COVER STORY

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Working out how to make and control wheels at the molecular level could have significant implications for nanotechnology. Now, Leonhard Grill and co-workers show how a molecular 'wheel' with three spokes (but no rim) can be rolled across a copper surface using the tip of a scanning tunnelling microscope (STM). Organic molecules comprising two wheels joined by an axle are deposited onto the surface. The STM tip is then lowered into close contact with one of the wheels and moved horizontally with respect to it. The manner in which the molecules move depends on many factors, including how they are aligned with respect to the underlying rows of copper atoms, the distance between the tip and the molecule, and the direction of tip movement. In some cases, the clear signature of a rolling motion — rather than the more usual hopping motion — is observed for the first time at the nanoscale. **[Letter p95; News & Views p82]**

SILVER LINING

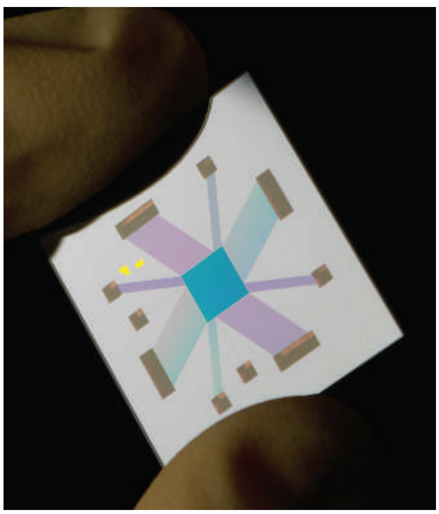
Images of quantum corrals and other two-dimensional structures created by scanning tunnelling microscopes (STM) have graced magazine covers around the world. However, these structures must be built atom by atom with the STM, which makes the process very time-consuming. Johannes Barth and co-workers have now demonstrated that similar structures can be built by allowing molecules to self-assemble on a silver surface. They show that self-assembled molecular gratings can act as one-dimensional resonators, and that single iron atoms can be positioned in such structures so that surface electrons are confined in quantum corrals as small as 2 × 5 nm in size. In addition to their role in experiments that explore and visualize aspects of quantum mechanics, these structures could also lead to the development of new materials and devices. **[Letter p99]**

SENSOR SENSE THYSELF

Scanning probe microscopes and various sensors rely on small mechanical cantilevers for their operation. In general, optical techniques are used to measure the movement of the cantilever in response to some force or object. The sensitivity of cantilever devices increases as they get smaller, but the optical readout approach is no longer suitable when the size of the cantilever becomes comparable to the wavelength of the light used. Now Michael Roukes and colleagues show that a self-sensing approach based on the piezoresistive effect can work at the nanoscale. They deposit a thin layer of gold on the cantilever and measure how its resistance to electrical current changes as the cantilever bends in response to forces and objects. They go on to demonstrate an unprecedented mass resolution of less than 1 attogram (10^{-18} g) at room temperature and ambient conditions. **[Article p114; News & Views p81]**

GOING THEIR SEPARATE WAYS

The separation of biological samples into their component parts is often achieved by sieving them through porous gels and is usually performed in a batch process that can be difficult to optimize. However, an alternative approach that offers improvements in both speed and resolution is the use of microfabricated arrays with periodic structures. Now, Jongyoon Han and co-workers have shown that mixtures of DNA or proteins can be separated in a continuous mode of operation using a nanofluidic device in which a set of parallel deep channels are connected by narrow ones that run perpendicular to them. The ease with which molecules can pass through the narrow gaps determines their trajectory through the filter array and leads to size- or charge-based separation. **[Article p121; News & Views p79]**



Sorting out DNA and proteins. p121

BREAKING DOWN BARRIERS

The successful use of nanomaterials for biomedical and biotechnological applications not only depends on reducing any potential toxicological effects, but also on their ability to effectively cross biological boundaries. Of particular interest are carbon nanotubes and their role as platforms for the targeted delivery of drugs. Now, Kostas Kostarelos, Maurizio Prato, Alberto Bianco and co-workers show that a range of chemically modified nanotubes can be internalized in a wide variety of different cell types, including mammalian, fungal and bacterial cells. Although the precise mechanism by which the cellular membranes are crossed is still not clear, it is suggested that the nanotubes, which have high aspect ratios, could be acting as nanosyringes that puncture the walls of the cells. **[Letter p108]**

GO WITH THE FLOW

Probing the unusual behaviour associated with fluid flow through confined nanoscale geometries will require easily integrated local fluid sensors. Bertran Bourlon, Mark Bockrath and co-workers have designed an ionic fluid-flow sensor from a single carbon nanotube. In their device, a stream of ions generates a voltage in the vicinity of the nanotube that shifts its conductance. This shift is linearly proportional to the flow rate, so the sensor can be easily calibrated. Although the sensor does not yet operate at the theoretical minimum, it already measures flow rates as low as 25 μl per minute. To put this in perspective, at this rate it would take almost a month to fill a bottle of milk! **[Letter p104]**