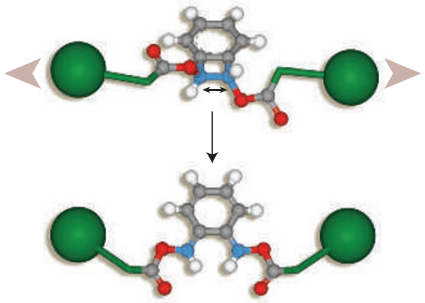
Mechanophore action



Nature **446,** 423–427 (2007)
Mechanical force is hardly a synthetic route in organic materials. For example, polymers tend to break when pulled, rather than rearranging their configuration of covalent bonds. But a study by C. R. Hickenboth and colleagues demonstrates that it is possible to harness the mechanical forces generated through ultrasound on a polymer by introducing in the polymer a mechano–chemically active group, or mechanophore, which contains a four-membered ring that is mechanically strained. The strain can be released by breaking one bond between two of the four carbon atoms and the rest of the molecule will remain linked. The polymer chains attached to both sides of the mechanophore are like handles from which this group can be pulled by its arms, which would otherwise be too tiny to be grabbed. Because the nature of this stimulus is directional, the reaction path for the ring opening is fundamentally different from that of a light- or heat-stimulated reaction. So this work opens up a new avenue to previously inaccessible bond configurations and therefore to different materials.

The rule of G4

Nano Lett. doi:10.1021/nl070013b (2007)
Is DNA an insulator, a semiconductor or a conductor? All possible results have been reported experimentally in the past, and the confusion seems to originate from the practical difficulty of producing reliable contacts. By now the general feeling is that long stretches of the molecule are not capable of conducting electronic carriers. Based on theoretical predictions implying conductivity, Hezy Cohen *et al.* have focused their attention on a close relative of DNA instead, the G4-DNA molecule, formed only by guanine bases. To eliminate the problem of the contacts, the researchers have performed a contactless experiment and measured the polarizability — the carrier response to an external electric field. They observed that unlike in standard DNA, in the G4 molecule carriers move along the chain to compensate the electric field imposed from the outside. It does not demonstrate conductivity yet, but the result is a strong experimental confirmation that G4-DNA could be a good candidate for those who plan to build molecular electronic circuits with our genetic material.

Single-protein chip

J. Am. Chem. Soc. doi:10.1021/ja068654g (2007)
A method of stabilizing a single protein for use as a sensor has been developed by Hagan Bayley and colleagues in the USA and the UK. The protein, α-hemolysin (αHL), has already been used to detect various moieties, including ions, DNA and other proteins. When placed in a lipid bilayer it forms a pore through which the analytes pass. A potential is applied to the bilayer, and the resulting ionic current monitored. The current alters when analytes passes through the pore, enabling their easy detection. The problem is that although αHL itself is robust, the lipid bilayers are not, and are often damaged by high temperatures or mechanical disturbance. To date, no stabilization method has been successful. However, Bayley and colleagues have now simply encapsulated the bilayer-containing αHL within agarose gel, and find that the system is robust, portable and can be stored for at least three weeks. The device is promising for applications such as fundamental studies of membrane channels, and in commercial biosensors.

Cell patterning

Nano Lett. doi:10.1021/nl070098g (2007)
High-precision surface pattering is usually restricted to inorganic substrates because of their electrical properties. And although polymer-based substrates are advantageous in terms of flexibility and functionality, they are often impractical because they are affected by cleaning processes. Joachim Spatz and colleagues now use a transfer methodology to decorate soft polymer surfaces with gold nanostructures prepared by diblock-copolymer micelle nanolithography. This approach can be used for surfaces varying in rigidity from glassy polymers to elastic hydrogels with no obstacles on either pattern precision or functionality. The advantage for cell adhesion is that the polyethyleneglycol hydrogels provide a repellent and inert surface that enables the positioning of larges proteins with a precision comparable to the size of the protein itself. Such a transfer technique should prove powerful for tailoring artificial matrices with specific properties of practical relevance in cell biology.

Shopping for cloaks

Opt. Express **15,** 3318–3332 (2007)
Metamaterials have seen significant recent interest, fuelled by intriguing applications such as cloaking. Although the recent demonstration of a metamaterials cloak is a significant achievement, these structures are rather complex to fabricate. Andrea Alù and Nader Engheta now demonstrate that comparable devices could be fabricated with much less effort by using plasmonic materials. Their idea is based on the negative electric permittivity of such materials near their plasmon resonance. Electromagnetic waves hitting such an object get reflected back, with their phase being exactly inverted. Therefore these objects work similarly to noise-cancelling headphones — any reflection and scatter is eliminated. The additional perfection achieved here is based on the elimination of higher-order scatter by using a material that also has a magnetic permeability larger than that of free space. The scheme is not dependent on perfectly hitting plasmon resonances and therefore represents a feasible avenue towards broadband cloaks, possibly at visible frequencies. The catch? It only works for structures comparable in size to the wavelength in question.