Dynamic twins

Phys. Rev. Lett. **102,** 205504 (2009)

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Twinning, whereby crystallographic layers are shifted with respect to each other so that the atomic planes are misoriented, is an important process during plastic deformation. Whereas twinning is a common occurrence in many metals, it is rare in aluminium owing to high formation energies of the crystallographic stacking faults that precede twinning. To study the details of twinning in aluminium under tensile strain, B. Q. Li and colleagues have reverted to *in situ* high-resolution transmission electron microscopy. Twinning was observed during crack propagation and even when the sample was merely held in a stable loaded state. However, after a few minutes in the stable state, the reverse detwinning process began as the applied stress decreased. Computational simulations confirm these observations and explain that the high stacking-fault formation energy makes detwinning energetically favourable as soon as the strain is reduced. Detwinning realigns the crystallographic planes and thus leaves no evidence in post-mortem observations of deformed aluminium. These *in situ* observations therefore not only confirm twinning, but also explain why it has been so difficult to study this process in aluminium.

On the edge

Lab Chip doi:10.1039/b904769g (2009)

Wet chemical etching is frequently used to fabricate glass microfluidic chips. A patterned mask is initially deposited on a glass surface. The glass is then immersed in an etchant solution that dissolves the exposed surface. However, the structure of glass means that the width of the channels increases more quickly than the depth, usually giving an aspect ratio of <5. Guoan Luo and colleagues have overcome this problem by using the phenomenon of laminar flow and a polydimethylsiloxane (PDMS) layer. A three-pronged channel is made in the layer that is attached to the glass surface. A buffer solution flows in the outer channels and the etchant flows in the middle. The buffer solution acts as a mask, protecting the side walls of the channel and allowing the etching of a channel with an aspect ratio of ~1. The PDMS layer can then be removed and the plate joined to other surfaces. The simplicity and low cost of this method makes it a promising option for microchip fabrication.

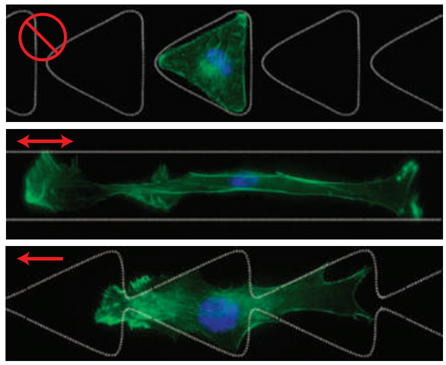
The power of three

Nano Lett. doi:10.1021/nl9012387 (2009)

Quantum dots (QDs) offer considerable advantages in bioimaging compared with organic fluorophores. However, despite the fact that QDs are only a few nanometres in size, the optical resolution of QD imaging is still a substantial fraction of the emitted fluorescence wavelength, according to the so-called diffraction limit. The maximum resolution is typically about 200 nm. Although efforts using various optical strategies have improved this resolution, the methods used are all complex. The solution proposed by Simon Hennig and colleagues is, on the contrary, rather simple. Their QD triexciton imaging (QDTI) is based on the fact that the fluorescence emitted via the recombination of three electron–hole pairs (or excitons) is at a shorter wavelength than the light corresponding to the recombination of one or two excitons. The team demonstrated *in vivo* QDTI imaging with a relatively standard optical microscopy set-up and commercial CdSe QDs, achieving almost double the lateral resolution and depth of focus than in the routine imaging mode.

Cells sorted

Nature Phys. doi:10.1038/nphys1306 (2009)



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Cells of different types are separated by Bartosz Grzybowski and colleagues using differently micropatterned 'ratchet' surfaces. The researchers etch shaped tracks into gold-covered titanium on glass substrates, coating the gold around the tracks with a self-assembled monolayer that resists cell adhesion. On disconnected triangles the cells do not move, and on straight-edged channels they move randomly in both directions. On the triangular ratchet channels, however, the cells move in a preferential direction by extending a protrusion into the adjacent triangle, which can anchor on the triangle's 'back side'. If the cell tries to move in the other direction, the protrusion cannot anchor because of the smooth funnelling shape it encounters. When two types of cells are used a spiked ratchet channel provides greater anchoring potential in different directions for each type of cell, because of their differing protrusion sites. This causes the cells to separate into reservoirs at opposite ends of the channel. The micropatterned ratchets are better than chemical gradients used for similar purposes, as they are not cell-specific and don't degrade over time. This technique could lead the way to separation of cancerous from healthy cells.

Shiny photonic crystals

Nano Lett. doi:10.1021/nl901232p (2009)

Methods based on wave optics, such as diffraction gratings and photonic-crystal design, have been proposed for enhancing optical absorption. And although theoretical studies have suggested that photonic-crystal geometries could improve the efficiency of organic solar cells, experimental demonstration is still lacking. Edward Samulski and colleagues now report an organic solar cell comprising a two-dimensional periodic photonic crystal made from highly ordered arrays of columnar structures. The photonic-crystal nanostructures are prepared in a single step with a non-wetting and scalable pattern-replication method. The nanostructures are subsequently embossed in the photoactive bulk heterojunction layer resulting in a threefold absorption increase, which is partly due to multiple excitation resonances. Efficiency improvement of 70% resulted not only from greater absorption, but also from electrical enhancement of the fill-factor and open-circuit voltage. The authors believe that their approach can be used to target specifically desired regions of the solar spectrum for photonic designs that show multiple resonances.