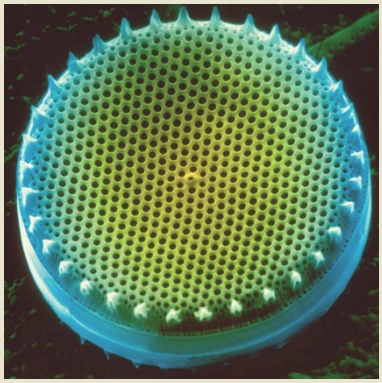
Golden diatoms



Artificial methods for the nano- and microscale fabrication of materials often appear elementary compared with Nature's exquisite capacity for producing and reproducing complex biological structures. Mirkin and colleagues now have turned to some of the most intricate architectures in nature, those of diatoms, a group of microalga characterized by their unique silica cell walls or 'frustules.' Following acid treatment to remove all organic components, the authors coated the frustules with thiolated, single-stranded DNA and then added layer upon layer (to a total of seven) of DNA functionalized gold particles onto the frustules. The result is a three-dimensional structure that reflects the patterns on the frustule with high fidelity. Applying different DNA functionalization protocols, nanostructures of different chemical makeups could be created with potential for application in fields ranging from optics to catalysis. (*Angew. Chem. Int. Ed.* **43**, 5500–5503, 2004) *GTO*

Open-air mass spectrometry

An innovation in mass spectrometry (MS) sampling promises to extend the technology's applications in forensics and biomedicine. Unlike the vacuum system used to contain samples with such MS methods as matrix-assisted laser desorption/ionization and secondary ion mass spectrometry, this new approach, desorption electrospray ionization (DESI), can sample an analyte on a spatially uninhibited surface in air. DESI directs electrosprayed charged droplets and ions of solvent onto the surface to be analyzed and uses atmospheric pressure to transfer the desorbed gas-phase ions to a mass spectrometer. The authors applied DESI to detect a plethora of molecules, from amino acids to peptides and proteins. DESI could detect an explosive compound from a leather surface as well as trace levels of a chemical warfare agent simulant on nitrile gloves washed after brief exposure to the chemical. Furthermore, by directly spraying a person's finger with a DESI spray, the authors showed that they could detect an antihistamine molecule ingested by the person 40 minutes earlier. (*Science* **306**, 471–473, 2004) *NC*

Mix and match synthetic vaccines

Researchers in Australia have assembled vaccines from a helper T-cell epitope, a lipid moiety and one of five target epitopes that induce both humoral and cell-mediated responses in immunized mice without using adjuvant. The trick here consists in using the lipid portion as a stand-in for an adjuvant for targeting and activating Toll-like receptors on dendritic cells. The target epitopes tested by the authors include three CD8$^+$ T-cell epitopes (influenza virus, *Listeria monocytogenes* and ovalbumin) and two B-cell epitopes (gastrin or luteinizing hormone-releasing hormone). Non-lipidated vaccines with the former epitopes offered no protection to immunized mice, whereas lipidated vaccines with the latter epitopes were as effective as vaccines with the toxic adjuvant cyclophosphamide. Mice vaccinated with viral or bacterial epitopes were protected against infection when given the corresponding live organism, showing, in the case of influenza, a reduction of 99.7% in viral titers. The influenza vaccine was given intranasally and can be manufactured using established methods with high quality control, which may give synthetic vaccines a leg up over those grown in chicken eggs. (*Proc. Natl. Acad. Sci. USA* **101**, 15440-15445, 2004) *TM*

Quenching thirst for peptide substrates

Current high-throughput screening methods using fluorescent probes to detect kinase and phosphatase activities require specialized equipment and often suffer from low fluorescence intensity. Now Rininsland *et al.* have developed an assay technology that exploits the interaction of a metal ion with a phosphate group to superquench fluorescent peptide substrates of these enzymes. Using microspheres coated with a fluorescent-conjugated polymer that binds Ga^{3+}, they showed that phosphorylated peptide substrates containing rhodamine dye bind to the metal ion and are subsequently quenched proportional to the amount of phosphorylation or dephosphorylation. In an alternative format, phoshorylation of a protein substrate lacking a dye molecule can be detected by assessing competition with a phosphorylated rhodamine tracer for access to Ga^{3+}-derivatized microspheres. The quenching assay is likely to be of interest to drug developers as several kinases and phosphatases are targets for small molecule therapies. (*Proc. Natl. Acad. Sci. USA* **101**, 15295-15300, 2004) *MZ*

Far-flung rescue

Embryonic stem (ES) cell research is hotly pursued because of the cells' potential to provide renewable sources of cells for repairing damaged tissues or organs, but now it appears that stem cells can also direct differentiation from a distance. Benezra *et al.* show that stem cells produce factors that encourage normal heart development in a mouse model of cardiac degeneration. They first demonstrated that mice with multiple mutations in differentiation-regulating transcription factor genes from the Id family have lethal cardiac defects and die *in utero*. Injecting as few as 16 ES cells into knockout blastocysts rescued 20% of the fetuses from a certain death. However, only part of the repaired heart was ES-cell derived, and furthermore, Id genes are not expressed in the heart itself, but rather in surrounding tissue (epicardium). This led the group to consider that the ES cells are directing differentiation through noncellular means. They demonstrated this by showing that injecting ES cells into the peritoneum of females before conception rescued embryos from cardiac lethality. Through microarray experiments, they identified two of the factors involved, insulin-like growth factor 1 (IGF-1) and Wnt5a, and showed that injecting IGF-1 into maternal circulation rescues Id knockout embryos. These experiments expand the ways in which ES cells might be used therapeutically. Furthermore, as Id transcription factors regulate multiple tissues, stem cell factors might correct congenital defects in many tissues besides heart. (*Science* **306**, 247–252, 2004) *LD*

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