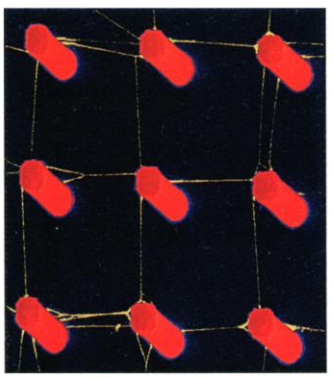
EDITORS' CHOICE

edited by Gilbert Chin

MATERIALS SCIENCE

A Nanoarea Network

For many of their potential applications, carbon nanotubes will need to be grown defect-free and in high yield, and, if possible, regular architectures should be obtainable directly rather than through post-synthetic trimming. Franklin and Dai have now fabricated extensive networks of highly oriented, single-wall carbon nanotubes suspended on silicon towers. The authors use an enhanced chemical vapor deposition method involving a "conditioning" step in which bulk amounts of catalyst are placed upstream of the silicon towers, whose tops also expose the catalyst. The conditioning step appears to convert some methane into more reactive benzene and enhances the yield and the lengths of the nanotubes, which grow up to 150 micrometers. Most of the nanotubes bridged adjacent towers, but some extended over several silicon towers. This geometry is attributed to the differences in methane flow between the top and bottom surfaces that serves to "float" nascent nanotubes until they can attach to another tower. Electrical measurements will show whether the suspended nanotubes form a continuous, conducting network. — JU



Carbon nanotubes wired from silicon towers.

SOURCE: (LEFT TO RIGHT) E. N. K. CLARKSON; FRANKLIN AND DAI, *ADV. MATER.* 12, 890 (2000).

Adv. Mater. **12**, 890 (2000).

BIOMEDICINE

Life (and Death) Without NEMO

The NF-κB signaling pathway has captured general attention because of its prominent role in cell survival and proliferation, immune and stress responses, and inflammatory reactions. Adding to interest in this pathway is the discovery that inherited genetic alterations in one of its key regulatory components are responsible for an X-linked human disease called incontinentia pigmenti (IP). Males with IP usually die before birth, whereas heterozygous females display variable abnormalities of the skin, hair, nails, central nervous system, and other tissues.

Smahi *et al.* show that most patients with IP have mutations in the gene encoding NF-κB essential modulator (NEMO), a protein required for activation of the NF-κB transcription factor. In parallel studies, Makris *et al.* and Schmidt-Supprian *et al.* show that female mice heterozygous for NEMO deficiency develop skin lesions and other characteristic features of human IP. Signaling via NF-κB can prevent cell death, leading the authors to speculate that loss of NF-κB activation by NEMO contributes to the embryonic lethality in males and to the selective loss of NEMO-deficient cells seen in females. — PAK

Nature **405**, 466 (2000); *Mol. Cell* **5**, 969 (2000); *Mol Cell* **5**, 981 (2000).

APPLIED PHYSICS

A Brighter Future by Going Dark

Microsecond-scale switching times, large viewing angle, and gray-scale capabilities make antiferroelectric liquid crystals (AFLCs) attractive candidates for electro-optic devices such as displays. However, their relatively poor dark state, which results in unacceptable amounts of light passing through crossed polarizers and in poor contrast between on- and off-states, has limited their utility. Inhomogeneities and misalignment of the AFLC layers, as well as wiggling of the optic axis in the presence of an applied electric field, have been thought to be the culprit. Most AFLCs have tilt angles (the angle between the polarizer axis and its optic axis) of 25° to 35°. D'havé *et al.* show that, in materials designed to have a tilt angle of 45°, the directors in alternating layers are orthogonal to each other and the dark-state problem is solved; the zero–applied field material becomes uniaxial with its optical axis in exactly the direction needed to block transmission. — ISO

Appl. Phys. Lett. **76**, 3528 (2000).

ECOLOGY AND EVOLUTION

Symbiotic Trilobites

The Cambrian trilobite *Parabolina spinulosa*.

Oxygen-poor habitats associated with sulfide-rich sediments are widespread in the oceans. To counteract the toxic effects of sulfide, many marine metazoa have evolved physical associations with autotrophic sulfur bacteria, which use reduced sulfur as an energy source and, in doing so, render the sulfur nontoxic. Metazoa with chemoautotrophic bacterial symbioses tend to exhibit morphological specializations, such as reduction of the mouthparts.

When did such symbioses first evolve? Fortey has investigated trilobites of the family Olenidae, one of the early arthropod groups that populated the late Cambrian and early Ordovician seas (505–445 million years ago), and interprets their morphology as being consistent with symbiotic associations with sulfur bacteria. The olenids, which appear to have been sluggish organisms meandering about the seabed at the margins of the sulfur-rich zones, have extended pleural areas (gill filaments)—a possible site for bacterial cultivation—and atrophied mouthparts. Moreover, their fossils are found in sulfur-rich nodules in Cambrian shales. Thus, these trilobites would represent the oldest known chemoautotrophic symbionts. — AMS

Proc. Natl. Acad. Sci. U.S.A. **97**, 6574 (2000).

IMMUNOLOGY

Organizing Transplant Rejection

Immune responses toward infectious pathogens are initiated within the organized secondary lymphoid tissue of the spleen and lymph nodes. Whether this also applies in allogeneic responses toward highly vascularised organ grafts, such as the heart, remains uncertain. In such cases, the potential for an immune response exists because T cells could respond to antigens expressed on the vascular endothelium of the graft.

Lakkis *et al.* have found that

CONTINUED ON PAGE 2287

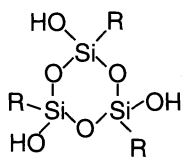
mice lacking lymphoid organs do accept heart allografts (transplanted heart tissue from genetically distinct or allogeneic donors). They also found that T cells from these lymphoid organ–deficient mice could induce graft rejection when transferred to lymphocyte-deficient mice that possessed lymphoid tissue, even when the cells came from mice that had previously accepted a cardiac transplant. Thus, the lack of a rejection response was not due to an attitude of immune tolerance on the part of the T cells, but resulted from their inability to perceive and respond to transplanted tissue in the absence of organized lymphoid organs. — SJS

Nature Med. **6**, 686 (2000).

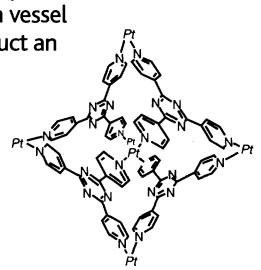
CHEMISTRY

Crafting Small Siloxanes

One route that chemists have taken to modify the catalytic properties of zeolites (aluminosilicates) is to anchor small transition molecule catalysts within their channels. Yoshizawa *et al.* have now turned the tables on this kind of "ship in a bottle" chemistry. They have enlisted the multinuclear platinum compound **3** to serve as a nanoscale reaction vessel in which to construct an elusive intermediate in silica sol-gel chemistry, the trisilanol **1** (in this case, R is a phenyl group). The individual phenylmethoxysilane reactants can enter the cage, but once the trisilanol forms, it cannot escape—but must suffer detection by mass spectrometry and nuclear magnetic resonance. — PDS



The ship 1.



The bottle 3.

J. Am. Chem. Soc., in press.

NEUROSCIENCE

Pathways to Pain Control

Membrane proteins that bind ligands on their extracellular side and G proteins on their intracellular side comprise one of the largest gene families expressed in the brain, the G protein–coupled receptors (GPCRs). The multiplicity of neuronal genes encoding peptides suggests that many of the GPCRs may recognize neuropeptides, but the scarcity of both receptors and ligands has made pairing of these partners difficult.

Elshourbagy *et al.* follow the same approach that led to their surprising linking of the receptor for orexin-A (a peptide involved in regulation of appetite) to narcolepsy (brief attacks of deep sleep). In this new work they isolate a GPCR that when co-expressed with a promiscuous G protein displayed high affinity binding of peptides ending in -Arg-Phe-amide (that is, the peptide family defined by the molluscan FMRFamide). Further screening indicated that the likely endogenous ligands are two peptides known as NPFF and NPAF, which are known to modulate opiate function in interesting but as yet incompletely understood ways—NPFF administered intracerebroventricularly behaves as an antiopioid, but potentiates morphine analgesia if given intrathecally. (Another neuropeptide-GPCR system with dichotomous effects on pain is described by Pan *et al.*) Having the receptor in hand will facilitate identification of nociceptive agonists and antagonists. — GJC

J. Biol. Chem., in press; *Neuron* **26**, 515 (2000).

PLANETARY SCIENCE

When Rubble Piles Collide

Recent observations by the Near Earth Asteroid Rendezvous (NEAR) spacecraft revealed that the asteroid Mathilde has a density close to that of water and a huge impact crater. The asteroid's low density and large craters suggest that it may in fact be a pile of porous rubble held together by gravity. Early in the life of the solar system, planet formation might have been initiated or accelerated by the accretion of multiple rubble piles within a dusty, gaseous environment.

Leinhardt et al. have begun the task of defining the crucial parameters and modeling the outcomes of different collisional scenarios in order to understand how objects like Mathilde may have formed and how planet formation may have occurred. In their simulations, they varied the sizes of the objects, their impact speeds, their spin rates and directions, and the angle of the impact. Slow, head-on collisions led to accretion while fast, high-angle collisions led to erosion. They could create contact binaries (dog bone–shaped objects) by high-angle collisions at slow-impact speeds; however, it was difficult to produce detached binaries or an appreciable amount of orbiting material. Nonetheless, their suite of simulations provides a useful map of some of the parameter space in the rough and tumble environment of rubble pile collisions. — LR

Icarus **146**, 133 (2000).

CREDITS: YOSHIZAWA *ET AL.*, *J. AM. CHEM. SOC.* IN PRESS