provides a distinct signature of each particular element. Both Suenaga's group and Krivanek's team have reported using EELS to study nanotubes that contain nanopods filled with single atoms such as erbium.[7,8]

Electromechanical probes such as scanning tunneling microscopes (STMs) and atomic force microscopes (AFMs) are alternative instruments for imaging molecules on a surface, but unlike TEMs, they cannot say anything about deeper layers. Alex Zettl of the University of California at Berkeley is interested in the exotic combination of manipulators like STMs and AFMs and detectors like TEMs. When embedded in a TEM, an STM or AFM can manipulate objects on a surface as the TEM dynamically images the resulting changes. Such manipulators have been embedded in the older generation of TEMs.[9] Zettl is among those working to incorporate them in the new generation of TEMs. The bottom line, says Zettl, is that "technology advances are opening many new doors."

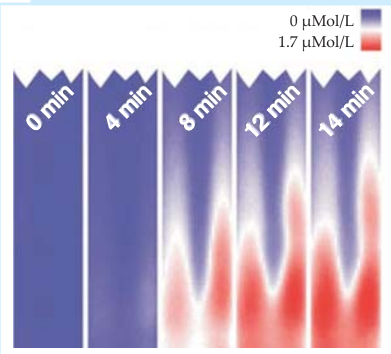
Barbara Goss Levi

physics update

These items, with supplementary material, first appeared at http://www.physicstoday.org.

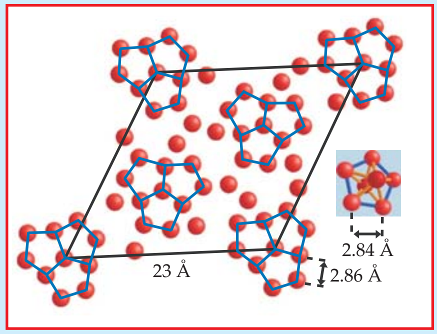
Replicating and trapping DNA. In living organisms, the complex directional capabilities of cell membranes ensure the concentration and confinement of DNA and the ingredients needed for its replication. But how was that accomplished at the dawn of life on Earth, when there were no such membranes to constrain indiscriminate diffusion and entropy growth? At the University of Munich, Dieter Braun's biophysics group has addressed those questions with a suggestive demonstration of efficient DNA replication and accumulation driven only by a quasistatic thermal gradient in a fluid-filled glass capillary stocked with nucleotides, a polymerizing enzyme, and a small initial template charge of a DNA with 143 base pairs. The 0.1-mm-wide capillary is meant to mimic pores at hydrothermal vents in early seas. The thermal gradient is provided by an IR laser. The gradient drives DNA molecules away from hot spots and sustains a convective flow that subjects the DNA to thermal cycles that create new DNA and concentrate it at the sealed ends of the capillary. The convective cycles promote unraveling of the double helix at 86 °C and its subsequent replication at 60 °C. The DNA population doubles every minute or so, until the closed system's exhausted nucleotide reserve eventually puts an end to that exponential growth. The figure shows the growing DNA concentration at one of the capillary ends over a span of 14 minutes. With continual nucleotide replenishment, such a system might replicate DNA at the rate of 1700 doublings per day. So aside from its possible relevance to paleobiology, the result is of biotechnological interest. (C. B. Mast, D. Braun, *Phys. Rev. Lett.* **104**, 188102, 2010.)

—BMS



Delayed freezing in a supercooled liquid metal. In the presence of a suitable nucleating agent, a liquid in a metastable state below its thermodynamically defined melting point freezes. That's what happens when atmospheric aerosol particles in clouds cause supercooled water droplets to form snowflakes. Researchers have suspected that the atomic surface structure of the seeding particles acts as a template, inducing local order in the disordered liquid and catalyzing its crystallization. Conversely, a solid with a different structure can inhibit crystallization, as has now been observed at the European Synchrotron Radiation Facility in Grenoble, France, by Tobias Schülli and his colleagues. The researchers coupled x-ray scattering data with molecular-dynamics simulations to study supercooled gold–silicon droplets on a silicon substrate, a system that is used to grow Si nanowires. Surprising results emerged when they heated the AuSi alloy above 676 K: As it cooled, the Si atoms leached onto the substrate and, as the figure shows, rearranged its surface atoms into pentagonal clusters. The alloy's atoms near the interface mimicked the substrate's surface structure (see inset), but the resulting local order did not promote crystallization in the droplets, which froze at 513 K, about 120 K below the freezing temperature for the AuSi alloy. Apparently, the pentagonal geometry inhibits freezing because it is not conducive to crystal packing. That finding suggests that substrates with such atomic structures offer a simpler method of maintaining and observing the supercooling process than techniques like magnetically levitating or otherwise suspending the liquid droplet. (T. Schülli et al., *Nature* **464**, 1174, 2010.)

—JNAM



Pollen's energy-efficient water conservation. The outer layer of a pollen-grain wall generally includes apertures through which the grain can gain or lose water. When in an arid environment, pollen grains avoid becoming dangerously dry by undergoing a process called harmomegathy—the grain's apertures are effectively sealed until the pollen lands in a wetter location. For more than a century, scientists have known that wall structure helps determine the form that a pollen grain assumes after harmomegathy. Now Harvard University's Jacques Dumais, former Harvard student Eleni Katifori, and colleagues have presented the first quantitative model of the process and confirmed it with electron micrographs such as shown here (the scale bars represent 20 μm). The model incorporates the classic result that stretching a surface costs a lot of energy; instead of stretching, the grain surface bends as the wall folds onto itself to avoid further desiccation. The