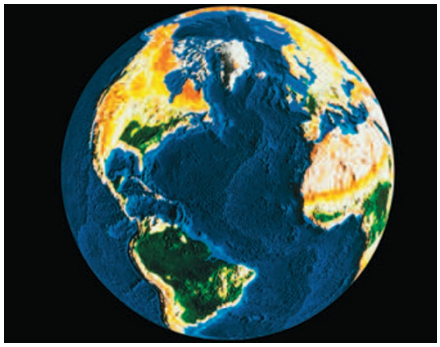
Multiferroic Earth



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J. Phys. Condens. Matter **19,** 432201 (2007)
Only few materials are known where magnetism and ferroelectricity are coupled so that ferroelectricity can be controlled by a magnetic field and vice versa. Although many known materials may still turn out to be multiferroic, the discovery of new materials with this property is a rare event — let alone an entire class of such compounds that has now been discovered by Sven Jodlauk and colleagues, who find multiferroicity in a number of pyroxene compounds. Pyroxenes are silicates with the nominal composition $AMSi_2O_6$, with A and M typically standing for transition metals. Altogether, pyroxenes make up about 20% of the Earth's crust and upper mantle. The crystal structure of pyroxenes leads to geometric magnetic frustration, which is common to many multiferroics. Multiferroicity is shown for $LiFeSi_2O_6$, $LiCrSi_2O_6$ and $NaFeSi_2O_6$, amongst others. Although the multiferroic transition temperatures in the pyroxenes studied so far is below 20 K, the expectation is that this family of multiferroics will lead to a better understanding of such materials, and possibly to the discovery of exciting new multiferroic compounds.

Networking particles

J. Am. Chem. Soc. doi:10.1021/ja074335t (2007)
Molecular computing devices for incorporation into the human body for *in situ* monitoring and treatment of disease may be a step closer, thanks to Ruslan Yashin and colleagues. Complex computing systems that use DNA in solution have been designed previously, but have not been suitable for therapeutic use. Yashin *et al.* have now integrated this technology with nanomedicine methods and developed networks of particles that can communicate remotely via the diffusion of signalling molecules. The researchers use sensor beads comprising polystyrene microspheres covered with a nucleic acid enzyme, such as deoxyribozyme, along with its substrate. When an oligonucleotide stimulus is detected by the enzyme, it reacts with its substrate to release a signal in the form of another oligonucleotide, which is then detected by a central hub particle. For a specific set of signals from different sensors, the hub will release its own signal to a microsphere 'actuator' that produces the final required output. Although this work was performed *in vitro*, the researchers suggest its potential for molecular computing-controlled drug release.

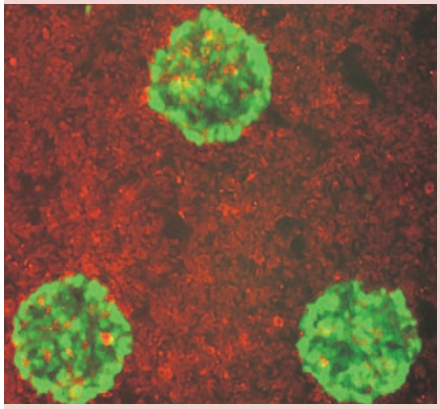
One defect only

Nano Lett. doi:10.1021/nl071845c (2007)
The word 'defect' usually has a negative connotation, but this is not always the case for crystalline structures. Atom impurities, vacancies or lattice distortions allow the properties of materials to be modified, which is essential for applications. In the case of carbon nanotubes (CNTs), the creation of large numbers of defects by macroscopic techniques has been successfully achieved, but control of the location and characteristics of these defects has so far been lacking. Maxime Berthe and co-authors have now shown how to create a single defect in a specific location of a CNT and how to get rid of it at a later stage. They placed the tip of a scanning tunnelling microscope on a single-walled CNT and applied a voltage ramp until they created a protrusion in the lattice. The protrusion could subsequently be removed by applying a voltage ramp of the opposite sign. The results clearly demonstrate the possibility to controllably and reversibly create single defects in CNTs, which could be used to tailor their electronic properties.

Trapped at the border

J. Am. Chem. Soc. doi:10.1021/ja076700m (2007)
Bundling of single-walled nanotubes (SWNTs) is a common phenomenon in suspensions, as the solvation forces are often insufficient to separate the tubes. Because the bundling quenches the nanotubes' fluorescence and limits their applications, it is desirable to remove the bundles from the mixture or separate out the individual tubes. This can be achieved by homogenization and ultrasonication in surfactant solutions, but some bundles can remain after this process because of the strong van der Waals attraction between tubes. Ultracentrifugation removes the bundles from solution, but is limited to analytical scales, so a larger-scale alternative is desired. To achieve this, Ziegler and colleagues use the fact that nanotube bundles are trapped at toluene–water interfaces. Nanotubes are already known to stabilize emulsions by locating at the interface, and the larger size of the bundles means they are preferentially trapped. The researchers find that shaking an aqueous suspension of nanotubes with toluene leaves a sample with both a higher fluorescence intensity and greater yield of individual SWNTs than that of a control sample from ultracentrifugation.

A cultural mix



Nature Biotechnol. doi:10.1038/nbt1361 (2007)
Liver toxicity is a common cause of the costly post-market withdrawal of a pharmaceutical drug and, as a result, more accurate and convenient screening of compounds before they reach this stage is essential. Now, a miniaturized model of the human liver, developed by Salman Khetani and Sangeeta Bhatia, shows improved testing of drug metabolism and toxicity. Using a soft lithography process, micropatterned islands of human liver cells (pictured) are created in a sea of mouse fibroblasts, connective tissue cells that provide a structural framework for many tissues. Within these islands, the liver cells are stabilized by the surrounding fibroblasts and their morphology and hepatic function are maintained for four to six weeks, whereas in conventional culture conditions these crucial features decline after a week. The researchers show that this coculture approach correctly identifies the liver toxicity profile of a wide range of chemical compounds, including drugs removed from the market by the FDA because of liver problems. This *in vitro* application of microtechnology could help reduce human exposure to unsafe drugs, as well as increase the chance of researchers finding clinical success.