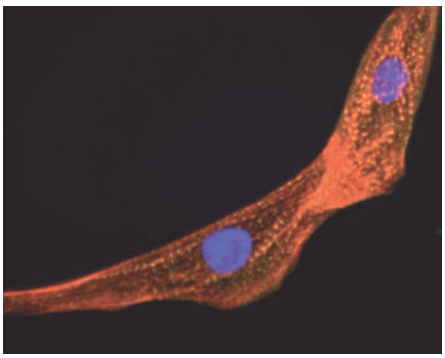
Heartening news

Biomaterials **32,** 1002–1009 (2011)



The elastic modulus or 'stiffness' of a hydrogel scaffold is known to influence the adhesion and behaviour of cells. For example, cells cultured on hydrogels that mimic the stiffness of adult heart (myocardial) tissue, are shown to exhibit the most *in vivo*-like behaviour. Heart tissue, when developing in the embryo, however, originates as a softer tissue called mesoderm and, in the chicken embyro, takes around two weeks to mature. Now, Engler and Young report that a hyaluronic acid hydrogel, which stiffens similarly to the chicken embryo heart, shows improved maturation of embryonic cells. Firstly, the stiffness — and its rate of change — of the developing chicken embryo myocardium is monitored. Then, these materials properties are replicated in the hyaluronic acid hydrogel by adding a crosslinking agent. Compared with a control for which the stiffness remains constant, the embryonic cells plated on the hydrogel are shown to express mature cardiac markers and form assemblies of contractile units, or myofibrils (pictured), that are at the maturing or mature stages of development and alignment.

Quite a stretch

Phys. Rev. Lett. **105,** 226802 (2010)

A lot of mechanical energy in our everyday life is wasted; all the pressure we exert on the ground when we walk, or the energy we spend when we move our limbs. A better use of this energy would make a lot of economic sense. Piezoresistance effects allow exactly this, through the conversion of mechanical stress into an electrical resistance. Unfortunately, piezoresistance effects in materials such as silicon are far too inefficient for practical purposes. Hence reports of a giant piezoresistance in silicon nanowires have been met with considerable interest, as these would indeed allow harvesting of mechanical energy. But, as Jason Milne and colleagues now point out, the actual piezoresistance effect in silicon nanowires is in fact close to the bulk value. A charge accumulation on the surface leads to time-varying effects that mask the true piezoresistance of the nanowires. Although in principle large piezoresistance effects may indeed be possible in nanostructures, these results clearly show that care has to be taken in extracting their values.

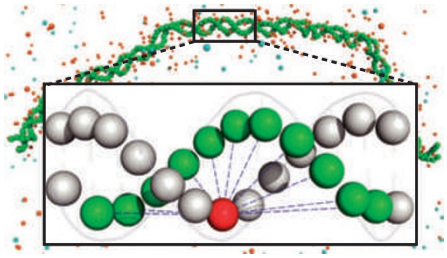
Carbon biosensors

J. Am. Chem. Soc. doi:10.1021/ja104850n (2010)

Field-effect transistors from a single carbon nanotube or a sheet of graphene can detect chemical quantities as small as a few molecules in solution. However, such sensitivity is generally only achieved in well-controlled liquid environments whose composition is very different from the physiological conditions under which these biosensors would ideally operate. In a first step towards the better understanding of complex sensing environments, Iddo Heller and colleagues have now studied the electrical characteristics of carbon nanotube and graphene transistors in different electrolytes. They find that chemical groups on both the carbon and the substrate surfaces can be ionized and screened in the liquid environment, leading to electrostatic gating in the absence of applied device voltages. The magnitude and the polarity of the gating effect depend on the pH and the ionic strength of the electrolyte, and are intriguingly different for graphene and carbon nanotube devices. The authors have developed a model of the electrostatic gating effect that could soon help in the optimization of such nanoscale carbon biosensors.

Accurate model of DNA

Proc. Natl. Acad. Sci. **107,** 20340-20345 (2010)



The persistence length of DNA — an effective length that separates elastic-rod behaviour from that of a fully flexible chain — depends considerably on the ionic environment. Small changes in persistence length can have a large effect in biological processes involving large length- and timescales, such as the folding of chromatin — the condensed structure of DNA and proteins that make up chromosomes. When modelling such processes, it is advantageous to use coarse-grained (CG) models instead of the more computationally expensive atomistic ones. But while gaining in computational speed, CG models often fall behind in accuracy. Now, Savelyev and Papoian report a two-bead model of double-stranded DNA that provides the correct dependence of DNA's persistence length on the ionic strength of the solution, and generates local chain motions comparable to those in fully atomistic dynamics. The model includes explicit mobile ions, and has been parameterized by matching order correlation functions from the CG and all-atom molecular dynamics simulations. Realistic computer simulations of chromatin folding and genome packaging should now be within reach.

Better three than two

Appl. Phys. Lett. **97,** 212104 (2010)

The spin of electrons in quantum dots (QDs) have for long time been considered promising as qubits. It has been shown that through electron spin resonance (ESR) it is possible to control the spins of electrons confined in couples of QDs defined by electrostatic potentials. Tatsuki Takakura and colleagues have now taken a further step towards individually controlling the electron spins in multiple QDs. To address a single spin by ESR, a continuous magnetic field and a rapidly varying one, with frequency specific to the QD, have to be applied. It was previously shown that a micromagnet can be used to generate magnetic field gradients on two QDs. When an alternating voltage is applied to the gates defining the dots, the confined electrons oscillate in the magnetic field gradient, effectively feeling a varying magnetic field. The team has now designed a micromagnet that demonstrates the feasibility of individually addressing the spins of electrons in three adjacent QDs. The results are interesting also because they could be extended to other systems, such as self-assembled QDs.

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