EDITORS' CHOICE

edited by Gilbert Chin

APPLIED PHYSICS

Organic Crystals Shine in Solar Cells

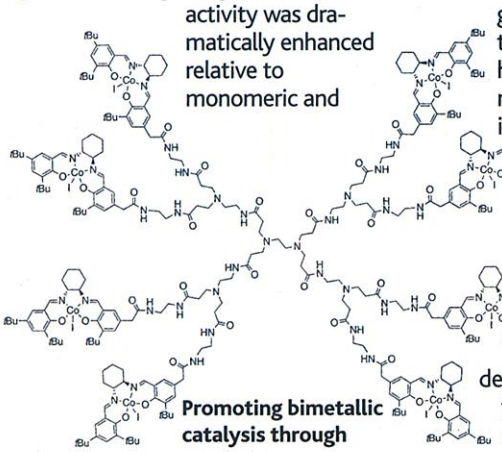
Organic materials are attractive candidates for low-cost electronics—they are lightweight and can be deposited on flexible and low-cost substrates, and in favorable cases they can be doped and can act as photoconductors. However, for applications in solar power generation, the performance to date of organic-based photovoltaics has attained conversion efficiencies in the range of only 2 to 3%. Exploiting their recent advances in the preparation of high-quality organic single crystals, Schön *et al.* now report that organic materials, in this case bromine-doped pentacene, may be leading candidates for inexpensive yet efficient solar cells. The addition of bromine to the organic crystal switches the high field region, the region most essential for photoinduced carrier separation, to the side with the highest photon density, and results in a conversion efficiency of 4.5%. Further optimization of their simple structures should result in still better performance. — ISO

Appl. Phys. Lett. **77**, 2473 (2000).

CHEMISTRY

Bound to Cooperate

Dendrimers are large, globular molecules fabricated from branching polymers that are attached to a central core. They are ideally suited for molecular recognition, the incorporation of guest molecules, and catalysis, particularly because they can be readily isolated after reaction through precipitation or filtration. Cooperative binding to dendrimer surface units has previously been demonstrated. Breinbauer and Jacobsen now show that a commercially available dendrimer, whose surfaces were modified with a known cobalt catalyst, not only was catalytically active but that its activity was dramatically enhanced relative to monomeric and dimeric constructs. Such cooperative effects on catalysis may result from the restricted conformations imposed by the dendrimer structure. — JU



Promoting bimetallic catalysis through proximity.

Angew. Chem. Int. Ed. **39**, 3604 (2000).

ASTROPHYSICS

Puny Star or Pudgy Planet?

The distinction between stars and planets has been blurred by observations of low-mass objects in a variety of astrophysical environments. These objects do not have enough mass to sustain hydrogen burning and cannot be characterized by standard evolutionary diagrams, although they may be stars that never reached thermal equilibrium and could be burning lithium or deuterium at lower temperatures. Some of the very low mass objects probably cannot even burn deuterium and may be planets. However, some of these do not orbit a star, so if they are planets, they must have formed differently from a normal planet or have been ejected from their planetary system. Without substellar evolutionary diagrams or a mechanistic definition of a planet, the observed low-mass objects are difficult to classify.

Chabrier *et al.* have brought some order to this problem by developing evolutionary diagrams for low-mass objects that burn deuterium. They have combined an interior model of deuterium burning in the core and convection of the deuterium to the surface with atmospheric models of deuterated water in order to determine the mass, temperature, luminosity, and spectral characteristics of deuterium-burning stars as a function of age. These models will help to distinguish puny stars from relatively massive planets. — LR

Astrophys. J. **542**, L119 (2000).

MICROBIOLOGY

Not to Be?

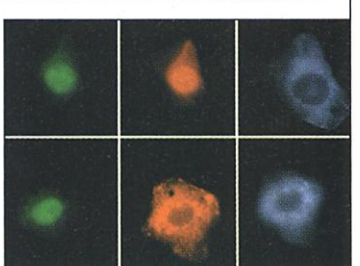
Geologists have observed 0.1 micrometer coccoid particles (thought to reflect the presence of very small microorganisms, or "nanobacteria") in minerals and meteorites, and biologists have implicated nanobacteria as nucleators in the formation of kidney stones. These findings and that of biomineralization in culture medium have been taken as a hallmark of the presence of nanobacteria; calcified particles from 0.45 μm filtrates of biological samples have been found to contain DNA and to support the transfer of biomineralization activity.

Cisar *et al.* have re-examined the evidence for nanobacteria, but they have failed to find nucleic acid or protein in decalcified samples, although

CELL BIOLOGY

Blocked Pores

During nuclear import proteins are transported from the cytosol across the double membrane of the nuclear envelope through nuclear pores. Nuclear import substrates possess short peptide motifs, known as nuclear localization signals (NLSs), that are specifically recognized by the nuclear import apparatus. One component of the nuclear import machinery is the protein p10, which directly binds to the small GTPase RanGDP and helps mediate import of proteins bearing classical NLSs.



RanGDP (green) is efficiently imported by both wild-type (top) and mutated (bottom) p10, whereas BSA-NLS (red) cannot enter the nucleus when mutated p10 is expressed.

In studying how p10 itself is transported across the nuclear envelope, Lane *et al.* discovered a single amino acid mutation that generates a dominant negative form of the protein. Mutated p10 imports RanGDP into the nucleus faster than wild-type p10, but in so doing appears to block access to components of the nuclear pore used by the karyopherins. The karyopherins are distinct components of the nuclear import machinery that bind to NLS motifs and are transported along with their cargoes across the nuclear pore. Therefore, relatively modest alterations to the interactions of nuclear import facilitators with the nuclear pore may result in profound changes to the throughput of nuclear entry pathways. — SMH

J. Cell Biol. **151**, 321 (2000).

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SOURCE: (LEFT) BREINBAUER & JACOBSON *ANGEW. CHEM. INT. ED.* **39**, 3604 (2000); LANE *ET AL., J. CELL BIOL.* **151**, 321 (2000).

they still observed transferable biomineralization activity. In addition, a closer look at the 16*S* rDNA sequences previously ascribed to nanobacterial species showed they were virtually identical to those of a notorious contaminating organism, *Phyllobacterium mysinacearum*. The transferable biomineralization activity appeared to be microcrystalline apatite (a constituent of teeth and bone) in combination with macromolecular triggers, such as phospholipids. Thus, it seems neither this world nor any other are yet ready for nanobacteria. — CA

Proc. Natl. Acad. Sci. U.S.A. **97**, 11511 (2000).

ATMOSPHERIC CHEMISTRY

Whose Ozone Is It?

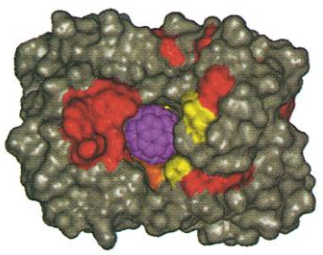
The U.S. Environmental Protection Agency has recently proposed tougher ozone standards that currently are not met in many areas of the United States. Concern has been raised that the standards may not be achievable because background ozone may reach concentrations that are almost half of the new standard. This background ozone includes intercontinental pollution that may be transported over the entire northern mid-latitudes. Lin *et al.* have examined the long-term trend in ozone background in surface air over the United States from 1980 to 1998 by analyzing hourly ozone observations for a large ensemble of rural sites. They observe an increase in the low end of the ozone probability distribution, which they attribute to increased background concentrations. The increase is largest in the spring and may reflect more efficient pollutant transport at northern mid-latitudes during this season. However, the geographical distribution of the ozone trends is not consistent with Asian pollution. — JU

Geophys. Res. Lett. **27**, 3465 (2000).

BIOCHEMISTRY

Getting a Firm Grip

The all-carbon molecule C_{60} (fullerene) would seem to offer little in the way of a handhold through which specific recognition could be achieved. Nevertheless, Braden *et al.* have extended earlier work and now describe the crystal structure of a monoclonal anti-C_{60} antibody. The predicted binding site is lined mostly with uncharged aromatic residues, which may grab onto the fullerene via π-system stacking interactions. The primary contribution to binding may arise from the precise fit; relaxation of the side chain conformations seen in the crystal is needed to squeeze the 1-nanometer fullerene through a 0.4-nm portal into the binding pocket. Subsequent study of this complex and others between biological macromolecules and carbon-based materials will serve to augment the toolkit of nanotechnology with the capacity for stereospecific recognition. — GJC



Modeling how C_{60} (purple) fits among aromatic side chains (red, orange, yellow).

Proc. Natl. Acad. Sci. U.S.A. **97**, 12193 (2000).

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Facilitator for Carcinogenesis

To grow and become invasive, tumor cells solicit aid from other cells, such as the vascular endothelial cells that form new blood vessels in the tissues that the cancer cells invade. Bergers *et al.* used a transgenic mouse model of multistage carcinogenesis to analyze the onset of angiogenesis during development of tumors of the pancreatic islets. They unexpectedly found that vascular endothelial growth factor (VEGF)—an established inducer of angiogenesis—and its receptors were constitutively expressed in islets and did not increase in abundance when angiogenesis began. Nevertheless, an inhibitor of VEGF signaling did inhibit angiogenesis and tumor growth. What did correlate with the onset of angiogenesis was expression of matrix metalloproteinase-9 (MMP-9), and expression of MMP-9 promoted angiogenesis and release of VEGF from cultured islets. In another mouse model of tumorigenesis, Coussens *et al.* find a similar facilitatory effect of MMP-9, and that it appears to be recruited from bone marrow–derived inflammatory cells. — LBR

Nature Cell Biol. **2**, 737 (2000); *Cell* **103**, 481 (2000).

CREDITS: BRADEN *ET AL., PROC. NATL. ACAD. SCI U.S.A.* **97**, 12193 (2000).