The material that's like an octopus

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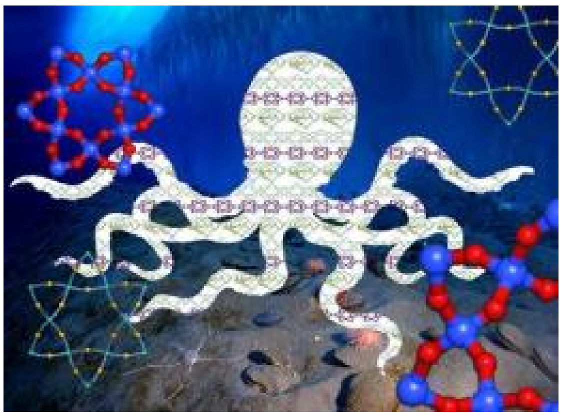

(Phys.org)—The atomic structure of a zinc-based material has a surprising amount in common with the tentacles of an octopus, Oxford University researchers have found.

When pressure is applied all around them most materials shrink. But materials exhibiting a rare property known as negative linear compressibility (NLC) are different.

'When pressure is applied all around NLC materials, instead of their dimensions getting shorter, they reduce their volume by getting longer,' Andrew Goodwin of Oxford University's Department of Chemistry tells me, 'think of it a bit like one of those collapsible wine racks.'

Andrew and his Oxford colleagues led an international team studying the unusual thermal properties of the material zinc dicyanoaurate. What they did not expect to find was that its honeycomb-like structure gave it uniquely powerful NLC behaviour, far beyond the kind of contraction and expansion exhibited by ordinary engineering materials.

A report of their research is published in Nature Materials.

There's widespread interest in NLC because of how materials with these properties could be used in artificial muscles or new types of sensors.

'It was quite surprising to discover that zinc dicyanoaurate is made up of structures that act rather like sets of supramolecular springs that cause it to behave in this way,' says Andrew. 'What's particularly exciting is that these properties scale up from the atomic scale to that of manmade objects and structures, suggesting all sorts of possible applications.'

Often scientists take inspiration from biological systems, or even try to copy them, but in this case the discovery of atomic structures could make them look afresh at biology.

'It seems that the octopus has found a way of harnessing the same intrinsic properties we've found in zinc dicyanoaurate,' Andrew explains. 'When it wants to contract a particular limb an octopus squirts liquid into the centre of a helical chamber inside the tentacle. This creates the equivalent of negative pressure on the tentacle, causing it to get fatter in cross section and, through the muscle architecture, contract in length.

'These same geometrical motifs found in materials at the atomic scale can also be found around us in the Animal Kingdom.'

The first to benefit from zinc dicyanoaurate's NLC properties could be the construction industry: including an ingredient like it in cement, that 'pushes back' when other components swell due to the presence of water, could help to prevent cracking in structures.

Other likely applications include the optical world where it could be used to create adjustable lenses or sensors that respond to pressure in a different way from those made of conventional materials.

Could it one day be used to make the sort of artificial tentacles sported by Spider-Man's nemesis Doc Ock? That's one application that may have to wait.

A report of the research, entitled 'Giant negative linear compressibility in zinc dicyanoaurate', is published in this week's *Nature Materials*.

More information: www.nature.com/nmat/journal/va … t/full/nmat3551.html

Provided by Oxford University