NOBEL PRIZE IN PHYSICS

AWARDS: Pair shares prize for discovery that enabled high-density computer hard disks

THE 2007 NOBEL Prize in Physics has been awarded to two researchers who independently discovered a physical effect—giant magnetoresistance (GMR)—that led to a new technology for reading data on computer hard disks, as well as a new field of science, magnetoelectronics or spintronics.

Albert Fert of France's National Center for Scientific Research (CNRS) and the University of Paris-Sud, in Orsay, France, and Peter Grünberg of the Research Center Jülich, in Germany, will share the $1.5 million prize.

The Fert and Grünberg research groups discovered GMR independently in the late 1980s, using different combinations of nanometer-thick layers of magnetic iron and nonmagnetic chromium. When they placed the materials in an external magnetic field, the researchers observed a large change in the materials' electrical resistance that surprised the physics community; that is, they observed GMR.

GMR is one of the more important discoveries of the last couple of decades, says Venkatesh Narayanamurti, a physics professor and dean of the School of Engineering & Applied Sciences at Harvard University. The researchers' exploration of thin-film materials played an important role in the discovery of GMR and its development as a technology, he adds.

Magnetic sensors based on the GMR effect that could access information stored on high-density computer hard disks were introduced in 1997. Now, some music players are also based on this technology. The sensors read tightly packed data on hard disks by detecting the magnetic fields associated with the aligned electron spins of magnetic bits on the disk.

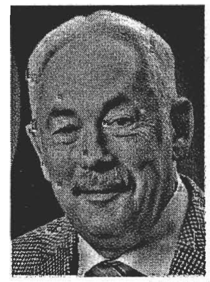
The sensors themselves were developed by IBM researchers. One of them, Stuart Parkin, is generally regarded as the most significant person in bringing GMR from the laboratory into commonly used devices. In 1994, the American Physical Society recognized Fert, Grünberg, and Parkin for their scientific achievements in GMR and related technology with the James C. McGroddy Prize for New Materials.

GMR also helped launch a new area of fundamental research called spintronics, says Stuart Solin, a physics professor and director of the Center of Materials Innovation at Washington University, St. Louis. In spintronics, electron charge and spin are manipulated to affect the properties and capabilities of magnetic materials including information storage and transmission. Work by Fert, Grunberg, and others "has advanced our understanding of the quantum mechanical consequences that spin properties have on the behavior of materials," Solin says. "Their discovery stimulated a huge amount of effort worldwide to explore these consequences."

When Grünberg was asked by the Nobel Foundation which application of GMR is most interesting, he described how various researchers are currently exploring GMR devices for detecting and selectively separating genetic material. "This is a topic that is very broad, and if it works, it will have many applications," he said.—RACHEL PETKEWICH

CNRS PHOTOTHÈQUE/CHRISTOPHE LEBEDINSKY

Fert



RESEARCH CENTER JÜLICH

Grünberg

MATERIALS SCIENCE Adhesive inspired by critter feet is strong and reusable

Conventional adhesives such as packing tape can't be reused nearly as many times as tree frog feet. Embedding an elastomer with liquid-filled microchannels that resemble those on tree frog feet, however, creates a strong, reusable adhesive, according to a new study (*Science* 2007, 318, 203.)

"In essence, we are trying to mimic bioadhesives on the feet of many insects and vertebrates," says author Animangsu Ghatak of the Indian Institute of Technology, Kanpur.

Man-made adhesives (see page 39) crack when they are peeled off of a surface. The cracking mechanism allows release but also leads to loss of stickiness. To stop cracks from spreading during peeling, researchers have had some success in micropatterning the surface of adhesives.

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Ghatak and his colleagues created their adhesive with inspiration from fluid-containing vessels found in animals such as tree frogs and bush crickets. The scientists buried channels filled with silicone oil in the bulk and subsurface of a polymethylsiloxane elastomer. The deep channels act as a barrier to crack propagation and increase adhesion by a factor of 30. By adding a separate layer of oil-filled channels at the subsurface, the team created an adhesive that peels off surfaces easily. The researchers currently are examining how the geometry of channels affects adhesion.

The work is "innovative and provocative," though there may be challenges for manufacturing large quantities at low cost, says Phillip B. Messersmith, a professor of biomedical engineering and materials science at Northwestern University.—RACHEL PETKEWICH