

Researchers look into transparent carbon

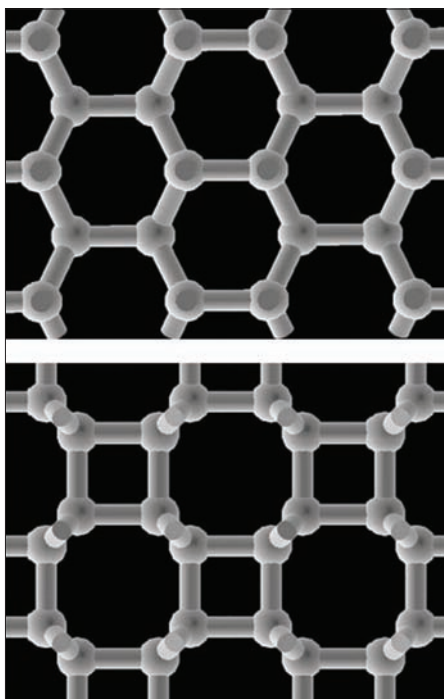
Almost everyone knows that carbon can take on more than one form, with diamond and graphite being the most common, and with the fullerenes, carbon nanotubes and this year's Nobel prize-winning graphene close behind. Now, evidence is mounting for the existence of a transparent form of carbon – bct-carbon – with a body-centred tetragonal (bct) structure something between graphite and diamond, first studied in simulations by Koichiro Umemoto and colleagues of the University of Minnesota, Tokyo and Tsukuba.

In separate work, Xiang-Feng Zhou of Nankai University in China and colleagues have made further studies with simulations. While their work is still theoretical, it does explain the experimental observation of a transparent allotrope of carbon formed in the compression of graphite. Remarkably, the material is harder than diamond and actually dents the diamond anvils used to provide the pressure to produce it.

Further reading

Koichiro Umemoto 2010 *Phys. Rev. Lett.* **104** 125504.

Xiang-Feng Zhou *et al.* 2010 *Physical Review B* **82** 134136.



In bct-carbon, rings of four atoms form a 3D network. In the lower image, "short" bonds are orthogonal to the page. The upper perpendicular view (top) shows the vertical structure, where the squares appear edge-on as horizontal bonds.

Experiments detect non-Abelian anyons

The standard elementary particles are either bosons or fermions, depending on whether or not multiparticle wave functions pick up a phase of +1 or -1 on swapping particles. Abelian anyons are quasiparticles that pick up other phases on being swapped, and have long been known to do so.

Now, there is evidence for more complicated non-Abelian statistics for quasiparticles in condensed matter where non-commuting matrices take the place of scalar phases. Perhaps surprisingly, non-Abelian anyons may be easier to detect than Abelian ones because an exchange gives states that do not interfere with the one that

existed before exchange (not being equivalent up to a phase).

Robert Willett and colleagues of Bell Laboratories, US, have shown (among other pieces of evidence) exactly this kind of non-interference in Aharonov-Bohm type experiments with quasiparticles of charges $e/2$ and $e/4$ in the quantum Hall effect. The work is generating a great deal of interest because such non-Abelian anyons could form the basis of robust quantum computers.

Further reading

R L Willett *et al.* 2010 *Phys. Rev. B* **82** 205301.

A smoking gun for cigarettes

Lighting a cigarette releases thousands of different molecules, so it might seem unlikely that any single molecule would be a unique marker for tobacco smoke, as opposed to smoke of any other kind. Surprisingly, Juan M Sanchez and colleagues of the University of Girona, Spain, found from samples of air in 56 local cafes and restaurants that the simple molecule 2,5-dimethylfuran can give the game away. This molecule seems to be unique to tobacco smoke and is not found in smoke from cars, cooking or other types of combustion. Looking for this substance is even sensitive enough to detect smoke in the breath of non-smokers who work in smoky environments.

Further reading

M Alonso *et al.* 2010 *Environmental Science and Technology* **44** 8289.

Nonlinear electrophoresis

Electrophoresis is a well known technique for separating molecules or particles based on their electric charge and the drag that they suffer on moving through a liquid carrier-medium. Now, Oleg Lavrentovich and colleagues of Kent State University in Ohio have found a new way to do it: by using liquid crystals as the carrier.

The intrinsic anisotropy of the liquid crystals opens up a range of new phenomena. These include drift velocities that are quadratic in the applied voltage as opposed to linear, which makes it possible to use alternating current and avoid electrolysis. It also offers the possibility to transport both charged and neutral particles, with the necessary asymmetry being provided by the medium itself. In addition to applications in chemical and biological or medical analyses, this also opens up a whole new range of microfluidic applications.

Further reading

O D Lavrentovich *et al.* 2010 *Nature* **467** 947.