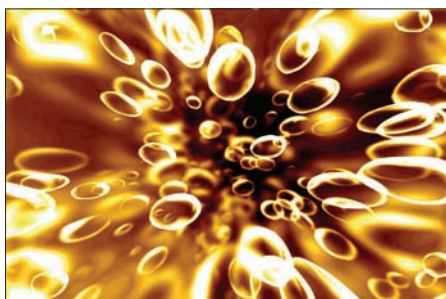


Researchers discover how we sense the taste of bubbles

The pleasure that everyone finds in drinking carbonated beverages – especially in the festive season! – is often attributed to mechanical agitation of the tongue caused by the bubbles. However, it is actually an effect caused by the carbon dioxide itself and researchers in the US have identified in the laboratory the fizz-detecting cells and the enzyme that make it all possible.

Jayaram Chandrashekar of the University of California, San Diego, and colleagues used a combination of electrophysiological measurements and genetic manipulation to show that the fizz detectors are in sour-sensing cells in the tongue. They are based on an enzyme, carbonic anhydrase 4, that turns carbon dioxide in water into a bicarbonate ion and a proton.

The enzyme is one of several targeted by acetazolamide, a drug used to protect against altitude sickness. Back in 1988 users had



Bubbles taste better thanks to our fizz detectors. (Courtesy Bram Janssens/Dreamstime.com.)

noted that it made fizzy beverages taste flat, thus making drinking champagne at the tops of high mountains a disappointment for anyone taking the drug.

Further reading

J Chandrashekar *et al.* 2009 *Science* **326** 443.

Optical diodes

Photonic crystals are materials with bandgaps, which do not allow certain wavelengths of light to pass. Just as bandgaps in semiconductors forbid electrons to have certain energies, is it possible to construct a photonic analogue of a diode?

Zheng Wang of MIT and colleagues there and at Yale University have done just this. They constructed an array of magneto-optical ferrite rods placed in a magnetic field in such a way that microwaves passing in one

direction were not allowed to propagate, while those moving the other way went through unimpeded, with a difference of 50 dB in the two directions.

Apart from the novelty of the physics involved, the work also suggests the possibility of novel optical fibres with hollow cores surrounded by materials of the kind described above. Having no material inside, they could allow very long-range transmission without repeaters.

Further reading

Z Wang *et al.* 2009 *Nature* **461** 772.

More insulating than the vacuum

A hot object radiates heat into the surrounding space so it might be tempting to think that nothing would be less conducting than empty space. Nevertheless, Shanhui Fan of Stanford University and colleagues have found something even less able to conduct heat – and it contains matter.

The idea is simple: a suitable photonic crystal opaque to a band of infrared could actually block more heat flow than pure nothing. At or above room temperature, a stack of 10 silicon layers, each 1 μm thick and separated by 90 μm gaps of vacuum, would have a thermal conductance half that of empty space, with the possibility of countless future applications.

Further reading

WT Lau *et al.* 2009 *Phys. Rev.* **B80** 155135.

Massive neutrinos and CNB timescales

There is plenty of evidence that neutrinos have mass, so what could it reveal about the cosmic neutrino background (CNB) – the neutrino analogue of the cosmic microwave background (CMB)? With massless neutrinos, studies of the CNB would peer farther back in time (to about a second after the Big Bang) than researchers “see” with microwave photons (380 000 years after the Big Bang). Massive neutrinos go slower than the speed of light and, over timescales comparable to the age of the universe, that makes a big difference.

Scott Dodelson of Fermilab and Mika Vesterinen of the University of Manchester have shown that the CNB originates from a distance of 1–10 billion light-years – less than the 40 billion light-years for the origin of the CMB, taking into account the expansion of the universe. This implies that the neutrinos of the CNB come from regions where there is now interesting astronomical data and could, if measurable, provide valuable information about what seeded the formation of distant galaxies and clusters of galaxies.

Further reading

Scott Dodelson and Mika Vesterinen 2009 *Phys. Rev. Lett.* **103** 171301.

Molecular flasks

Chemical reactions often proceed via highly unstable intermediates with lifetimes that are too short for techniques like X-ray crystallography to be usable. Now Takehide Kawamichi and colleagues of the University of Tokyo have found a solution. Their technique uses the tiny spaces in highly porous materials as molecular flasks, which slow the reactions due to steric (space restriction) effects. Cooling to cryogenic temperatures and reheating can effectively start and stop reactions and opens up the possibility of making movies of reactions. Using a reaction between an amine and an aldehyde the team observed the intermediate hemiaminal and determined its structure.

Further reading

T Kawamichi *et al.* 2009 *Nature* **461** 633.