PARASITOLOGY

Peculiar lipid production

African trypanosomiasis — or sleeping sickness — kills about 50,000 people each year according to the World Health Organization. Lee *et al.* (*Cell* **126,** 691–699; 2006) report that the parasite responsible (*Trypanosoma brucei*, pictured) has an unusual way of making a lipid it requires to survive in the blood stream.

The extracellular surface of *T. brucei* is covered in proteins that are attached to the membrane through glycosylphosphatidylinositol (GPI) anchors. The bloodstream form of *T. brucei* needs a 14-carbon fatty acid to make the GPI anchors, and this molecule — named myristate — is essential for pathogenesis. Whereas most organisms synthesize fatty acids using type I or type II fatty-acid synthases, Lee *et al.* find that in *T. brucei* myristate is made by a series of enzymes called elongases. As their name implies, these enzymes extend the fatty-acid chain, adding two carbon atoms at a time to a fatty acid that is attached to coenzyme A (CoA).

The authors examined four candidate elongase (ELO) gene products and determined that ELO1 converts a 4-carbon CoA into a 10-carbon fatty acid; ELO2 uses a 10-carbon CoA to synthesize myristate; ELO3 converts a 14-carbon CoA into an 18-carbon fatty acid; and ELO4 elongates arachidonoyl-CoA into a 22-carbon fatty acid. It was previously known that ELOs could extend long fatty-acid chains, but this is the first example of a parasite that uses ELOs instead of type I or type II fatty-acid synthases to make a large fraction of its fatty acids.

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The authors then examined two related parasites (*Leishmania major* and *Trypanosoma cruzi*) and determined that both organisms contain ELOs that are probably involved in fatty-acid biosynthesis. Additional work is needed to explore how ELOs function *in vivo*, but the authors suggest that it may be possible to exploit this unique pathway to develop new anti-parasitic drugs.

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any further. Researchers hope that by then new-style bottom-up devices will be ripe for commercial use. Designing structures at the nanometre scale allows the quantum-mechanical properties of matter to be exploited and devices with unprecedented functions to be built. Indeed, the 'qubits' that are the basic units of quantum computing were recurring stars of the Basel conference — most frequently in their incarnation as single electrons confined within the islands of semiconductor material known as quantum dots. Although it is unlikely that the next generation of computer chips will be based on quantum logic, significant progress is being made in constructing practical qubits to allow logic operations in a small circuit (Lieven Vandersypen, Delft Univ. Technology)[1].

Devices and electronic materials based on the properties of tailor-made molecules are also being designed. In various theoretical proposals and experimental realizations, single molecules sandwiched between two electrical contacts work as miniature electronic devices — as rectifiers, for example, which admit current in only one direction. The leap from constructing a prototype single-molecule device to integrating it into a larger-scale electronic circuit with reliable characteristics is clearly a big one. Here, the principle of 'self-assembly' is often exploited, in which anchor groups are chemically attached to molecules, forcing them to grab hold of surfaces and form an organized layer.

An innovative self-assembly approach reported at the conference involved the creation of a two-dimensional network in which organic molecules form electrical links between metal nanoparticles (Laetitia Bernard, Univ. Basel)[2]. First, the nanoparticles order themselves in a neat array, and are electrically isolated from each other by an insulating layer. After immersing this array in a solution of conducting organic molecules, its electrical resistance falls by several orders of magnitude, a drop ascribed to the organic molecules forming conducting links between the particles (Fig. 1). The organic molecules can be discarded, returning the system to an insulating state, and the high and low values for resistance can be reproduced over many cycles, indicating that a highly ordered network of molecular junctions is formed each time. The researchers claim that their network is a robust platform that can be used to experiment with other tailor-made molecules and nanoparticles and so create more complex nanoscale electronic circuits.

Taking the bioroute

Molecular electronics is an area where physicists have forged fruitful collaborations with chemists. Other physicists have crossed over to the life sciences, where there are many challenging problems to tackle at the single-molecule scale. Among the topics discussed at the conference were sensitive detectors for biological molecules in solution (Scott Manalis, MIT); what kind of tool can unfold single strands of RNA (Cees Dekker, Delft Univ. Technology); and whether a microscope can be constructed to determine the chemical structure of a complex three-dimensional molecule (Dan Rugar, IBM Almaden Research Center).

A basic tool now widely used for imaging biological structures is a cousin of the STM called the atomic force microscope (AFM). Instead of a sharp metallic needle, the AFM uses a thin vibrating strip of material — a cantilever — to feel the contours of a surface, potentially at nanometre resolution. The imaging process is based on the sensitive dependence of the cantilever's resonance frequency on interaction forces with the surface.

In a variation on this principle, microscale or nanoscale resonators have been found useful as stand-alone devices for sensing molecules or small particles and detecting their mass. At the ultimate detection limit, a nanoscale resonating strip cooled to cryogenic temperatures can weigh clusters of atoms down to a mass resolution of 7 zeptograms (7×10^{-21} g) (Michael Roukes, Caltech)[3]. That is equivalent to just 30 atoms of xenon. At the other end of the spectrum, micro- and nanoelectromechanical sensing systems that are cheap, portable, easy to use and have an integrated read-out are being developed for large-scale scientific or commercial applications, such as detecting chemical substances or monitoring biochemical reactions (Anja Boisen, Tech. Univ. Denmark)[4].

Creative buzz

Many of the early STM enthusiasts were present in Basel, including Heinrich Rohrer and Gerd Binnig, the IBM researchers who shared the 1986 Nobel Prize in Physics for the technique's invention. Among the anecdotes was the story that the first seminal paper reporting the new technique was rejected by a leading physics journal: hindsight is indeed a wonderful thing. Nowadays, STM and AFM are used in a huge variety of studies, including the effect of green tea on health by imaging cell structure, detecting acoustic bursts in butterfly cocoons and even as one source of ideas for a new form of science-inspired dance, as entertainingly demonstrated in a plenary talk (Jim Gimzewski, UCLA).

Indeed, a remarkable, almost contagious, creative activity in nanoscience was evident at ICN+T 2006. A point emphasized time and again was the importance of doing things that seem crazy at first glance. As one contributor put it at the end of his presentation, "I wonder if this will work, but I am going to try it anyway." ■

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3. Yang, Y. T., Callegari, C., Feng, X. L., Ekinci, K. L. & Roukes, M. *Nano Lett.* **6,** 583–586 (2006).
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