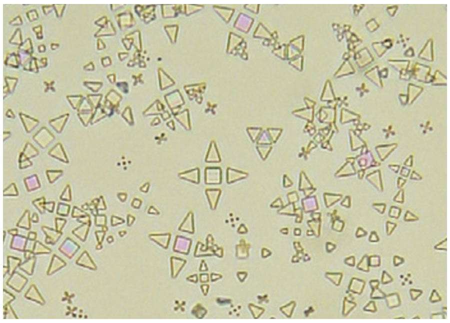
SELF-ASSEMBLY

A Venus flytrap for cells

Nano Lett. **14,** 4164–4170 (2014)



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Because cell cultures, tumours and tissues are heterogeneous, tools that can capture and analyse individual cells are important for diagnosis, therapy and surgery. There are many techniques to analyse single cells and some robotic devices can trap and manipulate particles and cells quite precisely. However, few tools can do this in narrow conduits such as blood vessels. Now, David Gracias and colleagues at Johns Hopkins University and the United States Army Research Laboratory report a self-folding 'gripper' that can capture single cells without the need for any external batteries to move the parts.

Inspired by previous work on stress-based folding of thin films, the researchers used photolithography to create arrays of grippers on silicon wafers that could be used either as analytical assays or released as free-floating tools for capturing cells. The grippers consist of four flexible arms made of thin films of SiO and SiO_2, which are connected to rigid segments formed from thicker films of SiO. The thickness of the films can be varied to control the desired angle of folding. Differential compressive stress between the SiO and SiO_2 films cause the grippers to fold on their own. When fibroblast cells were pipetted on a substrate consisting of attached grippers, live single cells could be captured within the arms of the grippers. The gap at the intersection of the arms allowed nutrients, waste and biochemicals to flow in and out. Free-floating grippers could capture red blood cells from a sample of beagle blood. *ALC*

QUANTUM DEVICES

Anomalies explained

Nature Commun. **5,** 4290 (2014)

A quantum point contact is a constriction in a two-dimensional (2D) electron gas formed by electrostatic gating. Applying a negative voltage to a pair of split gates depletes the electron gas underneath, resulting in the confinement of the carriers to a (quasi) 1D channel. The conductance of the channel is quantized in multiple values of the quantum $G_0 = 2e^2/h$, where e is the electron charge and h is the Planck constant. However, there are anomalies in the transport characteristics whose origin is still debated. A feature is observed at a conductance of $0.7G_0$, and a zero-bias peak is observed in the differential conductance. Contrasting models have been put forward to explain these anomalies. Now, using scanning gate microscopy, Hermann Sellier and colleagues have shown that the presence of localized charges in the channel can explain both of the anomalies.

The researchers — who are based at the University Grenoble Alpes, the Institute Néel in Grenoble and other institutions in France and Belgium — use the tip of the microscope to locally alter the electrostatic potential of the point contact and study its transport features, at a temperature of 20 mK. As they vary the tip–sample distance, they observe the oscillatory appearance of the 0.7 anomaly and at the same time a splitting of the zero-bias peak. They explain these results with the formation of a chain of localized electrons, called a 1D Wigner crystal, which forms as a result of the Coulomb interaction between electrons when their density is sufficiently low. The odd or even number of electrons in the chain gives rise to two different types of Kondo effect, whose signatures are found in the scanning gate microscopy measurements. *ED*

NANOPHOTONICS

A genetic approach

Appl. Phys. Lett. **104,** 241101 (2014)

Photonic crystal cavities can confine light of specific frequencies to small volumes of a few hundred nm^3. In such artificial structures it is possible to achieve very strong coupling between light and matter, and for this reason, photonic crystal cavities could be essential elements in photonic circuits. It is, however, important to optimize their quality factor, which is a measure of how precisely defined the frequency of the confined light is. Antonio Badolato and colleagues at the University of Rochester, the University of Pavia and the Ecole Polytechnique Federale de Lausanne have now found a way to design photonic crystal cavities with optimized quality factors.

A photonic crystal is a semiconductor slab with a periodic array of holes. A photonic cavity is created by fabricating photonic crystals with one or more holes missing from the array, thus leaving a small area where light can be trapped. The quality factor can be improved by varying the size and position of the holes surrounding the cavity. Efforts in the past have been based primarily on educated guesses on how these geometric parameters should be varied. Badolato and colleagues have instead used a procedure that works by finding the structures with the highest quality factors from a population of candidates by successive optimization, a process resembling genetic evolution. The designs were used to fabricate silicon photonic crystal cavities that exhibited quality factors that were an order of magnitude higher than those previously reported. *FP*

MOLYBDENUM DISULPHIDE NANOPORES

Better than graphene?

ACS Nano http://doi.org/trz (2014)

Nanometre-sized holes in a membrane could potentially be used to sequence DNA quickly and at low cost by threading single strands of the molecule through the pores under an applied potential; the DNA bases are read by measuring modulations in the ionic current passing through the pore or with the help of a transverse tunnelling current. These nanopores are typically made from solid-state materials such as silicon nitride or are biological nanopores such as α-haemolysin. Recently, graphene-based devices have also been explored, which could provide single-base resolution because of the atomic thickness of the material. Narayana Aluru and colleagues at the University of Illinois at Urbana-Champaign now suggest that MoS_2 could in fact be a better choice of two-dimensional material for creating nanopores.

The researchers used molecular dynamics simulations to explore the translocation of double-stranded DNA through a MoS_2 nanopore with a diameter of 2.3 nm. Distinct ionic current signals for each of the four DNA bases were observed, and a signal-to-noise ratio of around 15 was calculated. In comparison, the signal-to-noise ratio for graphene nanopores was calculated to be around 3. Furthermore, the simulations showed that, whereas bases stick to graphene during translocation, DNA does not adhere to the MoS_2 nanopores. Aluru and colleagues also illustrate — with the help of density functional theory simulations — that MoS_2 nanopore devices could potentially be used to detect bases via transverse tunnelling measurements. *OV*

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Corrected online: 13 August 2014

Correction

In the Research Highlight 'Quantum devices: Anomalies explained (*Nature Nanotech.* **9,** 567; 2014) the wording regarding the researchers' affiliations should have ended "...and other institutions in France and Belgium...". This has now been corrected in the online versions, after print: 13 August 2014.