of the four bases — adenine, cytosine, guanine and thymine — in the strand. Now, Kiyohiko Kawai, Tetsuro Majima and co-workers at Osaka University have shown how a small modification to one of these bases can make the conductivity independent of the sequence of bases.

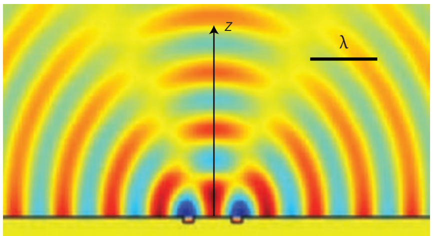
Generally, DNA conducts charge in the form of 'holes' created by the absence of an electron in the highest occupied molecular orbital of guanine bases. Unfortunately, this means that sequences with excess adenine–thymine pairs show much lower conductivity than sequences with excess guanine–cytosine pairs. To overcome this problem, Kawai, Majima and co-workers replaced one nitrogen atom in each adenine molecule with a carbon–hydrogen group to create 7-deazaadenine. This small change raises the highest occupied molecular orbital of each adenine–thymine pair to be closer to that of the guanine–cytosine pairs, without affecting the base-pairing process in the molecules.

The Osaka team tested the charge-transfer properties of several different DNA sequences, and found that all were improved by making this small change to adenine bases. The conductivity could be improved even further by modifying cytosine and thymine.

SURFACE PLASMONS

A new wave

Phys. Rev. Lett. **102,** 153903 (2009)



A surface plasmon is a collective excitation of electrons on a surface. As surface plasmons have much shorter wavelengths than the light that excites them, they have a key role in sub-wavelength optoelectronic devices. Recently, however, they have been joined by another type of surface excitation called a cylindrical wave, and researchers have been working to understand the interactions between these two types of excitations as part of efforts to explain the anomalously high transmission of light through nanohole arrays.

Now, Xiaoyan Yang, Haitao Liu and Philippe Lalanne from the University of Paris-South, Huazhong University and Nankai University have shown through simulations that cylindrical waves can scatter into plasmons and vice versa. The conversion process is expected to happen whenever there are subwavelength particles arrayed on a metal surface. Furthermore, the conversion efficiency is shown to have a simple inverse dependence on the permittivity of the metal surface involved.

The results show that nanostructure arrays on surfaces, which are regularly used to generate and control plasmons, also generate cylindrical waves, and that the scattering processes identified by Yang and co-workers may lead to pronounced interference effects for periodic nanoparticle ensembles.

NANOCRYSTALS

Blinking problem solved

Nature doi: 10.1038/nature08072 (2009)

Semiconductor nanocrystals are widely used in biological imaging, but they experience a problem known as blinking — photoluminescence from the nanocrystals switches off and on, seemingly at random, even when the laser exciting the luminescence is constantly turned on. Now Todd Krauss and co-workers at the University of Rochester, Eastman Kodak, Cornell University and the Naval Research Laboratory have made nanocrystals that do not blink.

When a nanocrystal is illuminated by a laser, an electron is excited to a higher energy level, leaving a hole behind. The electron and hole then recombine, emitting a photon with a wavelength that depends on the energy difference between the ground and excited states — which in turn depends on the radius of the nanocrystal. Previously, it was thought that a nanocrystal stops emitting light when it is charged. However, Krauss and co-workers have now shown that nanocrystals with a CdZnSe core and a ZnSe shell will continue to emit at their characteristic wavelengths, even when they are charged, although the broadness of the emission peaks will be a disadvantage for imaging applications.

Krauss and co-workers show that the properties of the nanocrystals can be explained by the recombination of a charged exciton — an exciton plus another charge — in a nanocrystal, where there is a gradual rather than abrupt transition between the core and the shell.

The definitive versions of these Research Highlights first appeared on the *Nature Nanotechnology* website, along with other articles that will not appear in print. If citing these articles, please refer to the web version.

Top down Bottom up

Blood ties

Magnetic nanoparticles are useful tools for tissue engineering and regeneration.

Melissa Krebs and Randall Erb are graduate students working on different subjects at different universities in different cities. They are also brother and sister — and recently their wish to work together sparked a collaboration on tissue engineering that means they are now co-authors as well (*Nano Lett.* **9,** 1812–1817; 2009).

Krebs is a student of Eben Alsberg, an expert on tissue engineering at Case Western Reserve University in Cleveland, Ohio, whereas Erb works on magnetic nanosystems in Benjamin Yellen's group at Duke University in Durham, North Carolina. Together with their advisers, the brother and sister devised a project that would draw on the expertise of each group: the use of a magnetic fluid to tie mammalian cells together.

The goal of the experiments, which also involved researchers from the University of Massachusetts, was to regenerate tissue by controlling the spatial arrangement of cells within a biomaterial matrix. Although a variety of approaches exist, they are often compromised by being slow, expensive or damaging to the cells.

Krebs, Erb and co-workers used inert, biocompatible ferrofluids to drive cells into linear structures under an applied magnetic field. The technique does not require special surfaces, the cells are not modified and no toxic chemicals are needed. The nanoparticles making up the ferrofluid can be removed after the assembly, allowing the structure to be transferred to a cell culture surface.

Such collaborations can be indispensable in some areas of medicine according to Alsberg. "It is often difficult to advance complex fields such as regenerative medicine without the contributions of researchers with often disparate backgrounds," he explains, adding that this particular multidisciplinary project had another advantage: "The collaboration arose through fortuitous circumstances since Mrs Krebs and Mr Erb are siblings. Dr Yellen was not aware of the work my lab was doing, and the opposite was true as well".