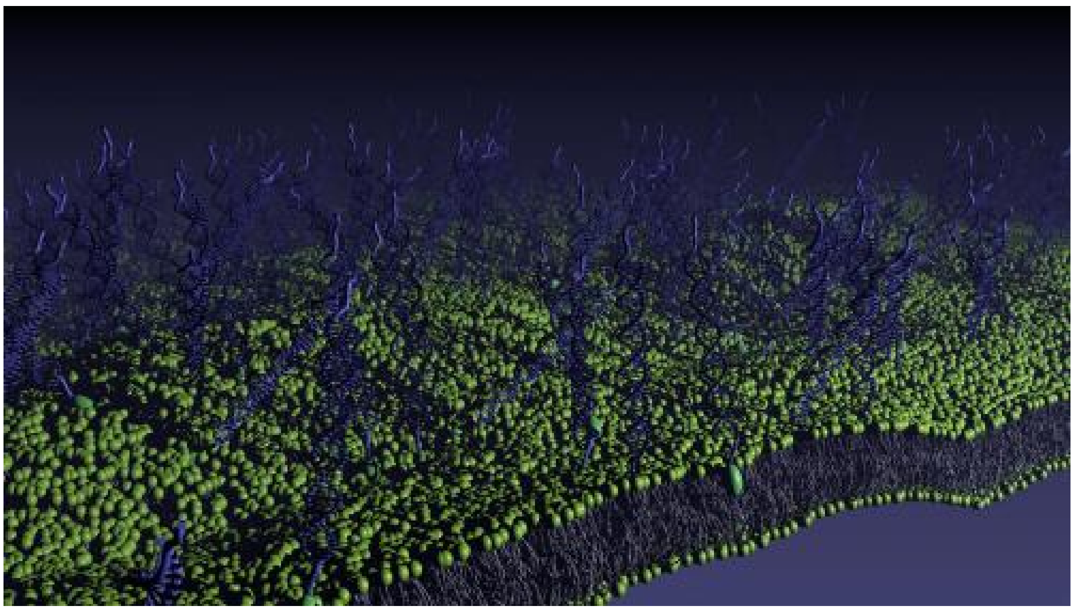
Responsive material could be the 'golden ticket' of sensing

January 7 2015



Lipid membrane functionalized with DNA-linkers Credit: Lorenzo Di Michele

Researchers from the University of Cambridge have developed a new self-assembled material, which, by changing its shape, can amplify small variations in temperature and concentration of biomolecules, making them easier to detect. The material, which consists of synthetic spheres 'glued' together with short strands of DNA, could be used to underpin a new class of biosensors, or form the basis for new drug delivery systems.

The interplay between the lipid spheres, called giant vesicles, and the strands of DNA produces a unique response when the material is exposed to changes in temperature. Instead of expanding when heated - as is normally the case - the material contracts, a phenomenon known as negative thermal expansion. Details are published today (7 January) in the journal *Nature Communications*.

In addition to its role as a carrier of genetic information, DNA is also useful for building advanced materials. Short strands of DNA, dubbed 'sticky ends', can be customised so that they will only bind to specific complementary sequences. This flexibility allows researchers to use DNA to drive the self-assembly of materials into specific shapes.

Basing self-assembled materials around vesicles - synthetic versions of the soft sacs which envelop living cells - allows for even more flexibility, since the vesicles are so easily deformable. Using short DNA tethers with a cholesterol 'anchor' at one end and an exposed sticky DNA sequence at the other, the vesicles can be stuck together. When assembled into a hybrid DNA-lipid network, the DNA tethers can diffuse and rearrange, resulting in massive vesicle shape changes.

Besides negative thermal expansion, the researchers also found that changes in temperature lead to a significant variation in the porosity of the material, which is therefore highly controllable. A similar response is expected by changing the concentration of the DNA tethers, which could also be replaced by other types of ligand-receptor pairs, such as antibodies.

"The characteristics of this material make it suitable for several different applications, ranging from filtration, to the encapsulation and triggered release of drugs, to biosensors," said Dr Lorenzo Di Michele of the University's Cavendish Laboratory, who led the research. "Having this kind of control over a material is like a 'golden ticket' of sensing."

More information: The paper, 'Thermal regulation of volume and porosity in lipid mesophases by coupling mobile ligands to soft membranes' is published on 7 Jan. in *Nature Communications*. DOI: 10.1038/ncomms6948

Provided by University of Cambridge