PHYS.ORG

Shocking new way to create nanoporous materials revealed

November 27 2011

Scientists have developed a new method of creating nanoporous materials with potential applications in everything from water purification to chemical sensors.

In order to produce a porous material it is necessary to have multiple components. When the minor component is removed, small pores are left in its place. Until now, creating nanoporous materials was limiting as it was believed the minor component had to be connected throughout the structure as well as to the outside in order for it to be removed.

However, new research published today (Sunday, 27 November) in the journal Nature Materials has demonstrated a much more effective, flexible method called collective osmotic shock (COS) for creating porous structures. The research, by scientists at the University of Cambridge, has shown how by using osmotic forces even structures with minor components entirely encapsulated in a matrix can be made porous (or nanoporous).

The lead author, Dr Easan Sivaniah from the University of Cambridge's Cavendish Laboratory, explains how the process works: "The experiment is rather similar to the classroom demonstration using a balloon containing salty water. How does one release the salt from the balloon? The answer is to put the balloon in a bath of fresh water. The salt can't leave the balloon but the water can enter, and it does so to reduce the saltiness in the balloon. As more water enters, the balloon swells, and eventually bursts, releasing the salt completely.

"In our experiments, we essentially show this works in materials with these trapped minor components, leading to a series of bursts that connect together and to the outside, releasing the trapped components and leaving an open porous material."

The researchers have also demonstrated how the nanoporous materials created by the unique process can be used to develop filters capable of removing very small dyes from water.

Dr Sivaniah added: "It is currently an efficient filter system that could be used in countries with poor access to fresh potable water, or to remove heavy metals and industrial waste products from ground water sources. Though, with development, we hope it can also be used in making sea-water drinkable using low-tech and low-power routes."

Other applications were explored in collaboration with groups having expertise in photonics (Dr Hernan Miguez, University of Sevilla) and optoelectronics (Professor Sir Richard Friend, Cavendish Laboratory). Light-emitting devices were demonstrated using titania electrodes templated from COS materials whilst the novel stack-like arrangement of materials provide uniquely efficient photonic multilayers with potential applications as sensors that change colour in response to absorbing trace amounts of chemicals, or for use in optical components.

Dr Sivaniah added, "We are currently exploring a number of applications, to include use in light-emitting devices, solar cells, electrodes for supercapacitors as well as fuels cells."

More information: The paper 'Collective osmotic shock in ordered materials' will be published in the 27 November 2011 edition of *Nature Materials.* DOI: 10.1038/nmat3179

Provided by University of Cambridge