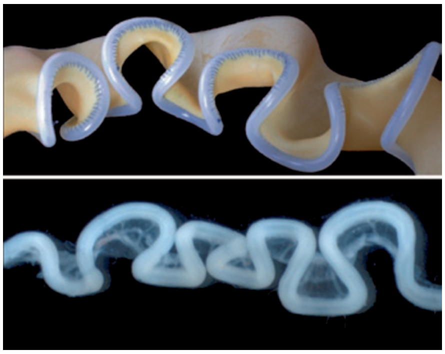
research highlights

Gut folding

Nature **476,** 57–63 (2011)



The gut in vertebrates is a folded tube attached to the mesentery — a sheet-like structure that connects the tube to the abdominal wall. Attempts have been made to explain the origin of the gut's characteristic looped patterns, which are reproducible in individual organisms but show variations across species, by invoking distinct diets and packing constraints in body cavities. Mahadevan and colleagues, using a combination of experiments, simulations and scaling laws, now show that the size and shape of the folds in the vertebrate gut can be described quantitatively by a simple theory that accounts for the differential growth between the tube and the mesentery, and for the geometric and elastic properties of these two tissues. To show this, they built a synthetic replica of the gut that consists of a stretched thin rubber sheet (the mesentery) stitched along its boundary to an unstretched, straight rubber tube — the imposed differential strain mimicking the differential growth of the two tissues. When allowed to relax, the rubber model folded into a structure reminiscent of the natural gut. *PP*

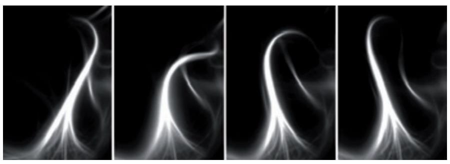
Out of the wire

Nano Letters **11,** 2584–2589 (2011)

(Ga,Mn)As is the model ferromagnetic semiconductor, used to demonstrate prototype devices that merge the suitability of semiconductors for electronics with magnetism. Unfortunately the Curie temperature T_C has never gone beyond 190 K, a real obstacle for the material to become mainstream. Lin Chen *et al.* have now increased T_C to 200 K by making (Ga,Mn)As nanowires. The main problem so far has been doping with Mn atoms. The more Mn is introduced to substitute Ga, the higher T_C, in principle. However, beyond a certain threshold Mn atoms locate between Ga atoms rather than substituting them, which in fact decreases T_C. A way to get rid of interstitial Mn atoms is to diffuse them out by thermal annealing. By patterning their material in nanowires, Lin Chen and colleagues have increased the surface available for the interstitial to diffuse out. They increased T_C from an original 160 K to 200 K, but it may go even higher. It may not always be true, but in this case going to the nanoscale certainly helps. *FP*

Beating in sync

Science **333,** 456–459 (2011)



Cilia and flagella — tail-like protrusions that some cells have — can undergo self-sustained beating patterns that drive active cell motion. In eukaryotic cells, the core of these protrusions consists of an ordered bundle of microtubules and, among hundreds of proteins, dynein motors. Dyneins cause neighbouring microtubules to slide against each other by walking on a microtubule while being attached to an adjacent one. Elastic connectors between microtubules transform sliding into bending, and the regulated activity of thousands of dyneins causes oscillatory beating. Zvonimir Dogic and colleagues have now found a minimal *in vitro* system that mimics the beating patterns of cilia. The system is composed of microtubules, clusters of kinesin motors and a non-adsorbing polymer. Entropic depletion of the polymer drives microtubule bundling, whereas microtubule–kinesin interactions cause the bundled microtubules to beat as in native cilia. Surprisingly, dense arrays of active bundles spontaneously beat in sync, just as ciliary fields do. Such a minimal system could serve to further decipher the mechanistic origin of the synchronized beating of cilia and flagella. *PP*

DNA lithography

J. Am. Chem. Soc. **133,** 11868–11871 (2011)

The design of DNA molecules that readily fold into arbitrary shapes — DNA origami — holds promise for the bottom-up fabrication of nanoscale devices, both through DNA-directed self-assembly and nanopatterning processes. The patterning of inorganic substrates with DNA templates usually requires the deposition of intermediate mask layers as these molecules are sensitive to common dry etchants. Haitao Liu and colleagues now show that SiO_2 surfaces can be patterned using self-assembled DNA alone in a vapour-phase etching process. Owing to a difference in affinity towards H_2O, deposited DNA molecules modify the local water concentration on SiO_2 surfaces. The etching rate of these surfaces with HF gas, in turn, increases in the presence of adsorbed water. The researchers exploit this dependence to modulate the etching rate in close vicinity of the DNA molecules. Depending on the relative humidity of the environment, this process allows them to fabricate trench or ridge patterns with feature sizes below 20 nm. On further refinement the method could reach molecular-scale resolution and enable the patterning of additional layers underneath the SiO_2, the researchers suggest. *CM*

Natural plasmonics

Nano Letters http://dx.doi.org/10.1021/nl2018959 (2011)

The light-enhancing effects of plasmonic devices have been widely recognized to be able to boost the performance of solar cells. Mostafa El-Sayed and colleagues now apply this capability to a natural light-harvesting system — the membrane protein bacteriorhodopsin (bR). Used by some bacteria, this protein captures light and uses this energy to create a proton difference across its membrane. This separation of electrical charges has been successfully used to power electrochemical cells, although the observed photocurrents have remained rather low. A problem with the efficiency of the bR photocycle is a bottleneck in the conversion of an intermediate, photoexcited molecular state back to the original state of the protein. This slow conversion can be sped up by the absorption of blue light, but this process hasn't been very efficient. El-Sayed and colleagues now deploy silver nanoparticles in the bR electrochemical cells. The plasmon resonance has been tuned to the blue-light-absorption region of bR so that the large field enhancement close to the nanoparticles accelerates the relaxation of the intermediate state. As a consequence, the photocurrents observed are up to 5,000 times higher than without plasmonic enhancement. *JH*

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