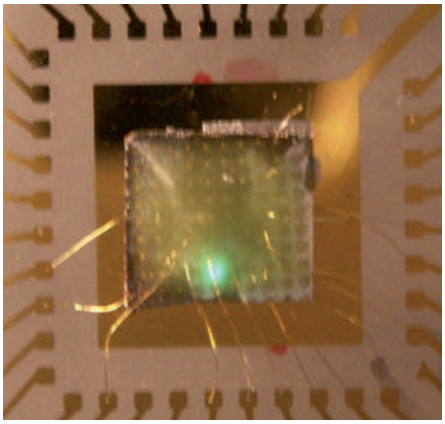
A brighter blue

Appl. Phys. Lett. **97,** 013501 (2010)



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Present commercial white-light-emitting diodes (LEDs) are all made from blue GaN emitters. The problem is that to achieve a good white-light colour balance from the phosphors used, the GaN needs to emit ultraviolet (UV) light. This remains a challenge, mainly owing to the fact that no suitable substrates are available on which to grow GaN-based UV LEDs. Ken Nakahara and colleagues from Tohoku University now present an alternative material to GaN — ZnO. Blue-light emission from ZnO has been demonstrated before, although the pulsed-laser deposition technique used in that study is neither suitable for large-scale production, nor has it been possible to extend the growth process to ZnO-based compounds that emit UV light. Therefore, the researchers have now used a growth process based on molecular beam epitaxy to realize UV MgZnO light emitters. After optimizations of growth process and device design, bright light emission was observed at wavelengths around 382 nm. Although device efficiencies may not yet be sufficient to challenge the dominance of GaN, they certainly establish ZnO as a viable contender for white-LED applications.

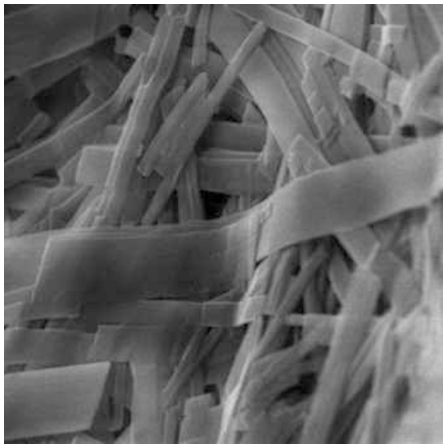
Mind the node

Phys. Rev. Lett. **105,** 027005 (2010)

One of the main characteristics of superconductivity is the formation of an energy gap between electrons participating in the superconducting state and those in the normal state. Since the discovery of superconductivity in iron pnictides, several models of the gap structure in momentum space have been proposed, some implying fully gapped electron and hole bands, others predicting the existence of nodes in the gap of one or the other charge species. Darius Torchinsky and colleagues have now used an ultrafast pump–probe technique to determine the band structure in the superconductor $Ba_{0.6}K_{0.4}Fe_2As_2$. They have reported two relaxation processes of the photoexcited carriers, a fast one strongly affected by excitation intensity, and a slower one, independent on the laser power. The researchers believe that the observations indicate fully gapped hole bands but the presence of nodes — or strong anisotropy at least — in the electron bands. Such results represent an important step towards understanding the gap structure, which is linked to the mechanism behind the origin of superconductivity itself.

Clean-up gels

Angew. Chem. Int. Ed. doi:10.1002/anie.201002095 (2010)



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The clean up of marine oil spills and the subsequent recovery of the oil are, at present, tackled with a combination of dispersants, sorbents and solidifiers. These materials have some limitations — either with the containment of the oil, environmental issues or oil recovery. Now, George John and colleagues report the use of an environmentally benign material that can selectively gel the oil phase of an oil–water mixture at room temperature and subsequently allows oil recovery from the gelled phase by vacuum distillation. The gelators are amphiphilic molecules synthesized from open-chain sugar alcohols. On addition of the gelator to an oil–water mixture, a network of entangled fibres (pictured) reliant on intermolecular hydrogen bonding between adjacent gelator molecules is formed in the oil phase. The researchers show that this phase-selective gelation occurs for many different types of oil, including diesel and hydrocarbon solvents, and is also independent of the nature of the aqueous phase — for example, it could be acidic or saturated with NaCl.

Sugar-to-fuel biosynthesis

Science **329,** 559–562 (2010)

Blue–green algae — also known as cyanobacteria — produce carbohydrates from carbon dioxide and water using energy from light. Hydrocarbons naturally produced by these phototrophic bacteria include mixtures of alkanes. But the biochemistry of the microbial biosynthesis of alkanes has been difficult to find. Now, researchers from the biotechnology company LS9, Inc. report the discovery of the two key enzymes (and the corresponding genes) involved in the alkane biosynthesis pathway: an acyl–acyl carrier protein reductase and an aldehyde decarbonylase. By comparing sequences in genomes of 11 cyanobacterial strains using a 'knock in' and 'knock out' genetic strategy, scientists identified an operon — a cluster of genes that regulates other genes — that when expressed in *Escherichia coli* leads to the secretion of mixtures of C13 to C17 alkanes. Because efforts to produce renewable alternatives to fossil fuels require expensive chemical hydrogenation, the newly discovered biosynthetic pathway for the conversion of intermediates of fatty-acid metabolism to alkanes is an important step forward in developing renewable fuels.

Two toned

J. Am. Chem. Soc. **132,** 11015–11017 (2010)

Contrast agents are used when performing magnetic resonance imaging to improve the image and aid interpretation. Two types of agent can be used: T1 agents give a bright image and are normally paramagnetic materials, and T2 give a dark image and are typically superparamagnetic. Jun-sil Choi *et al.* have now synthesized a dual-mode nanoparticle contrast agent consisting of a core of T2 agent, $MnFe_2O_4$, which is separated from the T1 material, $Gd_2O(CO_3)_2$, by a layer of SiO_2. Normally, when T1 and T2 materials are close together, the T2 agent quenches the signal of T1; however, when the SiO_2 is 16 nm thick the quenching of T1 is reduced to zero while at the same time the contrast effect of the T2 agent is still two thirds of its normal value. Additionally, the system exhibits AND-like logic and is thus self-validating — errors can be detected by comparing pre- and post-contrast images. This reduces defects in the image and should help to improve the accuracy of disease diagnoses.