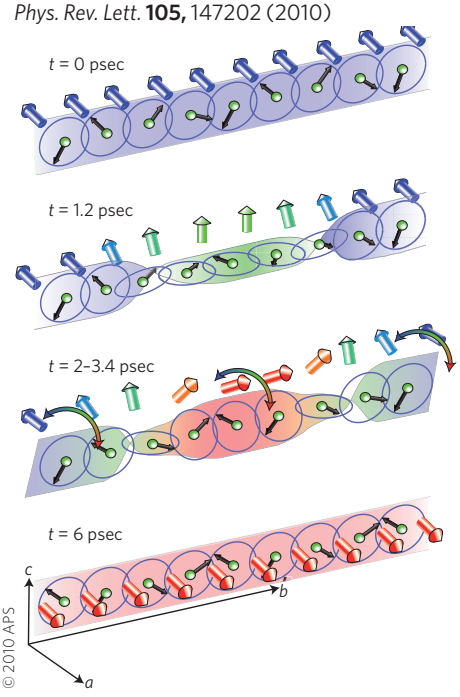
A fast switch

Phys. Rev. Lett. **105,** 147202 (2010)



The storage of information as magnetic signals is used for devices such as computer hard drives and magnetic stripes on credit cards. Key to the fast writing of data is the speed at which the orientation of the local magnetic fields can be switched. Masahito Mochizuki and Naoto Nagaosa from the University of Tokyo have now discovered a method that achieves ultrafast switching of magnetic information in chiral magnetic structures. They have studied the excitation of collective excitations of spins, so-called magnons, by light in the terahertz regime. For optical pulses of the correct strength, shape and length, the chirality of the magnetic spins switches within a few picoseconds. This is much faster than conventional mechanisms and occurs via a new pathway. Rather than directly turning the spins around, the optical pulse instead changes the underlying energetic potential of the spin states, so that one chirality is favoured over the other. Although the switching of magnetization by optical pulses in the terahertz regime seems unfavourable for applications, this mechanism could provide a generic template for similar switching of magnetization in other systems.

Molecular stamping

Nano Lett. doi:10.1021/nl102409d (2010)

Replication of features above 10 nanometres by moulding with elastomeric polymers can now be achieved routinely. Below this length scale replication is still a challenge as the feature size approaches that of the monomers used. However, because the theoretical limit of this approach is governed by accessible volumes, atomic radii and polymer–surface interactions, successful replication at subnanometre length should be possible in principle. George Whitesides and colleagues now take advantage of the regular arrays of single molecular-height steps on the faces of ionic crystals to demonstrate that the flexibility, very low interfacial free energy and resistance to contamination of hard-polydimethylsiloxane leads to replica moulding with subnanometre resolution. Elementary steps 3–5 Å in height, which define the minimum separation between molecular layers in the lattices of the ionic crystals potassium dihydrogen phosphate and calcite, show replication at the molecular scale.

On the right spot

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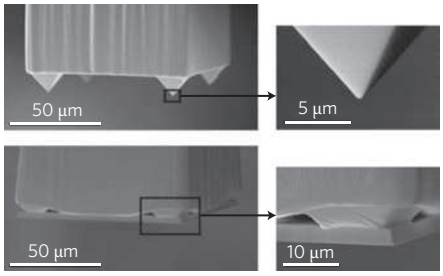
The optical spectrum of semiconductor quantum dots (QDs) consists of sharp lines similar to those of atoms, and because of this QDs are considered a candidate system for quantum information devices. A serious challenge however, is the control of their position inside devices. Minisha Mehta and colleagues have now reported a technique for growing (In,Ga)As QDs with high positioning precision in light-emitting diodes. The dots were grown in the middle of crossbar p-i-n GaAs devices. The team used a focused ion beam to create small dips in pre-established spots on the thin intrinsic GaAs layer. When the In was introduced in the growth chamber it diffused primarily towards the centre of the dips, and small InGaAs dots were created exactly where desired. The growth conditions were carefully tuned so that mostly one QD would be created in each dip. It was confirmed that the electroluminescence retains the character of the optical emission found in the best quality QDs. These results could have strong potential for the realization of electrically controlled quantum devices.

Insect-inspired adhesives

Proc. Natl Acad. Sci. USA **107,** 17095–17100 (2010)



The climbing abilities of geckos stem from van der Waals forces between their microstructured toe pads and the contact surface. In addition to adhesive structures on their feet, sap-sucking insects like aphids have organs that enable them to stick reversibly to surfaces. The organs expand by an increase of blood pressure and retract by contraction of tibial muscles. Inspired by this mechanism, Rogers and collaborators fabricated an elastomeric stamp for transfer printing. The stamp is a square with pyramid-shaped microtips placed at its corners. When the stamp is strongly pressed against a silicon platelet, the microtips collapse, allowing maximum contact for the van der Waals adhesion between stamp and platelet. When the stamp is lifted, the platelet and microtips return elastically to their original shape; thus only the tips remain in contact with the platelet, which can then be easily transferred to another surface. Changes in contact area can switch the strength of adhesion by a factor of 1,000. This printing method has important consequences for the manipulation and assembly of microobjects.

Organic DNA detection

Adv. Mater. doi:10.1002/adma.201000790 (2010)

Organic thin-film transistors (OTFTs) have been suggested as low-cost biochemical sensors, owing to easy processing and chemical tunability. So far, however, the *in situ* recognition of oligonucleotides has remained an outstanding challenge, not least because of the sensitivity of many organic semiconductors to water. Hadayat Ullah Khan and colleagues have now developed an OTFT-based sensor that detects single-stranded DNA (ssDNA) with high selectivity and sensitivity. The researchers report measurements at concentrations down to 1 nM, as well as the detection of mismatches as small as a single base-pair. Their microfluidic device is based on a bottom-gate transistor that is covered with a 5-nm-thin film of a polymeric dielectric. This top layer is functionalized with peptide nucleic acid that can bind to complementary ssDNA. The negative charge of attached DNA strands then leads to a local surface potential that reflects the affinity of the hybridization reaction and effectively modifies the current through the OTFT. With the device having operating voltages below 1 V, the researchers suggest it may find applications in integrated sensor platforms.