

BIOCHEMISTRY

Iron Tug of War

Iron is an essential component of many enzymes, and microbes synthesize and secrete siderophores—small molecules that bind avidly to free iron in soils and in oceans—for the purpose of sequestering as much of it as they can. Many of these siderophores contain 2,3-dihydroxybenzoic acid (2,3-DHBA) as an iron-chelating moiety; not coincidentally, the mammalian innate immunity protein siderocalin defends against pathogens by enveloping 2,3-DHBA siderophores and thus blocking bacterial iron acquisition. The anthrax bacterium makes petrobactin, a siderophore that uses the less common 3,4-DHBA as its iron chelator, which enables it to evade the clutches of siderocalin.

Using biochemical and structural analyses, Pflieger *et al.* show that the *Bacillus anthracis* protein AsbF catalyzes the conversion of 3-dehydroshikimate (3-DHS) into 3,4-DHBA via a manganese-dependent formation of an enolate intermediate, followed by elimination of the C5 hydroxyl. Why does this matter? These authors show that deleting *asbF* from an otherwise deadly strain of *B. anthracis* abolishes virulence in a mouse model of inhalation anthrax. Petrobactin is produced by other pathogenic *Bacillus* species, and Fox *et al.* demonstrate that AsbF from a *B. thuringiensis* strain also dehydrates 3-DHS. — GJC

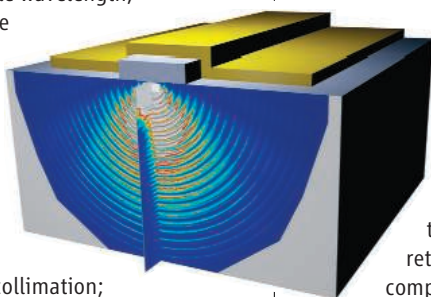
Proc. Natl. Acad. Sci. U.S.A. **105**, 17133 (2008);

Biochemistry **47**, 10.1021/bi801876q (2008).

APPLIED PHYSICS

Structured Lasers Hit the Spot

Compact semiconductor lasers find a host of applications from optical information storage media to chemical sensors. The robust quantum cavity laser, which operates at room temperature with tunable wavelength, is the workhorse. The window from which the light is emitted can be on the order of just a few micrometers. However, this small size generally results in poor collimation; the beam fans out, which is detrimental to the areal reading capacity and requires the laser to be driven harder for sensing applications. Yu *et al.* have used a structure of concentric rings patterned into a metal



layer deposited on the output facet of the laser to produce a plasmonic collimator that helps guide the output light. They find that the collimation of the output light beam can be improved by up to a factor of 30 while still retaining good output power as compared to unpatterned lasers. The improved collimation would also facilitate the coupling of light into optic waveguides and fibers for communication and possible optical computation applications. — ISO
Appl. Phys. Lett. **93**, 181101 (2008).



EVOLUTION

Old-Fashioned Carbon Fixing

The grass family has evolved several innovations that have made it one of the most widespread and speciose plant families. One of these innovations has been the origin of the C_4 photosynthetic pathway, which fixes carbon to form carbohydrates at relatively high temperatures and relatively low CO_2 (in comparison to the older C_3 pathway) and which is believed to have arisen independently several times within the grass lineage.

Vicentini *et al.* have created a well-supported phylogenetic tree of the grasses and concluded that the C_4 pathway originated after a major radiation in the grasses that split the family into two large groups. They calibrated their tree with six fossils and determined that the common ancestor of the grasses appeared approximately 94 million years ago (Ma) in the upper Cretaceous and that C_4 photosynthesis originated approximately 32 Ma in the Oligocene during a period when atmospheric CO_2 levels declined. Furthermore, the authors note that parallel incidents of C_4 evolution and reversion to C_3 pathways were clustered at times that may be related to changes in global environmental conditions and that correlated with changes in global CO_2 levels. — LMZ

Global Change Biol. **14**, 10.1111/j.1365-2486.2008.01688.x (2008).

CHEMISTRY

Reacting to the HIPE

Emulsions, such as salad dressing, consist of two immiscible liquids that are blended together to form droplets of one liquid suspended in the other. Emulsifiers and stabilizers can be added to prevent the droplets from coalescing, and when the dispersed phase occupies more than 74% of the volume, the mixture is known as a high internal phase emulsion (HIPE). Gitli and Silverstein prepared HIPEs with styrene or 2-ethylhexyl acrylate monomer in the oil phase and acrylamide monomer in the aqueous phase. The monomers were polymerized and cross-

linked to form an interpenetrating porous network, with a structure similar to an open-cell foam. The presence of the acrylamide was found to alter the molecular structure of the hydrophobic polymer. Initiation of the polymerization reactions could be triggered in either the oil or water phases, or at the interphase region, and had a direct impact on the structure and properties of the polymers. For all compositions, it was possible to reversibly swell and dry the polyacrylamide component, and the authors envision that these polymers could be used in biomedical and separation applications. — MSL
Soft Matter **4**, 2475 (2008).

IMMUNOLOGY

Uric Acid Lends a Hand

Antigen-presenting cells (APCs) recognize foreign molecules—for instance, the lipopolysaccharides produced by microbial invaders—that bind to cell surface receptors, which mobilize intracellular signal transduction pathways and initiate an anti-microbial response. APCs can also be activated by environmental factors such as the uric acid crystals that are associated with gout. Whether these sorts of particulate materials engage APCs by a similar receptor-based mechanism has been unclear.



Composite image of an AFM tip (orange) holding uric acid above an APC (green).

Using atomic force microscopy (AFM), Ng *et al.* found that uric acid crystals could bind strongly (100 nN) to cellular membranes via electrostatic interactions. This caused rearrangements of cholesterol-rich lipid rafts within the plasma membrane and stimulated intracellular signaling cascades. These results indicate that, in addition to the classical receptor-ligand pairings, direct cell surface contact by particulate materials can turn on APCs. This approach furthers our understanding of how cells of the immune system can be activated and may reveal the basis of how the adjuvant alum works. — HP*

Immunity **29**, 807 (2008).

*Helen Pickersgill is a locum editor in *Science's* editorial department.

CHEMISTRY

Running Off Together

Surface diffusion of large organic molecules on atomically flat metal surfaces can exhibit direction anisotropy. Eichberger *et al.* show how this process can be further influenced by the interactions that result between the molecules during collisions. They used fast scanning tunneling microscopy to study the diffusion of tetrapyrrolyl-porphyrin on a Cu(111) surface between 300 and 360 K, which occurs via one-dimensional random walks. They observed an unusual increase in the jump length of dimers formed when the molecules collide with the pyridyl groups aligned parallel to one another, and an increase of more than two orders of magnitude in the diffusion rate. They suggest that the dimers form through coordination to a thermally generated copper atom from the surface; the bonding of the pyridyl group in this manner would weaken the interaction of the subunits with the surface relative to the free monomers. — PDS

Nano Lett. **8**, 10.1021/nl802995u (2008).

BIOMEDICINE

Oncogenic Fusion Disguise

Human solid tumors typically display a vast array of genetic alterations, many of which are likely to be secondary events in tumor development rather than the primary drivers of tumor growth. One goal of cancer genomics research is to identify the alterations that cause tumorigenesis and occur at high frequency in a given tumor type, as these alterations are likely to be the most informative ones with respect to the biology of the tumor as well as being the most useful ones for diagnosis and therapy. This principle is illustrated most famously by the oncogenic fusion of the *BCR* and *ABL* genes in chronic myelogenous leukemia, the discovery of which ultimately led to successful therapy. To date, however, oncogenic fusion genes have been detected only at low frequency in solid tumors that are common in the general population. Jones *et al.* suggest that this may be a problem of detection. In a study of pilocytic astrocytomas (a common low-grade brain tumor in children), they found that 29 of 44 tumors harbored a genetic alteration that fused the *BRAF* oncogene with an uncharacterized gene called *KIAA1549*. The fusion gene, which was not found in other types of brain tumors, produces a protein with constitutively active BRAF kinase activity and confers tumorigenic potential on NIH-3T3 cells. This gene rearrangement was initially detected as a tandem duplication at 7q34, raising the possibility that similar duplications seen elsewhere in the cancer genome may likewise mark the sites of bona fide oncogenic fusion genes. — PAK

Cancer Res. **68**, 8673 (2008).

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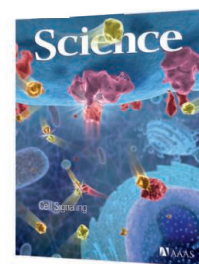
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