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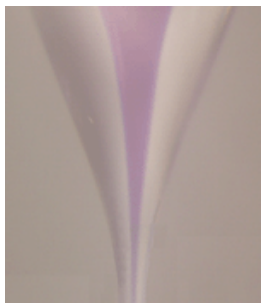
Micro-jets make designer droplets

28 February 2002

Drug delivery and food manufacturing could benefit from a new technique for coating tiny liquid droplets with other liquids. Ignacio Loscertales of the University of Malaga in Spain and colleagues have created a device that uses electrohydrodynamics to tailor the size of the 'core' and 'shell' of liquid droplets, which can be just tens of nanometres across (I Loscertales *et al* 2002 *Science* 295 1695).

Coated droplets are widely used in industry and research: volatile compounds can be isolated from their environment by a protective shell, and drugs can be coated with substances that enable them to target certain receptors in the body. The technique can also be used to encapsulate large biological ions so that they can be studied with mass spectroscopy.



Jet stream

These droplets can be formed when a 'coaxial' jet of two non-mixing liquids breaks up. To create such a jet, Loscertales and co-workers constructed two concentric needles that pump out a narrow stream of liquid within a wider stream. The needles were vertical, with their nozzles pointing downwards.

The team attached electrodes to give the inner needle a variable potential and the outer needle a potential of several kilovolts with respect to a grounded target beneath the nozzles of the needles. The device works by creating electrical stresses at the boundary between the two liquids, and this means that the inner liquid must be an electrical conductor and the outer liquid must be an insulator.

As the liquids emerge from the needles and flow downward towards the target, the voltage applied to the inner needle is adjusted to control the diameters of the inner and outer jets, which determines the geometry of the droplets that form. The exact voltage depends on the viscosity and conductivity of the liquids.

Loscertales and colleagues demonstrated their technique - which can produce droplets with diameters from 0.15 to 10 micrometres - with water and olive oil, and other solvents and polymer solutions. Polymers are widely used as coating layers, and some polymers are hardened with ultraviolet light to form a rigid shell around the droplet core.

Loscertales and colleagues are optimistic that their technique will prove to be more versatile than other techniques, which can only control the diameter of the droplet and the thickness of the coating over narrow size ranges.

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