and replacement of pipes and tanks and other equipment through CUI – corrosion under insulation. Practical and quite brilliant.

Product information:

- Manufacturer/distribution: USA/UK
 - Size: Available in one and five-gallon containers, covers 150 sq ft/14 sq m per gallon approximately
 - Colour and range: Available in translucent, matte, white and semi gloss, which may be tinted
 - Applications: Commercial and residential, interior and exterior on non-metal and metal surfaces including hot metals, rust and non-rigid insulation
 - Other: Class A fire-rated
- www.industrial-nanotech.com

Pollution-absorbing concrete

Titanium dioxide is a naturally occurring mineral and one of the most ubiquitous oxides used in industry. Under UV light it oxidises oxygen and airborne pollutants, breaking them down into ions and less harmful compounds that can be washed away. It can also convert UV light energy to heat and, thanks to its hydrophilic properties, has recently become instrumental in the development of selfcleaning and anti-fogging glass. Italcementi, one of the world's largest cement producers, has developed a technology, TX Active, that using titanium dioxide turns a material as prosaic as cement into a smart material. There is the potential for pollution abatement of up to 50 per cent and thanks to the prevention of a build up of grime, the building facades are less likely to deteriorate.

Product information:

- Manufacturer/distribution: Italy
 - Size: Not applicable
 - Colour and range: For use in mortars, paints, precast elements and pavers
 - Applications: Roads and external walls
 - Also active in artificial light conditions
- www.italcementigroup.com

Nanopaper: New wood science

Researchers at Sweden's Royal Institute of Technology say that in effect they manipulated cellulose, a readily available material sourced from plants, to create a super paper. The researchers have processed wood pulp with certain enzymes to break the cellulose fibres into crystalline nanoscale cellulose fibres, thereby creating a paper composed of much finer strands. This 'super paper' is tougher than bone, seven times more tear-resistant than normal paper and able to stretch by a further 10 per cent. The strength of the paper may be adjusted by altering its internal mechanism.

Product information:

- Developed: Sweden
- Size: Not available, in development
- Colour and Range: Not currently available
- Applications: future architectural applications may include wallpapers and possibly structural applications

given the development of paper as an architectural material, tough filters, packaging
www.kth.se

Nanosolar

This Silicon Valley company is anything but silicon based. Nanosolar's aim is to become a "global leader in solar power innovation" and this has been endorsed with funding in excess of \$0.5bn. Nanosolar currently produces two key products: Utility Panel??aimed principally at municipal power stations, and Solarply??for local-level power on individual buildings. Utility Panel is a lightweight roll of solar electricity foil that can be cut to any specification. It uses CIGs, currently the most efficient and durable thin film semi-conductor and has developed a proprietary ink for high-yield printing on a low-cost foil. It is 100 times thinner than silicon wafer with a 100 times faster processing technology.

Product information:

- Manufacturer/distribution: USA/Germany
- Size: Panel restricted to roll width and panel substrate
- Applications: Solar power for all building types

www.nanosolar.com

And finally...

Research into nanotechnology has, not surprisingly, uncovered many materials still in research. The range of materials is vast and I thought it may be interesting to conclude with some of those: Self-healing and thermoreversible rubber; self-cleaning fibres for fabrics that never need washing; ferrofluid; anti-reflective film based on cicada wings; wiperless windshields; scratch-resistant automotive coatings; plastic sheathing around wires that becomes a ceramic when exposed to heat or fire; metal rubber;; carbon nanotube yarns; self-assembling viral batteries; friendly walls that adjust humidity and prevent sick building syndrome, and wood sealants that protect wood from problems associated with water penetration.

PS For those of you interested in scale – a nanometre is a billionth of a metre.

Postscript :

Annabelle Filer is an architect and founder of SCIN, a company that sources and advises on surfaces. SCIN's aim is to bring materials to the forefront of design. www.scin.co.uk