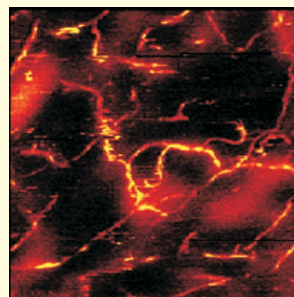


The giant planar Hall effect is a new type of magnetoresistance (MR) seen in a ferromagnetic semiconductor by a team of physicists from Caltech and the University of California, Santa Barbara. In the usual Hall effect, current flowing along a planar conductor is slightly swept to the side when a magnetic field, oriented perpendicular to both the current and the plane, is turned on. In the new experiment, the applied magnetic field lies in the conducting plane, at some angle to the current. The physicists found that, for all nonzero angles—except those aligned with directions of high crystallographic symmetry—there were always two large and abrupt jumps in the Hall voltage as the magnetic field strength was varied. This type of anisotropic MR switching behavior was previously seen in magnetic metals, but the effect in the magnetic semiconductor (GaMnAs) is a factor of 10^4 stronger. MR effects are important in the huge magnetic read-head industry and are also central to the development of spintronics, in which an electron's spin, not just its charge, is instrumental in carrying out high-speed operations. (H. X. Tang et al., *Phys. Rev. Lett.* **90**, 107210, 2003.) —PFS

Left-handed materials are now being explored experimentally. LHMs—which do not exist in nature—have a negative index of refraction, $n < 0$, meaning that light entering such a material at an angle is refracted on the same side of the normal as its incidence. In principle, an LHM with $n = -1$ can perfectly focus light without any curved surfaces. The first composite LHMs were built three years ago (see PHYSICS TODAY, May 2000, page 17, and June 2001, page 9), but some aspects of the theory were controversial. At this year's March meeting of the American Physical Society in Austin, Texas, two more labs reported devising LHMs and beginning to study the bizarre properties of such materials. Andrew Houck from MIT reported that microwaves refracted through a wedge-shaped LHM "prism" indeed obeyed Snell's law with a negative n : The microwaves never crossed the normal. The MIT group also provided preliminary evidence that light from a point source can be focused with a flat rectangular LHM slab. Technically, only the real part of n must be negative in an LHM. Patanjali Parimi from Northeastern University in Boston reported measurements of both the real and imaginary parts not only of the index of refraction, but also of the permittivity and permeability of an LHM sample in a microwave waveguide. The prediction of perfect focusing can only be realized when the imaginary part of n , which represents absorptive losses, is zero. (A. A. Houck, J. B. Brock, I. L. Chuang, *Phys. Rev. Lett.* **90**, 137401, 2003. P. V. Parimi et al., preprint available from s.sridhar@neu.edu.) —PFS

Optical near-field Raman microscopy of single-walled carbon nanotubes has been done. Scientists from the University of Rochester, Portland State University, and Harvard University combined near-field optics, surface-enhanced Raman scattering (SERS), and scanning probe techniques to achieve 25-nm resolution images using 633-nm laser light. The researchers fashioned a silver wire with an extremely sharp (10–15-nm radius) tip and placed it within about 1 nm of the sample, in this case a



nanotube. When they directed the laser light to the tip, SERS took over: A greatly enhanced electric field at the tip excited the nanotube, which, in turn, emitted photons that were collected in the far field and analyzed. By scanning the tip over the sample, images like the one shown here were built up. The image is chemically specific—the only frequencies of light emitted correspond to vibrational excitations of the molecule being studied—and can be combined with spectroscopy. The researchers hope that better resolution will allow them to obtain detailed pictures of proteins in cell membranes. (A. Hartschuh et al., *Phys. Rev. Lett.* **90**, 095503, 2003.) —BPS

Ultraslow light in a room-temperature solid has been generated. In recent years, light has been greatly slowed in gases, Bose–Einstein condensates, and solids at cryogenic temperatures (see, for example, PHYSICS TODAY, July 1999, page 17, and March 2001, page 17). Typically, the technique of electromagnetically induced transparency is used to create large variations in the medium's index of refraction over a very narrow spectral range. Now, physicists at the University of Rochester have used a different technique—coherent population oscillations—to achieve the same result in a ruby crystal at room temperature. The scientists modulated the ground-state electron population at the beat frequency of two pulsed lasers. A spectral "hole" only about 36 Hz wide developed in the ruby's absorption and the light's group velocity was slowed to 57.5 m/s. The researchers could control the velocity by changing either the modulation frequency or the input intensity. In fact, they found that two pulses were not even necessary: A single very intense pulse could interact with itself to produce the desired effect. A possible application is to optical delay lines in the telecommunication industry. (M. S. Bigelow, N. N. Lepeshkin, R. W. Boyd, *Phys. Rev. Lett.* **90**, 113903, 2003.) —SGB ■