'Smart' microcapsules in a single step

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Microcapsules. University of Cambridge

(PhysOrg.com) -- A new, single-step method of fabricating microcapsules, which have potential commercial applications in industries including medicine, agriculture and diagnostics, has been developed by researchers at the University of Cambridge. The findings are published last Friday (Feb. 10) in the journal *Science*.

The ability to enclose materials in capsules between 10 and 100 micrometres in diameter, while accurately controlling both the capsule structure and the core contents, is a key concern in biology, chemistry, nanotechnology and materials science.

Currently, producing microcapsules is labour-intensive and difficult to scale up without sacrificing functionality and efficiency. Microcapsules are often made using a mould covered with layers of polymers, similar to papier-mâché. The challenge with this method is dissolving the mould while keeping the polymers intact.

Now, a collaboration between the research groups of Professor Chris Abell and Dr. Oren Scherman in the Department of Chemistry has developed a new technique for manufacturing 'smart' microcapsules in large quantities in a single step, using tiny droplets of water. Additionally, the release of the contents of the microcapsules can be highly controlled through the use of various stimuli.

The microdroplets, dispersed in oil, are used as templates for building supramolecular assemblies, which form highly uniform microcapsules with porous shells.

The technique uses copolymers, gold nanoparticles and small barrel-shaped molecules called cucurbiturils (CBs), to form the microcapsules. The CBs act as miniature 'handcuffs', bringing the materials together at the oil-water interface.

"This method provides several advantages over current methods as all of the components for the microcapsules are added at once and assemble instantaneously at room temperature," said lead author Jing Zhang, a PhD student in Professor Abell's research group. "A variety of 'cargos' can be efficiently loaded simultaneously during the formation of the microcapsules. The dynamic supramolecular interactions allow control over the porosity of the capsules and the timed release of their contents using stimuli such as light, pH and temperature."

The capsules can also be used as a substrate for surface-enhanced Raman spectroscopy (SERS), an ultra-sensitive, non-destructive spectroscopic technique that enables the characterisation and identification of molecules for a wide variety of applications, including environmental sensing, forensic analysis and medical diagnosis.

Provided by University of Cambridge