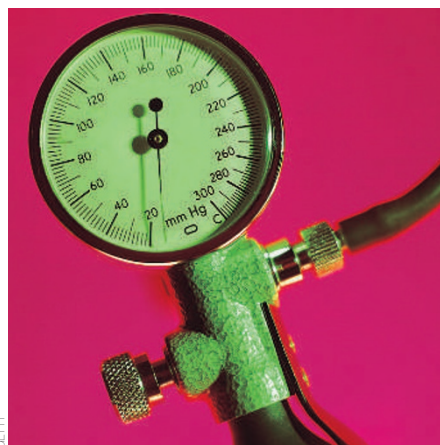


Turn on the pressure



GETTY

Phys. Rev. Lett. **98**, 065701 (2007)

To study the response of a material to extreme pressures, several methods are available. There are of course diamond anvil cells that can slowly ramp up pressure to values as high as 200–300 GPa. On the other hand, to achieve extremely short loading times, high-intensity lasers are needed. However, a problem in using lasers has been the non-uniformity of the compression zone. Based on an improved experimental design, Raymond Smith and co-workers have now achieved the first precise laser-based measurement of the longitudinal stress–density correlation in a material. X-ray laser radiation is used to evaporate a bromium-doped polystyrene foil. The plasma thus

generated quickly expands into a vacuum gap before uniformly hitting the target, a polycrystalline aluminium foil. This creates a spatially uniform loading area of over 500 μm in diameter, where the pressure is ramped up within only 10 ns. The researchers find a stiffer than expected reaction from the aluminium, which could lead to new insights into the dynamic response of materials under shock loading.

Ionic rectification

Nano Lett. doi:10.1021/nl062806o (2007)

Nanofluidic channels with dimensions comparable to the Debye length — the distance over which significant charge separation can occur — exhibit unique transport characteristics due to the effects of surface charge. These effects can also trigger ionic-current rectification, which occurs due to charge distribution and asymmetric geometries. Arun Majumdar and colleagues now show that in a nanofluidic diode, rectification can be achieved by introducing surface-charge discontinuity in patterned nanofluidic channels. Device current–voltage characteristics follow a one-dimensional model at moderate to high ionic concentration, and exhibit ionic flow control at high bias voltages. Similar devices could be designed for integration with other micro- and nanofluidic channels, and could prove useful in separation processes, fuel cells and control of ionic and pH concentrations.

Anti-water hydrogel

Macromolecules

doi:10.1021/ma062965u (2007)

Hydrogels are superabsorbent networks of polymer chains, and are commonly used for applications such as contact lenses or scaffolds in tissue engineering. Hydrogel surfaces are naturally hydrophilic, due to the nature of their components. Haraguchi *et al.*, however, report a nanocomposite hydrogel that has a hydrophobic surface, despite the fact that its constituents, poly(*N*-isopropylacrylamide) (PNIPA) and clay particles, are both hydrophilic at room temperature. The authors believe that the effect is due to a number of factors: firstly, the hydrophobic isopropyl groups on the PNIPA chains may align towards the surface, increasing its hydrophobicity. The rotation of the isopropyl groups towards the surface is also aided by the network structure of the polymer chains being only lightly crosslinked between the clay particles. The water content and the surface roughness of the nanocomposite gels could also play a part.

Giving it more space

Angew. Chem. Int. Edn

doi:10.1002/nie.200603753 (2007)

Polymer-inclusion complexes (PICs) with cyclodextrins (CDs) show a broad structural flexibility that makes them attractive for hydrogels and drug-discovery systems. In water, however, CD units complexed to the monomers usually dissociate during polymerization. Now, Ritter and co-workers use monomers featuring adamantyl side groups that can be reacted together to form water-soluble PICs. The turbidity temperature of the resulting polymers — at which the CDs dissociate from the adamantyl side groups, inducing a phase transformation of the PIC — is directly proportional to the concentration (typically, between 35 and 60 °C for concentrations ranging from 50 to 250 g l^{-1}). The researchers show that the phase transformation is also influenced by the length of the spacer between the polymer backbone and the adamantyl groups. Using long spacers leads to sharp phase transformations and lower turbidity temperatures. At low concentrations and with short spacers, re-complexation proves to be more challenging. Ideally, the phase transformations of PICs would be tailored to occur in a suitable temperature range for particular applications.

Bone cells tackle nacre



CHRIS 73 / WIKIPEDIA

Biomaterials **28**, 2155–2162 (2007)

Nacre, a composite of an organic matrix and aragonite (calcium carbonate) platelets, represents a successful paradigm for strength and hardness in nature. Because it is a natural material it is expected to be inherently biocompatible, and some researchers suggest its use as a bone-graft substitute. In fact, it has

been reported that nacre implants in animals are well tolerated, and that the organic matrix has a stimulating effect on bone-producing cells. Integration of the graft material with bone and the process of bone repair depend crucially on the concerted action of bone-producing and bone-destroying cells. Now Evelyne Lopez and colleagues report that nacre inhibits the action of bone-destroying cells, apparently by impairing their migration on the material. The higher mineral content, with respect to bone, may be responsible for this. However, the crystal structure or surface effects may also have an effect, along with signal molecules that may be present in the organic matrix. This study doesn't rule out nacre as a biomaterial, but suggests that conditioning strategies or specific size/shape parameters may be required for a successful implant.