equipment, such as the glucose monitors used by diabetes patients, require frequent and mildly painful extraction of blood samples. One promising noninvasive technique is based on irradiating the glucose-rich subdermal tissue with near-IR light and analyzing the spectra of the inelastically scattered photons, which correspond to an impinged molecule's unique vibrational modes. Light scattered from the target tissue is aligned by a hollow reflecting parabolic optical element before it reaches a filter that separates inelastic photons from elastically scattered ones. However, the high degree of alignment required for efficient filtering leads to optical elements too large for practical use. Now a team of researchers at MIT has developed a hyperbolic element—the gold-colored conical component shown in the picture—that when coupled to a focusing lens at its output, provides the same filtering efficiency as a parabolic element five times its length. In effect, light that is reflected in the hyperbolic chamber can be virtually traced back to a distant point-source whose rays are less scattered when they exit through the focusing lens. Results from the device's measurements of glucose in human skin folds correlated with those from a finger-prick monitor. The researchers say their instrument can be made even smaller by further optimization of the optics and electronics and can be used to detect other biomolecules or to monitor industrial chemical processes. (C.-R. Kong et al., *AIP Advances* **1**, 032175, 2011.) —JNAM

A double take on the double arc. More than just a tool for movie stars to break into a vault, the plasma cutting torch has many industrial uses, as depicted here. In plasma cutting, an electric arc is established between a cathode on the torch and the metal workpiece, which acts as the anode. A collimated gas stream blows at high speed through a conducting nozzle in the torch and, in the presence of the arc, becomes the high-temperature plasma that melts through the metal. The nozzle can be damaged if the arc, instead of passing through the orifice, contacts the wall and then jumps onto the workpiece. That so-called double arc has also been seen in a transient, nondestructive form that spikes in milliseconds; neither form is well understood. A trio of researchers in Argentina has now studied the nondestructive double arc experimentally, using the nozzle as a probe of the plasma properties. A surprising finding is that, contrary to long-held assumptions, the nonequilibrium plasma within the nozzle is not in a steady state when close to double arcing. Instead, it is highly sensitive to electric fluctuations arising in the power source. Their results could also overturn the hypothesis that because an insulating film forms on the nozzle's interior, the transient spikes are nondestructive. The transient discharges instead seem to occur within the space-charge layer between the plasma and the nozzle wall—no film needed. (L. Prevosto, H. Kelly, B. Mancinelli, *J. Appl. Phys.* **110**, 083302, 2011.) —SGB

Making waves with the Moon's shadow. As it sails across Earth during a solar eclipse, the lunar shadow creates a bow wave in the ionosphere like a moving boat does in water. That's what researchers in Taiwan and Japan found when they analyzed data from more than 1400 GPS receivers on those islands during the long-lived eclipse of 22 July 2009. Predicted more than 40 years ago, the wave effect arises from the localized cooling within the darkest regions of the shadow; the temperature, density, and pressure differences set up acoustic gravity waves that ripple along, ahead of and outward from the faster-moving shadow's leading edge. The researchers note that the receivers, each gathering data from 9 or 10 GPS satellites, give them about 13 000 lines of sight through Earth's atmosphere, which allows them to tease out the spatial distribution of total electron content in the ionosphere with 30-second time resolution. The acoustic gravity waves they saw had periods of 2–3 minutes and 5 minutes and formed two wavefronts. The analogy to a moving boat is quite accurate in that the bow wavefront spreads at a much slower velocity than the boat is moving; the eclipse shadow was clocked at 954 m/s, the ripples at 300 m/s. What's more, the Earth scientists also saw a stern wavefront consistent with the hydrodynamic predictions, separated from the bow wave by about 1700 km—the length of the shadow boat. (J. Y. Liu et al., *Geophys. Res. Lett.* **38**, L17109, 2011.) —SGB

Toward an easily fabricated artificial leaf. Photosynthesis, the original green technology, converts solar energy into the chemical energy of nourishing sugars. In the step that crucially depends on sunlight, plants and other organisms use solar energy to break water down into oxygen and hydrogen. Today, research teams worldwide are replicating that ubiquitous natural feat in the lab. One group, led by MIT's Daniel Nocera, has now devised an artificial leaf with several attractive features: It's compact, uses inexpensive and easy-to-get materials, works in environments that are not corrosively acidic or basic, and allows wireless operation. The figure shows the oxygen bubbles generated by a 1 × 2 cm artificial leaf immersed in an electrolyte; the device, though, can also function in pure water. The apparatus consists of a piece of silicon covered by catalytic chemicals—on one side is a compound called cobalt oxygen-evolving catalyst; on the other is an alloy of nickel, molybdenum, and zinc. When struck by light, the silicon spits off electrons and holes that, aided by the catalysts, induce the water's disintegration. Nocera and colleagues expect they can readily increase the modest efficiency of their proof-of-principle artificial leaf; at present, in wireless mode, 2.5% of the incoming radiation energy is chemically stored, though a variation with wires achieves 4.7% efficiency. Those figures are a bit better than the efficiencies typical of crop plants, but more expensive artificial systems have achieved efficiencies of 18%. (S. Y. Reece et al., *Science* **334**, 645, 2011.) —SKB ■