DROPLETS ON A RUNWAY

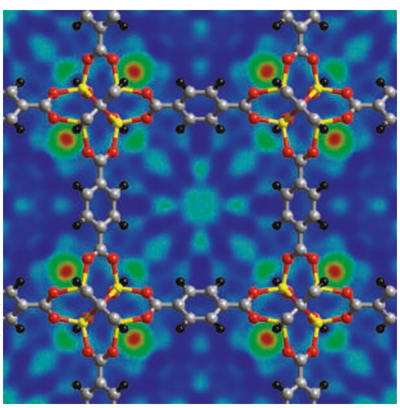
Isolated droplets of liquid can be set in motion, without any mechanical pressure or flow, by forcing them into the grooves of an open microfluidic chip by an electrowetting effect. Open microfluidic systems are, in essence, structured surfaces. They should obviate clogging problems and simplify manufacturing compared with conventional microfluidics devices that have covered channels. Baret and colleagues, who designed and tested this 'smart' open system (*Langmuir* doi:10.1021/la52228b; 2005), think this may be the starting point to build active components, such as micro-valves and pumps, without moving parts. The system consists of a grooved conductive substrate coated with a dielectric, and in electrical contact with the conducting liquid through a platinum electrode. Whether the liquid takes the shape of a droplet or invades the grooves, thus forming long filaments, depends on both the aspect ratio of the grooves and the extent to which the liquid wets the surface. The wetting is sensitive to the applied voltage, so it is possible to either fill the grooves with liquid by increasing the voltage or alternatively drain liquid from the grooves if the voltage is lowered or the grooves become wider (higher aspect ratio).

Suits you sir?

Researchers in the USA have developed a simple method for producing uniform smooth spherical micro- and nanoparticles from a combination of metals and an organometallic complex as a ligand (a 'metalloligand'). Moonhyun Oh and Chad Mirkin found that the addition of an initiation solvent, such as diethyl ether, to a precurser pyridine solution of metal acetate salt and metalloligand resulted in the spontaneous formation of spherical inorganic polymer particles (*Nature* **438,** 651–654; 2005). The particles, composed of polymerized metal–ligand networks, formed via coordination of the carboxylate groups on the metalloligand with the metal ions from the metal acetate salt. The polymerization process is reversible — the particles reforming into the starting materials by the addition of excess pyridine. This method allows the properties of the particles to be chemically tailored by judicious choice of the metal and organic ligand used, and hence are promising for future practical applications.

Hiding hydrogen

A commercially viable method of non-pressurized hydrogen storage remains elusive. One class of materials that have been extensively investigated with this purpose in mind, are known as metal–organic framework (MOF) compounds. Constructed from metal-oxide clusters linked by organic components, they are sufficiently porous that hydrogen is able to permeate their structure and become adsorbed in high concentrations. In order to be able to optimise the adsorption process, an understanding is needed of the mechanism whereby hydrogen attaches to the MOF lattice. Using Fourier-difference analysis of neutron diffraction data and first-principles energy calculations, Yildirim and Hartman (*Phys Rev Lett.* 95, 215504; 2005) investigate the adsorption of hydrogen onto the internal surface of MOF5 (a widely studied MOF compound). Their study shows that hydrogen uptake levels as high as 11 wt% can be achieved. It is found that the metal-oxide clusters rather than the organic 'linkers' are the primary sites of hydrogen adsorption. As the hydrogen concentration is raised, an increasing number of secondary adsorption sites are formed. As these sites fill, the hydrogen molecules form closely packed 'nanocage' structures, which may exhibit novel structural properties.



Pillars for your hard drive

The general concept of increasing the capacity of modern hard drives is to move from a two-dimensional flat geometry, where bits are stored by magnetizing areas on the hard drive, to three dimensions. Similar to skyscrapers in crowded cities, a vertical arrangement allows a more efficient use of surface area. One approach for data storage is to use nanohole pitches in aluminium, filled with cobalt. However, the density of pillars achieved so far has been limited. A further constraint is that the surface has to be sufficiently flat for modern read heads to fly only a few nanometres above the disk without crashing. Hirotaka Oshima and colleagues (*Jpn J. Appl. Phys.* **44,** L1355–L1357; 2005) have demonstrated the potential of this technology by producing a magnetic media based on nanopillars that are dense enough for storage densities beyond 1 Tbit in^{-2}. The pillars show sufficiently strong dynamic magnetization and operate at disk speeds of up to 4,800 r.p.m. Given current size limitations of the recording head, at present one bit of data consists of more than one pillar. Therefore, this technology has the potential of achieving even higher storage capacities.

Ever-decreasing circles

Small vesicles are preferable to large ones for drug-delivery applications because the efficiency of delivery generally increases as particle size decreases. However, the reduced quantity of drug that can be encapsulated in a small vesicle is a problem. Fujikawa *et al.* (*Langmuir* doi:10.1021/la052590q; 2005) present a solution that combines the best of both worlds: they reduce 70-nm vesicles in size to 20–25-nm ones, while retaining most of the active encapsulated molecules, leading to a fifty- to hundred-fold increase in concentration inside . The vesicle membranes consist of fatty acid molecules, arranged in a bilayer. When the vesicle is placed in a solution with micelles made of fatty acids and phospholipids, the micelles 'extract' the fatty acid molecules from the vesicle membrane, causing the vesicles to shrink in size. Up to 80% of the active molecules inside the vesicles are retained, resulting in the concentration increase. For drug-delivery applications, the next step is the stabilization of the vesicles to physiological conditions, and the authors are looking at polymerizing the membrane to achieve this.