unhindered trade of GMOs.

Biotech opponents read the results differently. "The U.S. lost on most major issues," counters Philip L. Bereano of The Council for Responsible Genetics in Cambridge, Massachusetts. The Miami group drafted wording that would have allowed the WTO to overrule the biosafety treaty, he says; putting the two agreements on equal footing is seen as a victory by GMO opponents. And Bereano says it is a vindication that the environmentalists' darling, the precautionary principle, is written into the agreement.

The treaty puts off for 2 years the issue that kept the U.S. and E.U. at each other's throats until early morning in Montreal: whether to include the trade of GMOs that are not likely to propagate in the environment. The treaty states that such "commodity" GMOs intended for food or feed must be labeled "may contain" GMOs. But it does not require exporters to segregate GMO-containing products from traditional products. Some countries and companies already refuse GMO products and pay a premium for nonmodified crops—a market process that is likely to continue until the parties meet again in 2002. –LAURA HELMUTH

MATERIALS SCIENCE

# Stretching Horizons For Electrical Devices

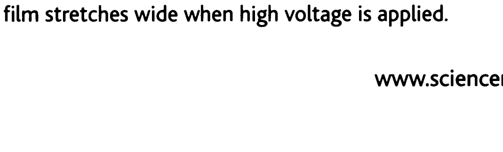
Hunting for materials that change shape when zapped electrically, researchers have found a new champion literally hanging out in the kitchen. A rubbery acrylic used to stick widgets to refrigerators triples its length when squeezed with high voltage. Known as a dielectric elastomer, the stuff has shattered the standard for electrically induced elongation, researchers report on page 836. The acrylic and its stretchy silicone brethren might someday control video displays, animate small robots, or power artificial limbs.

Ron Pelrine and his colleagues at SRI International in Menlo Park, California, achieved the record-breaking stretches while searching for better materials for electrical actuators, devices that turn electrical energy into mechanical work. Magnet-and-coil actuators drive stereo speakers, car door locks, and many other familiar electric contraptions. But smaller, higher tech actuators, such as those that guide the tip of a scanning tunneling microscope, rely on materials that deform when stimulated electrically. Substances that perform this trick include piezoelectric crystals, electrostrictive polymers, magnetostrictive alloys, and carbon nanotubes. The measure of motion for such materials is linear strain, the change in length divided by the initial length. The previous best was 41%; the SRI group hiked the figure up to 215%. "I was very excited by these results," says Ray Baughman, a materials scientist with Honeywell International in Morristown, New Jersey. "The strains you get here are just giant."

Pelrine's team fashioned parallel-plate capacitors from films of the elastomers by mounting each film on a rigid frame and painting electrodes of conductive grease on either side. They charged each capacitor to several kilovolts and flattened the material in the middle with an electrical double-whammy known as Maxwell stress. Opposite charges on the two sides of the film attracted each other and squished it like a hamburger between a spatula and a frying pan. Meanwhile, like charges along each surface of the film repelled each other, forcing it to stretch even more. With this technique alone, the researchers set the old record with a silicone elastomer.

To get even bigger strains, Pelrine and colleagues employed a new twist: stretching the film before they applied the voltage. The prestraining toughened the film so the researchers could apply higher voltages. It also stiffened the film in one direction so that energy from the electrical squeeze was funneled into straining the material in a perpendicular direction. The extra boost enabled Pelrine and colleagues to obtain strains of 117% for a silicone elastomer and 215% for the acrylic.

Some researchers aren't bowled over by the numbers. "How does this advance the science of the field?" asks Qiming Zhang, a materials scientist at Pennsylvania State University, University Park. The physics behind Maxwell stress is well understood, Zhang says; the interesting question is what underlying mechanism distinguishes the newfound elastomers from other stretchy substances.



CREDIT: R. PELRINE/SRI INTERNATIONAL

**Spreadsheet.** A circular capacitor on an elastomer film stretches wide when high voltage is applied.

Pelrine says the SRI team focused on finding promising materials. "Basically, we've tried everything we can try," he says. Indeed, he came across the star acrylic while sticking a plastic safety latch to his refrigerator door and decided to test it. Identifying materials with exotic properties is scientifically worthwhile, Pelrine says, especially if it leads to deeper study. He points to the discovery of high-temperature superconductors, in which huge improvements on the performance of conventional superconductors led researchers to new physical principles. "The jump in performance using the acrylic elastomer, for example, is so large," he says, "it begs the question of why it is so much better than other elastomers."

As for applications, dielectric elastomers provide 100 times more motion but roughly 1/30th as much pressure as piezoelectric crystals. They may therefore prove useful for tasks that require long movements but less pushing or pulling, such as covering and uncovering pixels on video displays or moving the limbs of small robots. Because the materials stretch farther and generate more pressure than living muscle, they may be useful for powering prosthetic limbs. Elastomers currently require high voltages, however, which may limit how they can be employed. "No one actuator technology is going to solve all the problems," Baughman says.

–ADRIAN CHO

CANCER RESEARCH

# A Face-Off Over Tumor Blood Supply

Last September, cancer biologist Mary Hendrix of the University of Iowa, Iowa City, and her colleagues published a paper in *The American Journal of Pathology* that stirred up a hornet's nest in cancer research. It suggested that in very aggressive melanomas of the eye, blood-conducting channels that nourish the growing tumor are formed not by the endothelial cells of true blood vessels but by the cancer cells themselves (*Science*, 3 September 1999, p. 1475).

If correct, the finding could have major implications for efforts to find new cancer drugs. Currently, drug developers are working furiously to find compounds that inhibit the growth of the new blood vessels around cancer cells. Those drugs are aimed at endothelial cells, however, so they may not work against tumors that use an alternative means to get blood.

But the work touched off a critical backlash. Some blood vessel specialists and others maintain that the structures the Iowa team described could not be blood-conducting channels. Some of their concerns are presented in a commentary published in the February issue of *The American Journal of Pathology*. That's unlikely to resolve the issue, however, as Hendrix and her colleagues are sticking to their guns. So time has also been set aside for both sides to thrash out their arguments at a Keystone meeting on angiogenesis in Salt Lake City in early March.

Pathologist Robert Folberg, a member of the Iowa team and now chair of pathology at the University of Illinois, Chicago, came to