

edited by Gilbert Chin

CHEMISTRY

Triggering Polymer Destruction

Dendrimeric polymers are synthesized in several reaction cycles that add monomer groups to a central core—hence they normally expand geometrically with each round of synthesis. Szalai *et al.* have created a small dendrimer that can be disassembled geometrically: a single chemical triggering event leads to two subsequent fragmentations in each subunit and completely reduces the polymer back to monomers. The dendrimers are built from 2,4-bis(hydroxymethyl)phenol units. The removal of a carbocation creates a phenoxide that then cleaves and liberates two alkoxide groups in the presence of a suitable nucleophile. They synthesized a small dendrimer with nitrophenoxy reporter groups and a single “trigger” group and show that a second-generation dendrimer can be disassembled in under a minute. If such a

process can be extended to higher generation dendrimers, it could be used to release molecules, such as drugs, that have been trapped noncovalently within the spaces between the arms of the dendrimer vehicle. — PDS

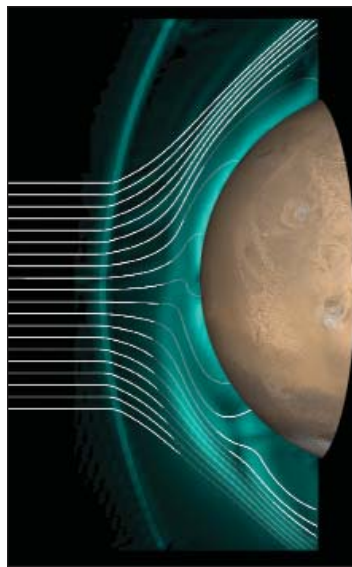
J. Am. Chem. Soc. 10.1021/ja0386694 (2003).

PLANETARY SCIENCE

Martian Minimagnetopause

The solar system is not as empty as it may seem; the space between the planets is permeated with an interplanetary magnetic field (IMF) and bombarded continuously by the solar wind. When the IMF and the solar wind intersect at a planet, even a small planet like Mars (with a thin atmosphere, weak magnetic anomalies, and a paltry plasmasphere/ionosphere), the magnetic field lines are compressed and pile up, and the solar wind particles interact with the planet.

Harnett and Winglee have



The solar wind (white lines), and the magnetic pile-up and minimagnetopause (inner blue surfaces) at Mars.

developed a three-dimensional, non-ideal magnetohydrodynamic model of the magnetic pile-up and particle interactions. The simulations show the formation of a minimagnetopause above the magnetic

anomalies in the southern hemisphere of Mars. The minimagnetopause keeps the solar wind from reaching the Martian surface, it demagnetizes ions, and it increases the size and magnitude of the magnetic field and current. The minimagnetopause only appears on the dayside and is caused by the relatively stronger magnetic anomalies in the southern hemisphere. This previously unrecognized and asymmetric interaction may change our understanding of the Martian environment, particularly whether hydrogen and oxygen remain neutral species in the Martian exosphere or exchange with interplanetary space. — LR

Geophys. Res. Lett. 10.1029/2003GL017852 (2003).

VIROLOGY

Doing Triple Duty

Adenovirus is a small DNA virus that replicates its genome and assembles new virus particles inside the nucleus of the host cell. The protein components of the viral capsid are synthesized in the cytosol and so must be imported into the nucleus. Wodrich *et al.* show that one of the viral capsid proteins, protein VI, has near its C terminus both nuclear localization and export signals (NLS and NES). Because protein VI binds to the major adenovirus capsid protein (hexon) in the cytosol, it can carry hexon molecules into the nucleus, using its NLS to hitch a ride on the host nuclear importers, and then return empty-handed to the cytosol via its NES-exporter interaction. When capsid proteins are sufficiently concentrated in the nucleus to allow for efficient virus assembly, both nuclear transport signals in protein VI are degraded by proteolysis, trapping the

MICROBIOLOGY

Pitting Erythrocytes

When invaded and occupied by *Plasmodium falciparum*, normally pliable red blood cells become rigid and inelastic, properties that contribute to the occlusion of capillaries and the symptoms of malaria. Shelby *et al.* have developed a microfluidic apparatus for studying single infected red cells using molded silicone elastomer to mimic a

An uninfected red cell (red) squeezes past nondeformable and knobby infected cells.

capillary. The elastic modulus of the elastomer channels can be tuned to approximate that of blood vessel walls. Uninfected erythrocytes pass easily through synthetic capillaries 2 μm in diameter, but infected cells fail to enter an opening as large as 6 μm . Interestingly, uninfected red cells

are able to traverse the blockade by squeezing past infected cells. The authors were able to reproduce a phenomenon that occurs in the spleen, in which the bulk of an infected erythrocyte enters a 2- μm tube, leaving the parasite jammed at the entrance; the membrane ruptures, leaving the parasite behind, and the parasite-free red cell emerges out the other end. In the spleen, such “pitted” erythrocytes can then be returned to circulation. This kind of device might offer a rapid screen for agents that inhibit or reverse the biomechanical effects of malaria parasites on red cells. — CA

Proc. Natl. Acad. Sci. U.S.A. 100, 14618 (2003).

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CREDITS: (LEFT) SHELBY ET AL., *PROC. NATL. ACADEM. SCI. U.S.A.* 100, 14618 (2003); (RIGHT) LAUREL RACHMEIER AND ENIKA HARTNETT

Downloaded from www.sciencemag.org on April 20, 2007

protein in the nucleus and uncovering its third function as a structural component of the capsid itself. — SMH

EMBO J. **22**, 6245 (2003).

DEVELOPMENT

No Cutting out of Bounds

Mechanisms that support spatial patterning during development include the localized activation of regulatory factors and signaling pathways. In *Drosophila*, dorsal-ventral polarity is established in part by activation of the Toll receptor on the ventral side of the embryo. Its ligand, Spätzle, is processed by a serine protease called Easter, and the activation of Easter is realized via a cascade of three other extracellular serine proteases.

Hashimoto *et al.* and Ligoxygakis *et al.* have shown that Easter activity is spatially regulated in early embryos

by the maternally expressed and secreted serine protease inhibitor serpin 27A (Spn27A), which was detected throughout the perivitellin fluid surrounding the embryo. Loss of Spn27A function resulted in increased Easter activity, an increase in processed Spätzle, unrestricted activation of Toll, and a ventralized embryonic phenotype, whereas injection of Spn27A restored normal polarity and cell differentiation. Spn27A and Easter were also detected in a stable 1:1 complex. In mammals, the serpin antithrombin inactivates the extracellular serine protease thrombin as it diffuses away from sites of vascular damage, thereby restricting the initiation of the blood-clotting protease cascade to sites of injury. — LDC

Dev. Cell **10**, 1016/S1534580703003381(2003);
Curr. Biol. **13**, 2097 (2003).

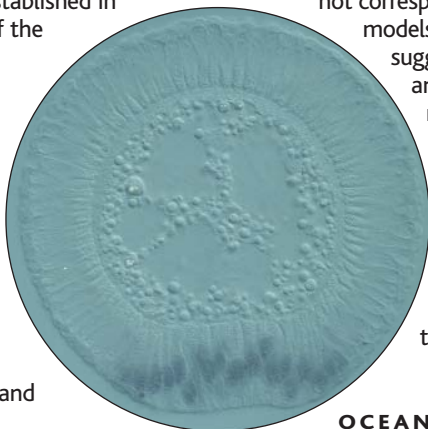
MATERIALS SCIENCE

Melting the High Spots

Carbon films have been used as the protective layer for magnetic disks and read heads, but they begin to fail when they are thinner than 3 to 4 nm. An alternative material, tetrahedral amorphous carbon, forms

a highly sp^3 bonded network, yielding pinhole-free films that are only 1 to 2 nm thick and remarkably smooth. Casiraghi *et al.* used atomic force microscopy to follow the carbon-ion deposition process and to elucidate the growth mechanism responsible for the smoothness. By measuring the change of the height-height correlation function with respect to film thickness, they extracted a roughening exponent α of -0.39 and a growth exponent β that ranged from 0.0 to 0.1. These exponents do not correspond to any existing growth models, but such low β values suggest that surface diffusion and relaxation must play a role during growth. The authors argue that diffusion is aided by local heating due to the impact of the carbon ions, and they present Monte Carlo simulations in which impact melts and flattens the film locally. — MSL

Phys. Rev. Lett. **91**, 226104 (2003).



Dorsal-ventral polarity as shown by the ventral marker Twist.

OCEAN SCIENCE

Warm and Salty Fingers

The stratified conditions found in fjords, bays, and many larger bodies of water inhibit vertical mixing of many ocean components, including O_2 . If O_2 diffusion across a zone that separates layers of different density—called a pycnocline—is too slow to support the rate at which organic matter is oxidized, suboxic or anoxic conditions can develop in the deeper layers. In the Black Sea, a stable suboxic zone lies between the upper oxenic waters, originating from Mediterranean inflow through the Bosphorus Strait, and the deeper anoxic zone. However, the restricted mixing within this configuration means that the downward flux of O_2 is insufficient to balance the upward flux of sulfide that is observed.

Konovalov *et al.* report the discovery of thin layers of oxygen-rich waters, extending as much as 200 km into the Black Sea, which inject massive amounts of O_2 into the oxenic and suboxic layers. These 5-m-thick "fingers" of oxygenated water are created by the mixing of colder and fresher Black Sea water with warmer and more saline Mediterranean water. On the basis of these observations, the authors suggest that lateral transport may be equally important in many other water bodies that exhibit permanent pycnoclines. — HJS

Limnol. Oceanogr. **48**, 2369 (2003).

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