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Simple technique leads to complex micro- and nanoparticle shapes

Chemical engineers at the University of California, Santa Barbara, have discovered a way of making polymeric micro- and nanoparticles in a wide variety of shapes and sizes, with a method that requires only commonly available lab chemicals and equipment.

Polymeric particles are used in applications ranging from medicine to cosmetics, and spherical particles are the norm. Other shapes have before now been possible, but technically challenging to produce on a large scale. And shape is important. In medicine, for example, shape influences how drug-carrying particles circulate in the bloodstream and adhere to their targets. It also affects immune system clearance and the rate of drug release.

[Samir Mitragotri](#), his former research student Julie Champion and postdoc Yogesh Katare use as a starting point polystyrene beads with diameters of between 60 nm and 10 μm . In one approach the particles are liquefied by heat or with solvents, and then stretched. In a second scheme the beads are cast into polyvinyl alcohol films, and the films stretched to create voids around the particles. These spaces are then filled by liquefying the beads.

With the two techniques, implemented either alone or in combination, more than 20 different shapes can be formed. These include rods, eggs, lenses, diamonds, ravioli and tacos. Most of the resultant particles are micro-scale, but the technique can easily be extended to the nanoscale.

‘The shape exists at a nano-scale at two levels,’ says Mitragotri. ‘First, we have made nanoparticles with non-spherical shapes. Second, we have made micro-scale particles with characteristic nano-scale features. In general, the scale of the shape depends on the scale of the starting sphere.’

‘This work offers a simple, but highly versatile and flexible approach to particles with different sizes and, more importantly, shapes,’ says University of Michigan chemist [Joerg Lahann](#). ‘It could therefore lead to novel strategies for long circulating particles, which will find application in drug delivery or vaccines.’

Francis Sedgemore, 12/8-07

References

Samir Mitragotri: <http://www.chemengr.ucsb.edu/people/faculty/mitragotri.html>

Joerg Lahann: <http://www.engin.umich.edu/dept/cheme/people/lahann.html>

“Making polymeric micro- and nanoparticles of complex shapes”, Champion et al., *PNAS* 104, 11901 (2007); doi: 10.1073/pnas.0705326104 :

<http://www.pnas.org/cgi/content/abstract/104/29/11901>

Figure

Complex shaped particles.jpg

A collection of scanning electron microscope images (colour added) of possible particle shapes. These include capsules (C), tacos (E), and lenses (R).

Image credit: Peter Allen & Julie Champion

