Non-friction

Nature Nanotech. http://doi.org/p5r (2013)

It's impossible to get rid of friction completely — but under certain conditions, friction between two solid surfaces can almost vanish. This phenomenon, known as superlubricity, has been observed at the nanoscale and microscale in high vacuum; but its existence at larger scales is questionable because of structural deformation. Rufan Zhang and colleagues, however, show that superlubricity can occur under normal conditions even in centimetre-long structures.

Zhang *et al.* placed double-walled carbon nanotubes — one nanotube inside another, like a sword in a sheath — on a silicon nanorod. Using the tip of a scanning electron microscope, they then pulled out the inner nanotube, with the nanorod acting as a force sensor. The whole process was monitored under an optical microscope using nanoparticles attached to the nanotubes as visible markers.

The authors registered friction between the nanotubes that was as low as 1 nN and independent of the pull length. The existence of superlubricity in these conditions is unexpected and the observations may improve our understanding of friction and micro-and macroscales. *IG*

Bottoms up

Phys. Rev. Lett. **111,** 181801 (2013)

The LHCb collaboration at CERN report the first observation of the decay of one *B* meson into another. A meson is a quark–antiquark pair, and *B* mesons are so-called because they contain a bottom, or *b*, quark. In previous measurements of the decays of *B* mesons, it's been the *b* quark that decays to a charm quark through the weak interaction, with the other quark of the meson as a spectator. But LHCb has picked up the decay of B_c^+ — a bound antibottom–charm pair — in which the antibottom quark is the spectator instead, and the charm quark undergoes a weak interaction to produce a strange quark, alongside two light quarks.

Specifically, the team have used 3 fb^{-1} of data from proton–proton collisions in the Large Hadron Collider at centre-of-mass energies of 7 TeV and 8 TeV to access distinct signatures of the B_c^+ decay. It's a satisfying 'first', but these measurements will also serve to constrain models of the production and decay of particles, to better understand many of the interactions taking place inside the LHC. *AW*

Photons on the edge

Nature Photon. **7,** 1001–1005 (2013)

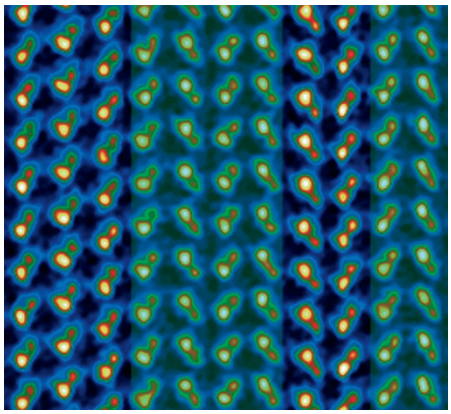
Conducting electron states at the edge of an insulating material are robust against perturbation — and a rich treasure trove of physics is also promised by these 'topological insulator' systems. Observing some of these effects in condensed-matter systems, however, is made difficult by material impurities. Instead, Mohammad Hafezi and colleagues have now demonstrated photonic topological edge states: their approach provides an optical test-bed for the physics of topology and its effects.

Hafezi and his team created an array of optical ring microresonators on a silicon substrate. The resonators were connected in such a way that a photon could hop from one to its nearest neighbour, and in doing so the photon would acquire a phase that was dependent on whether it was hopping forwards or backwards. The Hamiltonian describing this system is analogous to that of two-dimensionally confined electrons in a magnetic field, and thus it should exhibit the same edge states.

And indeed it does: the researchers imaged light inserted into one corner of the array and confirmed that it propagated along the edges, even when defects were intentionally introduced. *DG*

Material mix

Adv. Mater. http://doi.org/p34 (2013)



Mixing compositionally identical but structurally different crystals in a controlled way creates a polytypic metamaterial with potentially useful optical or electronic properties. The prototypical mix is that of wurtzite and zincblende structured crystals of a III–V compound such as indium arsenide. In terms of the stacking of InAs bilayers, the (hexagonal) wurtzite structure is represented by the ABAB… sequence and (cubic) zincblende as ABCABC… (the sequences of letters indicate bilayers that are shifted relative to each other).

Nanowires, with their large aspect ratios, are at present the best platform for the controlled growth of polytypes. And now, Luying Li and colleagues have determined the local electric polarization fields in a polytypic InAs nanowire using electron-microscopy techniques — an exemplary piece of structure-property analysis.

From high-resolution images of the projected positions of atomic In and As columns (pictured), Li *et al.* were able to derive the spontaneous polarization throughout wurtzite structured InAs regions: these lack inversion symmetry, a prerequisite for polarization. The authors found that the polarization values vary significantly along the stacking direction, and attribute this variation to strain that develops from the wurtzite–zincblende interfaces. *BV*

Written by Iulia Georgescu, David Gevaux, Abigail Klopper, Bart Verberck and Alison Wright.

Minimal contact

Nature **503,** 385–388 (2013)

The design of a superhydrophobic surface can be thought of as an optimization problem: liquid droplets spend as little time as possible in contact with the perfect candidate material. Hydrodynamics would seem to offer a natural lower limit on this contact time, but James Bird and co-workers have gone below the theoretical minimum by engineering surfaces that redistribute the droplet mass, effectively changing the hydrodynamics of the problem.

Theory suggests that contact time is minimized by a surface with just enough texture to trap an air layer below the liquid. And because droplet dynamics look increasingly axisymmetric in this limit, common wisdom holds that axisymmetric recoil, in which the droplet's centre remains stationary, corresponds to the shortest contact time. But Bird *et al.* reasoned that if the liquid at the centre actually assisted the recoil, contact time might be reduced below the theoretical limit.

The team fabricated macrotextured surfaces designed to induce asymmetric recoil, resulting in a non-uniform velocity field — and contact times that were significantly shorter than those on smooth surfaces. As well as testing their engineered surfaces, they also observed centre-assisted recoil on the wings of the Morpho butterfly, and on nasturtium leaves, both of which have similarly textured superhydrophobic surfaces. *AK*