SURFACE PATTERNING

Caught in the mesh

Angew. Chem. Int. Edn **46,** 5115–5119 (2007)

When borazine molecules decompose on a hot rhodium surface, they form a mesh of hexagonal boron nitride that has regularly spaced nanometre-sized pores. In principle, these periodic pores could serve as a template for placing nanoscopic molecules or structures in an array for use in molecular electronics, data storage or optics.

Now, Jürg Osterwalder of the Universität Zurich Switzerland and colleagues have used scanning tunnelling microscopy to demonstrate that naphthalocyanine molecules can indeed be trapped in the boron-nitride pores. The molecules are comparable in size to the 2-nm boron nitride pores and when vapour-deposited onto the mesh at room temperature, they form a well-ordered array with the same periodicity as the nanomesh.

This method of templating could prove very useful as the molecules are trapped by surface forces that do not interfere with their functionality. In addition, the nanomesh is stable in water, which means that molecules can be deposited from solution rather than with expensive ultrahigh-vacuum methods.

CARBON NANOTUBES

Greater than gecko!

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The feet of a gecko — a wall-climbing lizard — are covered with microscopic hairs called setae, which are split into smaller nanostructures known as spatulas. This hierarchical arrangement allows the gecko foot to adhere to surfaces without using any sticky liquids. Researchers at the University of Akron and Rensselaer Polytechnic Institute in the US have replicated gecko foot structures with superior adhesive properties by patterning multiwalled carbon nanotubes (MWNTs) on flexible substrates.

Ali Dhinojwala and colleagues first grew MWNTs on silicon substrates using conventional photolithography patterning processes. The MWNTs were then transferred onto flexible adhesive tape to form the 'gecko tape'. To test how adhesive the gecko tape is, they pressed it against a surface and applied a shear force — a load that is similar to dragging the gecko feet almost parallel to the surface. The gecko tape supported shear forces four times higher than the natural gecko foot hairs and could stick to a variety of hydrophilic and hydrophobic surfaces including Teflon. Both the micrometre-sized nanotube bundles and the individual MWNTs were necessary for the superior adhesion properties.

The tape can be repeatedly peeled and reused without losing its adhesive properties, suggesting that this material could be used as a reversible adhesive in microelectronics, robotics and various space applications.

NANOPARTICLES

Softer skin

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Titanium dioxide is a common ingredient found in many cosmetic products such as sunscreens because it acts as a filtering system by absorbing ultraviolet light. During this process, however, TiO_2 generates reactive oxygen species (ROS) that are known to damage cells and DNA, leading to some concerns about its use in this capacity.

Researchers at the Polish Academy of Sciences and École Polytechnique Fédérale de Lausanne in Switzerland now report that TiO_2-induced ROS can alter the stiffness of human skin cells. Małgorzata Lekka and colleagues incubated human skin cells with TiO_2 nanoparticles and subjected them to different intensities of ultraviolet light. After a period of exposure, the cell stiffness was measured using an atomic force microscope. At a low TiO_2 concentration (4 mg ml^{-1}) and under low-intensity ultraviolet light, ROS were generated and the skin cells experienced a 30–75% drop in stiffness after 1 minute of exposure.

When the skin cells were additionally incubated with an antioxidant, such as beta-carotene, their stiffness did not alter. It is suggested that ROS production, which is thought to damage cellular structures such as the cytoskeleton and lead to the dramatic loss in cell elasticity, is inhibited by the antioxidant.

TOP DOWN BOTTOM UP

Meeting of minds

A collaboration between stem-cell researchers and physical scientists started at an event to bring researchers from different fields together.

A transatlantic project to investigate the use of nanomaterials in stem-cell growth can trace its roots back to a small meeting that included the use of chocolate bars and pieces of fruit in ice-breaker sessions and dinner above the Roman Baths in the historic city of Bath. It was at this meeting that Peter Donovan, a stem-cell researcher at the University of California, Irvine, and Alan Dalton, a materials physicist at the University of Surrey, first heard about each other's work.

The meeting was organized by SETsquared — an initiative by four universities in the south of England to support new technology companies — and brought together clinicians and a wide range of researchers. At the meeting Donovan learned about the carbon nanotubes and nanostructures that physicists could make, while Dalton realized that the materials he had been making for years could be used as scaffolds for cell engineering. It became clear to both that working together was the way to go. Back in Surrey, Dalton convinced Richard Sear, a theoretical biological physicist, to join the team. Together, they will probe how stem cells grow and respond to their material environment.

"It would have been very difficult for either group to have worked independently on the project," says Donovan, "because of the expertise required for each part of the project. I think we all knew that we had more to gain by working together and that there was no real danger of one member of the group easily gaining the expertise to do the other parts of it and walking away with the whole project".

"As a physicist, this type of study would normally be outside my comfort zone," says Dalton, "and I would never have entered this area unless we were working with the very best stem-cell people".

The definitive versions of these Research Highlights first appeared on the *Nature Nanotechnology* website, along with other articles that will not appear in print. If citing these articles, please refer to the web version.