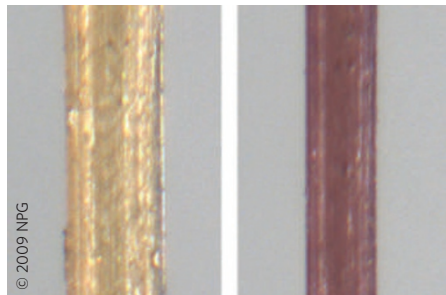


## The pressure mounts

Nature doi:10.1038/nature07970 (2009)



Mechanical stimuli can have beneficial effects on biological materials, for example in muscle contraction, and bone and tissue growth. Reproducing this behaviour in synthetic polymers is problematic because mechanical stresses normally cause random covalent bond cleavage, destroying the material. Nancy Sottos and co-workers prevent breakdown in glassy and elastomeric polymers by incorporating selected polymer strands of a spiropyran into the bulk solid material. On application of a mechanical load, the spiropyran directs the resulting force towards a relatively small number of bonds, triggering an electrocyclic ring-opening reaction via the C–O bond. By attaching poly(methyl acrylate) or poly(methyl methacrylate) to specific points on the spiropyran, it can be used to create crosslinked bulk polymers that show mechanical transduction. The reversible covalent bond activation in the spiropyran is accompanied by a colour change, making mechanically induced changes in the bulk polymers easy to see. This should lead to materials that are less prone to damage caused by strain. Future developments based on this approach could create polymers that regenerate in response to a mechanical stress.

## Sensitive palladium

Nano Lett. doi:10.121/nl9008474 (2009)

Fast and selective hydrogen sensors are crucial to ensure the safety and optimize the performance of electrochemical devices, such as fuel cells, powered by hydrogen. Because of their rapid response, palladium nanowires are prime candidates, but their sensing characteristics require a high operating temperature, and they have problems with mechanical failure and interference from other molecules such as water and ammonia. Reginald Penner and colleagues have now prepared nanocrystalline palladium nanowires that show unprecedented sensitivity to hydrogen, and are capable of resisting fracture on repeated exposure to hydrogen at any concentration. The nanowires were

prepared by lithographical electrodeposition from a plating solution containing ethylenediaminetetraacetic acid, which results in a mean grain diameter size of up to 15 nm. The sensors showed a rapid increase in resistance in the presence of hydrogen (a maximum value was reached within two seconds at 10% concentration). The response scaled with hydrogen concentration spanning five orders of magnitude down to 2 ppm, with excellent reproducibility and baseline stability at room temperature.

## Hydrogels clean up

Langmuir doi:10.1021/la804306w (2009)



Hydrogels — polymer networks with a substantial proportion of incorporated water — are known largely for their use in the biomaterials field. Emiliano Carretti and colleagues have instead found an intriguing use for them in art conservation, made possible by the use of a co-solvent to control their rheological and solubilizing properties. The researchers use poly(vinyl alcohol) crosslinked with borate, and hydrate the network with water mixed with an organic liquid such as 1-propanol; propanol was chosen as it is a common solvent used when

cleaning paintings to solubilize unwanted polymeric coatings. With only small concentrations of polymer, the addition of propanol enabled strong, elastic gels to be made, with the advantages of easy control over the extent of the region treated and straightforward removal from the surface after treatment. Carretti and colleagues have made use of the gel's advantages to clean oxidized varnish from the surface of the wood panel 'Santo Stefano', painted by Ludovico Cardi ditto il Cigoli in the late sixteenth to early seventeenth century.

## No need for chromium

Phys. Rev. B **79**, 165208 (2009)

Room-temperature ferromagnetism has been observed in numerous semiconductors and oxides, raising hopes for applications in spintronics. But the trouble always seems to be the same: to be useful for spintronics, the magnetization should be 'carrier-mediated' (that is, arising from the interaction of electrons and holes with localized magnetic moments) and not arising from magnetic impurities. Among the ferromagnetic oxides, chromium-doped  $\text{In}_2\text{O}_3$  does indeed seem to show carrier-mediated ferromagnetism. Gavin Lawes and colleagues investigated the material in depth and compared it with the case of undoped  $\text{In}_2\text{O}_3$ . Surprisingly, they observed room-temperature ferromagnetism in both cases. In addition, they made use of a low-temperature phenomenon known as Andreev reflection to measure the electron polarization, and found that in both cases electrons are 50% polarized. The results show on the one hand that chromium is not necessary for ferromagnetism. On the other hand, even if the polarization measurements were only possible at low temperature (1.3 K), they provide another confirmation that ferromagnetism in  $\text{In}_2\text{O}_3$  is carrier-mediated.

## Metallic glasses in good shape

Scripta Mater. **60**, 431–434 (2009)

Metallic glasses have some remarkable properties such as a higher strength than steel, making them interesting for aeronautical applications, medical devices and sports equipment. But at the same time they can be brittle, and this has hampered their commercial development. Simon Pauly and colleagues have now developed a bulk metallic glass composite that leads to improved compressive deformability while maintaining the high yield strength of the metallic glass. Their composite is based on Cu–Zr alloys. For some composition ranges, these alloys have shape-memory effects, where the crystals show a reversible transformation from austenite to martensite phases. To support the glass formation in this system, the researchers added small fractions of aluminium, which resulted in metallic glass composites that also contain varying amounts of crystalline phases. With increasing crystalline fraction, the compressive deformability of the composites improves, a result of what is believed to be the absorption of compressive strain through the martensitic phase transformation within the crystalline phase. These improved properties may therefore lead to new applications for metallic glasses.