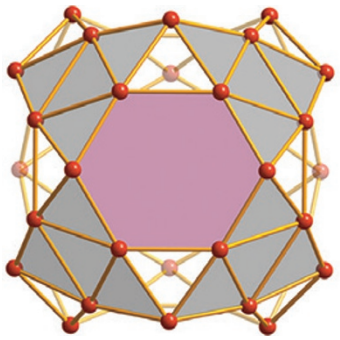
Boron clusters

Nature Chem. **6,** 727–731 (2014)



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Fullerene-like boron clusters have remained, until now, in the realm of theoretical studies. Now, Lai-Sheng Wang and colleagues report experimental evidence of a fullerene-like molecule for the B_{40} anion and for neutral B_{40}. Laser-vaporization techniques are used to form the clusters that are subsequently separated with a mass spectrometer and characterized using photoelectron spectroscopy. Together with the fullerene-like cluster of B_{40}^-, a quasi-planar isomer is observed, which is slightly more stable than the fullerene-like cluster. However, the fullerene-like cluster of neutral B_{40} is much more stable than its corresponding quasi-planar structure. Instead of resembling the football-like structure of carbon-based fullerenes, the all-boron cages have hexagonal holes at the top (pictured) and bottom, and four heptagonal holes along the sides. Chemical bonding analyses of the neutral B_{40} suggest all valence electrons are delocalized σ or π bonds. Preliminary calculations indicate that the fullerene-like boron cages could be used for hydrogen adsorption and release, or can be doped with a metal atom. Wang and colleagues have named the all-boron fullerenes 'borospherenes'. *AS*

Headache relief

Phys. Rev. Lett. **113,** 055701 (2014)

Acetylsalicylic acid, or aspirin, as it is more commonly called, has been known since ancient times for its analgesic properties. Over the past decade, the solid form used in the pharmaceutical product marketed worldwide has been shown to be only one of two possible polymorphs. The additional polymorph, known as form II, was predicted to be energetically very similar to form I, and the rather subtle difference between their structures required very careful structural studies for them to be eventually identified and distinguished experimentally. The question that naturally arose, therefore, was why form II was so much less abundant, and indeed seems to be less thermodynamically stable. Kinetic effects were examined first, and these may indeed play some role. But as Anthony Reilly and Alexandre Tkatchenko now show by means of first-principles calculations, long-range van der Waals interactions seem to be the key to understanding the two different behaviours. By explicitly including these many-body effects in their simulations, clear differences in the vibrational modes of the aspirin molecules are seen, uncovering a mechanism behind the stability of form I aspirin. *AT*

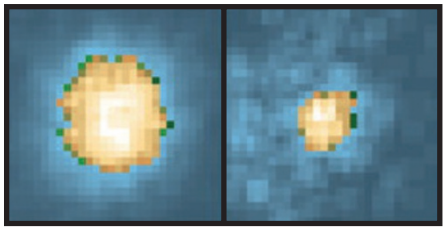
Mapping in-cell topology

Nature Commun. **5,** 4494 (2014)

Intracellular structures can be mapped with a resolution of tens of nanometres by using a few imaging techniques, such as super-resolution light microscopy, cryo-electron microscopy or fluorescence correlation spectroscopy. However, most microscopy techniques lack sufficient temporal resolution to track molecules that diffuse quickly, or they need fixed samples. Living cells can be tracked with fluorescence spectroscopy, but following hundreds of inert fluorescence trackers at high spatial and temporal resolution is not straightforward. Building on previous work on intracellular fluorescence imaging, Michael Baum *et al.* now show that this can be done by using multiscale fluorescence cross-correlation spectroscopy. With this technique, the researchers found that both the cell's nucleus and cytosol impose similar constraints on the mobility of most proteins, that chromatin is the dominant obstacle that prevents protein translocation into the nucleus, and that the cytoskeleton has only a small effect on protein transport, which suggests that cytosolic organelles play a significant role in the topology of the cell's porous interior. The researchers' approach should be readily applicable to the study of the effects of drug-induced perturbations on protein mobility. *PP*

Resolved by gold

Nano Lett. http://doi.org/tzx (2014)



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A widely used technique to enhance the spatial resolution in fluorescence microscopy relies on the simultaneous use of a primary laser beam, which excites the fluorescent object to be imaged, and a secondary doughnut-shaped beam, which inhibits the emission of the object far from the point excited by the primary laser. This approach, which is named stimulated emission depletion microscopy, has a resolution limit that improves with the intensity of the secondary beam; hence very intense lasers are usually required to achieve the best performance. Yannick Sonnefraud and colleagues now show that plasmonics can help to overcome this constraint. The plasmon resonance generated in a thin gold coating surrounding silica spheres doped with fluorescent dyes is used to locally enhance the intensity of the secondary laser. The power density of this beam can be reduced by a factor of four with respect to that used with non-coated spheres, while obtaining a similar inhibition effect on the dye emission — that is, a similar spatial resolution. *LM*

Symmetry breaking in metamaterials

Nature Commun. **5,** 4441 (2014)

Spontaneous chiral symmetry breaking is a phenomenon that is at the core of the existence of our universe as it is today. It determined the fact that fundamental particles indeed have a mass and what their mass is. Spontaneous symmetry breaking consists of the 'hiding of symmetry' of a particular physical system, whose underlying laws and initial state are invariant under a particular symmetry transformation, during its evolution. By changing an external parameter, the system evolves to an asymmetric state, which does not retain the initial symmetry that remains hidden in its governing laws. Now Yuri Kivshar and collaborators have demonstrated this effect in chiral magnetoelastic metamaterials comprising enantiomeric units. The asymmetry is observed in the acquisition of a non-zero polarization rotation of the forward-scattered wave during a microwave pump–probe experiment, when the pump power is increased. This effect creates an artificial phase transition from an achiral to a chiral response. This study opens the way to the *ad hoc* design of metamaterials with artificial phase transitions, such as those that go from a positive to negative index and from elliptic to hyperbolic dispersion. *ON*

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