PHYSICS UPDATE

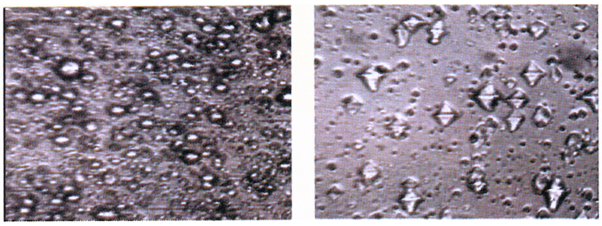
SUPERCONDUCTIVITY-DEPENDENT FRICTION. Despite the tremendous industrial importance of friction, much remains unknown about its fundamental origins. Now, a Northeastern University group led by Jacqueline Krim has found a new clue at the nanometer scale. They used a delicate quartz microbalance that incorporated a lead substrate 150 nm thick, topped off with a layer of frozen nitrogen only 1–2 molecules thick. The microbalance was jiggled back and forth at 8 MHz, with the overlying nitrogen slipping and sliding along on the ride. Previously, the researchers measured exceedingly tiny frictional shear stresses with this approach. This time, an unexpected finding emerged: When the lead substrate was chilled below its superconducting transition, the friction between it and the solid nitrogen dropped by half. Krim says this is the first direct experimental evidence that conduction electrons can contribute to friction. (A. Dayo, W. Alnasrallah, J. Krim, *Phys. Rev. Lett.* **80**, 1690, 1998.) —PFS

BIG LIGHT THROUGH LITTLE HOLES. Apertures smaller than the wavelength of light shouldn't transmit much of that light. So it came as a surprise to Thomas Ebbesen (NEC Research Institute, Princeton, New Jersey; Louis Pasteur University, Strasbourg, France) when he illuminated an array of subwavelength holes (150 nm diameter, 900 nm apart, in a silver film coating a quartz substrate); at selected wavelengths (up to ten times the size of the holes), plentiful amounts of light came out the other side. In fact, more than twice as much light was transmitted as impinged directly on the holes' total area. The leading explanation is that the light couples to surface plasmons, electronic excitations at conductor–insulator interfaces. Adding to the mystery, however, is that the transmission was the same whether the light entered the array from the air or from the quartz. Ebbesen and his colleagues believe that their arrays, which transmit light at special wavelengths, will complement photonic crystals, which exclude light at special wavelengths. (T. W. Ebbesen, *et al.*, *Nature* **391**, 667, 1998.) —PFS

PROTON EMISSION FROM HIGHLY DEFORMED nuclei has been measured for the first time by a multinational team working at Argonne National Laboratory. A rare decay observed mainly in proton-rich isotopes of elements heavier than tin (Z = 50), proton radioactivity has until now been successfully modeled by assuming a spherical nucleus. The researchers used Argonne's ATLAS accelerator to create holmium-141 (Z = 67) and europium-131 (Z = 63) nuclei, implanted them in a silicon detector, and measured their halflives and emitted proton energy spectra. The data did not agree with predictions based on penetration of a spherical potential barrier. Using a newer model that includes quantum tunneling through a deformed barrier, the researchers found that the nuclei have highly deformed shapes. Their data also allowed them to obtain the first experimental information on the ground state of a highly deformed nucleus beyond the proton drip line. (C. N. Davids, *et al.*, *Phys. Rev. Lett.* **80**, 1849, 1998.)—BPS

A LARGE MAGNETOCALORIC EFFECT has been found in certain materials containing gadolinium, reported Vitalij Pecharsky (Ames Laboratory, Iowa State University), Robert Shull (National Institute of Standards and Technology, Gaithersburg, Maryland) and Carl Zimm (Astronautics Corp of America) in separate talks at the March meeting of the American Physical Society in Los Angeles. At a fixed temperature, the entropy of a magnetic system is lowered as the spins align with an applied magnetic field. If the field is then removed adiabatically, the system will be cooler than it was before the field was turned on. This magnetocaloric effect typically produces a temperature drop of 0.5–2 K for a field change of 1 tesla. The Ames group found that combining Gd with silicon and germanium increased the effect to 3–4 K T^{-1}. Shull made a magnetic nanocomposite with Gd clusters that also showed a greatly enhanced magnetocaloric effect. Zimm reported on a very efficient Gd-based sub–room-temperature refrigerator. Magnetic refrigeration is used for, among other things, liquifying hydrogen and natural gas. —SGB

WATCHING POLYMERS BLEND. About 30% of all plastics sold are polymer blends, but, like oil and water, different polymers often don't mix easily. To blend them, they are typically processed in a heated pipe—called an extruder—that melts the raw materials, mixes them and forces the resultant blend out through a small orifice. Now, Kalman Migler and Erik Hobbie (National Institute of Standards and Technology, Gaithersburg, Maryland) have built a stroboscopic microscope and laser-based light scattering system to learn more about what happens during extrusion.



For viscous drops in a much less viscous fluid (flowing from right-to-left in the accompanying photos) subjected to moderate shear rates, the drops elongated as expected in the direction of the flow (left). When subjected to strong shear, however, the drops stretched perpendicular to the flow (right), a result of internally generated "normal forces." Migler reported the NIST work at the March American Physical Society meeting in Los Angeles. —SGB