physics update

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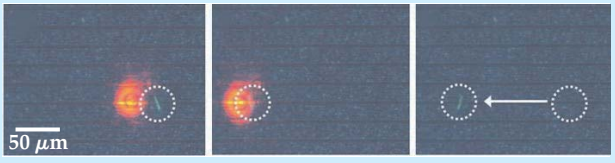
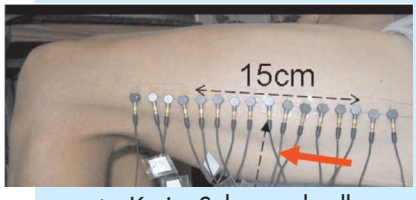
Laying nanowires down with optoelectronic tweezers. Standard optical tweezers are used to manipulate one particle at a time by trapping it in a focused laser's strong field gradients. OETs also use field gradients, but the gradients are created between electrodes by shining light (which needn't be from a laser) onto a photoconductive material whose conductivity can change by three orders of magnitude. As a spot or pattern of

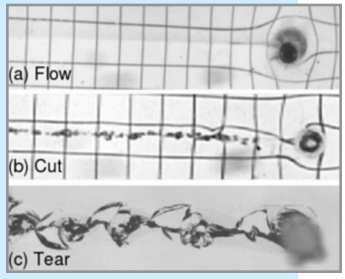


light is moved across the material, the resulting electric field, its gradient, and any trapped particles also move. The University of California, Berkeley, group that developed OETs loaded a liquid buffer containing the particles of interest into a cell with the photomaterial and an electrode on the cell's bottom. In the original OET, a second electrode was at the top; when an AC voltage was applied to the device, a vertical electric field was generated wherever the illumination fell, and nanorods could be stood upright and moved around. At the Conference on Lasers and Electro-Optics (CLEO) in May, the group revealed a lateral-field version (LOET) with the electrodes interleaved on the bottom of the cell. That configuration allowed the researchers to orient and move nanowires parallel to the plane of the electrodes, as shown in the images. In the first panel, the circled nanowire is close to the spot of light prior to the AC field being switched on. Subsequently, the wire is drawn into the spot and moved 200 microns in about 10 seconds before the light is turned off. According to Berkeley's Aaron Ohta, the OET uses much less power than optical tweezers, and now the LOET can be used to build circuitry. (CLEO paper CThGG5, abstract available at http://www.cleoconference.org.) —PFS

Listening to muscle noise. Muscles make noise. For example, if you lean your ear on the palm of your hand, you can hear a low rumbling produced by the masseter muscle—a jaw muscle used for chewing. During voluntary contractions, such muscle noise, or physiological tremor, occurs naturally along the transverse direction of the muscle fibers due to the longitudinal shortening of the muscle's actomyosin filaments. Karim Sabra and colleagues at the Scripps Institution of Oceanography have developed an elastography technique that uses measurements of the noise to determine muscle's elastic properties. Standard elastography techniques estimate stiffness by using an active external source, such as indentation or an ultrasonic transducer, to generate propagating shear waves. The Scripps method, in contrast, is passive: Surface sensors, such as the skin-mounted accelerometers attached to the leg in the figure, record the intrinsic muscle noise. Cross-correlating the signals from those accelerometers clearly revealed a propagating shear wave traveling down the leg; from the phase velocity, the experimenters could extract muscle properties—the absolute shear modulus (that is, stiffness) and the dynamic shear viscosity—as the muscle contracted. This low-cost, noninvasive technique for measuring muscle stiffness, say the researchers, can be used to diagnose and monitor muscle activity and can provide information about muscular dystrophy and other neuromuscular diseases. (K. G. Sabra et al., *Appl. Phys. Lett.* **90**, 194101, 2007.) —PFS



Ripping fluids. Viscoelastic materials are known to exhibit both solid-like and fluid-like behavior under conditions of restricted flow or deformation. The Pennsylvania State University's Andrew Belmonte and Joseph Gladden (now at the University of Mississippi) have done the first study of how one such material, a concentrated solution of surfactants and organic salt, responds to something more drastic: a blunt cutting tool. When a cylinder is slowly dragged through the material, the material flows smoothly around it, as a liquid normally does. At higher speeds, a small cylinder creates a cleft that lingers long enough for air bubbles to become trapped in the material, whereas a larger cylinder creates a tear with a jagged shape like what's observed in torn sheets of rubber and plastic (see PHYSICS TODAY, February 2007, page 33). In that case, however, the torn surface heals itself within a few hours. What underlies all this behavior is the aggregation of the surfactant molecules. Usually, and in their most familiar context as detergents, surfactants cluster together by their hydrophobic tails in spherical structures called micelles. But with the addition of the organic salt, the surfactant molecules reorganize into long, flexible tubes—worm-like micelles—again with their tails inward and hydrophilic heads pointing outward. The resulting gel-like material is held together not by covalent chemical bonds but by the much weaker interactions among the surfactant molecules. (J. R. Gladden, A. Belmonte, *Phys. Rev. Lett.* **98**, 224501, 2007.) —PFS



Quantum point contact sustains 5/2 quantum Hall state. If the theorists are right, the quasiparticle excitations of the 5/2 quantum Hall state share a remarkable collective degeneracy that can be exploited for fault-tolerant quantum computing (see PHYSICS TODAY, October 2005, page 21). But before experimenters can build even a single logic gate, they need to confirm the 5/2 state's true nature. And before they do that, they need to trap the 5/2 state within the confines of a gated quantum dot or quantum point contact. That preliminary step has just been carried out. Jeff Miller of Harvard University and his collaborators from Alcatel-Lucent's Bell Labs, Harvard, and MIT fabricated seven different-sized QPCs out of a semiconductor heterostructure made from gallium arsenide and aluminum gallium arsenide (see figure). Using clever tunings of voltages and magnetic fields, Miller and his collaborators observed the 5/2 state not only in the gallium arsenide bulk of the heterostructure but also between the QPCs. In addition, their measurements reveal comforting, but not conclusive, evidence of tunneling by edge states across the QPC. That tunneling is a vital ingredient for harnessing the quantum computing potential of the 5/2 state. (J. B. Miller et al., *Nature Physics*, in press.) —CD ■