**BIOCHEMISTRY**

**Subunit Arithmetic**

The largest and least well-described (in structural terms) of the five respiratory enzyme complexes in mammalian mitochondria is the NADH:ubiquinone oxidoreductase, also known as complex I. Only recently has it been determined that the number of distinct subunits is 46, in comparison to 30 and 14 for the corresponding complex I orthologs in plants and bacteria, respectively. Applying a comparative genomic analysis using both nuclear and organellar sequence data, Gabaldón et al. show that complex I in the eukaryotic ancestor of the fungi, plants, and metazoa had grown to 35 subunits from the simpler bacterial/archaean core, having added subunits that came along as the endosymbiont was acquired and stabilized and gaining new recruits from the host. In the subsequent eukaryotic radiation, more subunits have been added to and subtracted from all over the complex, as judged by the three-dimensional maps generated from biochemical and electron microscopic studies. This piecemeal aggrandizement contrasts with the modular assembly of existing multisubunit enzymes into the prokaryotic complex I. — GJC


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**MATERIALS SCIENCE**

**Stabilized by Stress**

Thin films are often used as protective coatings against wear and corrosion; nitride films are also used as decorative layers. Typically, these films have a 1:1 metal:nitrogen composition, as in TiN, ZrN, or CrN, all of which have a NaCl-like structure and are highly conductive. Although it is difficult to make films with higher proportions of nitrogen, there have been reports of films with a M₃N₄ composition. Under high pressure inside a diamond anvil cell, the orthorhombic structure of these materials transforms into a metastable cubic structure, and the films become transparent and less conductive.

Chhowalla and Unalan have designed an industrially viable, filtered cathodic arc process to create cubic ZrN₄ films. Metal vapor is generated by an arc discharge on a pure Zr cathode and reacted with fully ionized atomic nitrogen. The deposition process produces films with inherent compressive stresses and, in combination with the localized high temperatures where the plasma is deposited, creates conditions that stabilize the cubic phase of ZrN₄. These films were found to be much harder than either ZrN or orthorhombic ZrN₄, and showed excellent wear resistance when used to coat a steel-milling tool. — MSL


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**CHEMISTRY**

**Fixing Nanoscaffolds**

Crystals of a virus have been used as templates for making metal-organic nanocomposites. Falkner et al. exploited the large void spaces in cowpea mosaic virus crystals (~50% of the crystal) by crosslinking the virus particles with glutaraldehyde. These scaffolds were exposed to tetrachloropalladate(II) ions, which bind to basic amino acids, and then to a buffer containing tetrachloroplatinate(II) ions and sodium hypophosphite. The hypophosphite reduced Pd(II) to the metal, which in turn reduced Pt(II) to the metal. The metallic content of the composite was 10% Pd and 55% Pt by weight, as determined by energy-dispersive x-ray spectroscopy.

The metallic content of the composite was 10% Pd and 55% Pt by weight, as determined by energy-dispersive x-ray spectroscopy. — PDS


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**IMMUNOLOGY**

**Sentries at the Portal**

The liver is a huge and metabolically active organ, enriched with substantial numbers of non-conventional immune cells that help to protect it from pathogens and potentially harmful immune responses to benign foreign material (such as antigens in food). Particularly striking are the many natural killer T (NKT) cells, which likely serve to regulate hepatic immunity.

To examine the behavior of hepatic NKT cells in situ, Geissmann et al. used mice in which one of the alleles coding for the NKT chemokine receptor CXCR6 had been replaced with green fluorescent protein. Intravital confocal microscopy revealed that NKT cells remained confined to the blood vessels within the liver, moving randomly and visiting each hepatocyte every quarter of an hour. This behavior differs from that of conventional activated T cells, which generally pass across the vessel endothelium into the surrounding tissue. Nevertheless, as do T cells on patrol in lymph nodes, hepatic NKT cells stop moving upon encountering antigen, consistent with their surveillance duties. In the absence of CXCR6, the number of hepatic NKT cells was significantly reduced, suggesting that this chemokine receptor mediates a survival signal. — SJS


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**CELL BIOLOGY**

**Perp Finds Its Purpose**

During mammalian development, the single-layered ectoderm surrounding the embryo initiates a stratifica-
show that p63 directly identified a gene and explore the coastline of...

Distribution of the desmosomal protein desmoplakin (green) in the presence (above) and absence (below) of Perp.

opmental program, but little is known about its targets or the mechanisms involved.

Ihrie et al. show that p63 directly regulates a gene whose product helps epithelial cells stick to each other. This gene, called Perp, encodes a membrane protein of the tetraspanin type and is highly expressed in developing skin. Perp localizes to desmosomes, specialized intercellular adhesive complexes that maintain the structural integrity of the skin and are crucial for its strength and resiliency. Newborn mice deficient in Perp display defects in desmosomes, and they die a few days later with severe skin blistering. The authors hypothesize that Perp plays a role in the shuttling, assembly, or stabilization of core desmosomal proteins. — PAK

Cell 120, 843 (2005).

ENVIRONMENTAL SCIENCE

Water Treatment Plants

Long-term ingestion of low concentrations of arsenic is detrimental to human health, yet in several countries around the world, large populations are constantly exposed to drinking water contaminated with arsenic. In Bangladesh, arsenic concentrations exceed World Health Organization guidelines in 60% of the groundwater.

Arsenic can be removed by filtration and via adsorbents, such as natural zeolites, but there still is a need for simple and cost-effective methods using materials that are readily available in developing countries.

Al Rmallowi et al. show that the dried pulverized roots of the water hyacinth can rapidly remove arsenic from water. The method is effective for both arsenite [As(III)] and arsenate [As(V)] and requires comparatively little material (50 µg of As are adsorbed per g of roots in 24 hours). Water hyacinths grow abundantly in ponds, lakes, and rivers in Bangladesh, India, and other tropical and subtropical countries. The simplicity of the method suggests that these plants may be useful in the treatment of drinking water, particularly in rural areas. — JFU


Water Treatment Plants

The sterol regulatory element–binding proteins (SREBPs) are a family of endoplasmic reticulum (ER) membrane-bound transcription factors that, in mammals, stimulate the transcription of genes involved in cholesterol and fatty acid synthesis, and are regulated by feedback inhibition. SREBP is activated through proteolytic cleavage in the Golgi; high concentrations of sterols promote formation of a complex between SREBP and the SREBP cleavage-activating protein (SCAP) and the ER protein Insig, which traps SREBP-SCAP in the ER. Hughes et al. identified a gene (sre1) in fission yeast with sequence similarity to that encoding human SREBP-1a and a similar membrane topology, and also the yeast homologs of SCAP (scp1) and of Insig-1 (ins1). Microarray analysis of sterol-depleted wild-type yeast and yeast lacking scp1 indicated that Sre1 promoted the transcription of genes involved in sterol biosynthesis and also that of genes required for the shift from aerobic to anaerobic growth. Yeast lacking sre1 or scp1 were unable to grow in the absence of oxygen, whereas low oxygen stimulated the expression of Sre1 targets in wild-type cells. Shifting yeast to low oxygen reduced ergosterol synthesis; after several hours, wild-type cells were able to adapt and increase ergosterol synthesis, whereas cells lacking sre1 could not. Thus, the authors propose that Sre1 monitors oxygen availability through oxygen-dependent sterol synthesis. — EMA

Cell 120, 831 (2005).
Fixing Nanoscaffolds
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Science 308 (5719), 167.
DOI: 10.1126/science.308.5719.167c