samples of the cancer that the Parsons group studied. Indeed, Johns Hopkins's Kinzler says, "there have been other candidate [prostate cancer] genes proposed, but I think this is the real McCoy." And he predicts, "the chances are, it's going to be involved in other cancers."

Researchers still have a lot to do to find out just how the gene's loss could contribute to these cancers, although its sequence provides some important clues. As a phosphatase, the PTEN protein may counteract the work of the growth-stimulating kinases, which can help make cells cancerous when they are mutated into an overactive form. The researchers have not yet shown directly that the protein is a phosphatase, however, nor have they identified any possible targets for its phosphate-removing activity.

The cytoskeletal connection might also help explain the abnormal growth of cancer cells. Because of its links to the protein matrix outside the cell, the cytoskeleton is thought to be part of the system that helps cells know that they are in contact with neighboring cells. Normal cells tend to stop multiplying when they encounter their neighbors, but cancer cells often keep dividing, as if they never got the message to stop. PTEN's absence might be what blocks the message. PTEN may also somehow help anchor cells, in which case its loss may enable a cell to metastasize. "If [*PTEN*] does have a role in cell motility or cell structure, that might be quite interesting," says Eric Fearon, a cancer geneticist at the University of Michigan, Ann Arbor. How the protein's proposed roles as a phosphatase and a cytoskeletal protein might relate to each other is unclear, however.

Even before researchers know how the gene works, it may prove useful to clinicians. Tavtigian points out that if this gene is the one mutated in Cowden disease, it could form the basis of a prenatal diagnostic test. And if the loss of the gene helps a cancer invade other tissues, then *PTEN*'s status may help oncologists predict how malignant a glioma or prostate tumor will be—information that could help clinicians decide how aggressive they should be with surgery, chemotherapy, or other treatments. "If you had a molecular marker that could aid a clinician in that decision, that would be very significant," Steck suggests.

And then there's the possibility that the PTEN work might provide guides to better cancer therapies by leading researchers to protein it normally dephosphorylates, putting the brakes on cell growth. A drug that either blocks the phosphorylation of the protein or removes phosphates from it might cure a cell of any cancerous tendencies.

Given all this potential, Li's life will not likely slow down any time soon, Parsons notes: "I think it's going to continue to be crazy here for at least another 6 months."

–Elizabeth Pennisi

MATERIALS SCIENCE

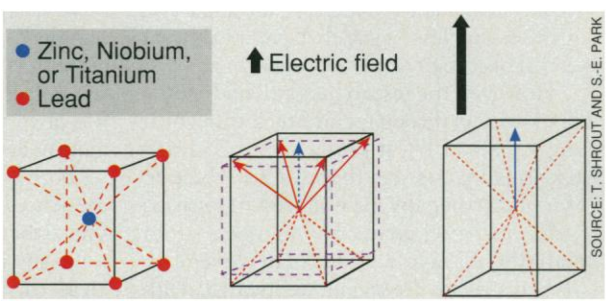
Shape-Changing Crystals Get Shiftier

A talented family of materials has gained some even more gifted members. So-called piezoelectric crystals have the unique ability to swell or shrink when zapped with electricity, as well as give off a jolt of juice themselves when compressed or pulled apart. Engineers have exploited this trait for decades to convert mechanical energy to electricity and back again in applications ranging from phonograph needles to telephone speakers.

Now, a pair of researchers from Pennsylvania State University has bred new piezoelectric wunderkinds, some of which display an effect 10 times greater than that of current family members. A paper by the researchers, materials scientists Thomas Shrout and Seung-Eek Park, is scheduled to appear this spring in the inaugural issue of the journal *Materials Research Innovations*, but early word of the new work is already turning a few heads. "It's an exciting breakthrough," says Eric Cross, another piezoelectric materials expert at Penn State, who is not affiliated with the project. "Improvements by a factor of 10 are not easy to come by in a field that's 50 years old and considered mature." If the materials are commercialized, as Cross and others believe they will be, they could usher in a new generation of piezoelectric devices that would improve everything from the resolution of ultrasound machines to the range of sonar listening devices.

Piezoelectric materials owe their abilities largely to the asymmetrical arrangement of positively and negatively charged atoms in their crystal structure. The positive and negative charges balance out in each of the crystal's unit cells—its basic repeating units—but the positive charges, for instance, may be weighted toward the top of each cell. An electric field can displace the charges even farther, which distorts the overall shape of the unit cell and of the crystal as a whole. The process can also run in reverse: Squeezing or stretching the material shifts the charges relative to each other, redistributing electric charge around the surface of the crystal, which can produce a small electric current.

The usual showcase for these properties is a cheap ceramic material called PZT, containing millions of crystalline grains in different orientations. PZT, which is composed primarily of lead, zirconium, titanium, and oxygen, can deform by as much as 0.17% in a strong applied field. To boost this shape-shifting ability, researchers have tried to grow single crystals of PZT, in which all the unit cells would line up in the same direction. Their contributions to the piezoelectric effect would also line up, enhancing it. But because PZT's components tend to separate during processing, the ceramic is extremely difficult to grow as a single crystal, says Shrout.



Crystal growth. A weak field displaces atoms toward the corners of the unit cells, but a stronger field rearranges the lattice.

To coax the material into forming single crystals, Shrout and Park tried varying its composition. They settled on a couple of different mixtures, such as a combination of lead, zinc, and niobium spiked with varying amounts of lead-titanate (PT). The researchers found that a small admixture of PT—less than 9%—yielded materials that not only grew into single crystals, but also ended up with piezoelectric abilities that are enhanced more than they expected.

Just why that is, "we still don't know for sure," says Shrout. But he and Park believe that at least part of the enhancement is due to the fact that an electric field applied to the new materials does more than just shift a few atoms around in the unit cell, as in PZT: "We think it causes the whole crystalline lattice structure to change from one form to another," says Shrout. The changed crystal structure, in turn, frees individual atoms to respond more strongly to the field, increasing the overall distortion of the material. Likewise, a mechanical distortion probably produces a similar lattice shift, enabling the material to generate more current than standard PZT.

Whatever the reason for the effect, it's likely to be very useful, says Robert Newnham, another piezoelectricity expert at Penn State. The new crystals will undoubtedly cost more than ceramics like PZT, says Park, because growing single crystals is a slow and painstaking process. But he adds that he and Shrout are working on ways to speed it up. If they succeed, the new piezoelectric wunderkinds could grow up to live expansive lives indeed.

–Robert F. Service