Untangling particles in a light field

Microfluidic 'lab-on-a-chip' systems require efficient technologies for sorting microscopic particles. Now, MacDonald *et al.* have shown that mixtures of micron-sized particles can be sorted using a three-dimensional optical lattice. Optical sorting exploits the ability of light to control the motion of matter, a principle akin to that of 'optical tweezers.' Because the optical polarizability of a particle depends on its size and index of refraction, particles differing in these properties will be deflected to varying degrees by an applied light field. The authors demonstrate sorting by size (separating protein capsules of 2 m and 4 m) and by index of refraction (separating 2- m-sized polymer and silica particles). Unlike fluorescence activated cell sorting (FACS), the approach does not require a fluorescent tag. A key to the method's success lies in optimizing the interconnectedness of individual lattice points and tilting the lattice so as to maximize differences in the particles' angles of deflection. (*Nature* **426**, 421–424) *KA*

Protein Jell-o

A major challenge in fabricating protein arrays is maintaining the proteins in a native conformation. Hydrogels, a semi-wet environment, may offer advantages over conventional dry surfaces. Kiyonaka *et al.* propose to construct protein arrays with a 'supramolecular' hydrogel made from a self-assembling low-molecular-weight gelator. Structural characterization of their hydrogel revealed that the gelator forms thin crystalline fibers that aggregate into thicker fibrils containing nanoscale hydrophilic and hydrophobic regions. The hydrogel was then tested in an assay of the enzyme lysyl-endopeptidase. Cleavage of a peptide substrate coupled to the fluorescent probe DANSen could be readily monitored by changes in the wavelength and height of the emission peak. The authors suggest that supramolecular hydrogels are superior to conventional hydrogels in that more water is sequestered and the preparation process is simpler. (*Nat. Mat.* 3, 58–64, 2004) *KA*

Metal-manipulating microbe

Scientists have sequenced the genome of *Geobacter sulfurreducens*, a bacterium with potential use in bioremediation of metals such as uranium. *Geobacter* spp. generate energy as adenosine triphosphate by using metal ion–mediated electron transport to oxidize organic compounds to CO_2. They also play key roles in global cycling of metals and carbon. Interest in *G. sulfurreducens* for bioremediation stems from its ability to precipitate metals in groundwater by the addition of acetate. This subsoil microbe is also of interest to biotechnologists studying ways to capture electricity from the breakdown of organic waste with energy-harvesting electrodes. The genome of *G. sulfurreducens* reveals some hitherto unsuspected capabilities of this organism, including evidence of aerobic metabolism, one-carbon and complex carbon metabolism, motility and chemotactic behavior. Additional analysis of the genome should help researchers decipher how this microbe can be used for bioremediation and energy generation. (*Science* **302**, 1967–1969, 2003) *MS*

Research Notes written by Kathy Aschheim, Laura DeFrancesco and Meeghan Sinclair.

Broad immune boosters

Researchers have developed synthetic oligodeoxynucleotides (ODNs) for use in vaccines that can stimulate immune responses in a broader range of animals than previously possible. With existing ODN chemistries, companies had to tailor base composition to ensure that sequences immunostimulatory to mice produce a similar immune boost in humans. ODNs containing CpG dinucleotides mimic the ability of microbial DNA to activate the immune system through Toll-like receptor 9 (TLR9). These compounds show promise as vaccine adjuvants and in the treatment of asthma, allergy, infection and cancer, and they are currently being tested in clinical trials. However, optimal sequences for activating TLR9 vary among species. Different CpG-containing DNA sequences are therefore usually required for preclinical animal and human clinical studies. Agrawal and coworkers now use a synthetic nucleoside [1-(2′-deoxy-β-D-ribofuranosyl)-2-oxo-7-deaza-8-methyl-purine; R] to replace the C in CpG, resulting in an RpG dinucleotide. Human- and mouse-specific ODNs containing the RpG dinucleotide are potent immunostimulators in both mouse and human systems. Mouse and human immunomers (3′-3′-linked DNAs) with RpG dinucleotides also stimulate immune cells from human, monkey, pig, horse, sheep, goat, rat and chicken in a motif-independent fashion. (*Proc. Natl. Acad. Sci. USA* **100**, 14303–14308, 2003) *MS*

Making scent


courtesy N. Dudareva

Scent is one of several attributes used by flowers to attract pollinators, and scent production is a tightly regulated process, changing from day to night and during the life span of the flower. The isolation of genes responsible for producing scent volatiles has set the stage for studies into their regulation. Now, Dudareva and colleagues describe two different mechanisms for controlling scent and suggest a new role for the plant hormone ethylene. In snapdragons, decreases in volatile emissions following pollination could not be accounted for solely by changes in transcript levels of the major biosynthetic enzyme, benzoic acid carboxyl methyltransferase (BAMT), which transfers a methionine from *S*-adenosyl methionine to benzoic acid. Rather, changes in intracellular methylation capacity as well as reductions in gene expression seem to jointly cause the loss of scent. Meanwhile, in petunias, the BAMT transcript levels correlate well with reductions in emissions. In both cases, treating the plants with the plant senescence hormone, ethylene, caused reductions in BAMT gene expression, and in addition, successful pollination (that is, fertilization) was required, seemingly a way to ensure reproductive success. The authors suggest that this work will help the horticulture industry enhance scent in cultivated species, many of which have lost it. (*Plant Cell* **15**, 2992–3006, 2003) *LD*