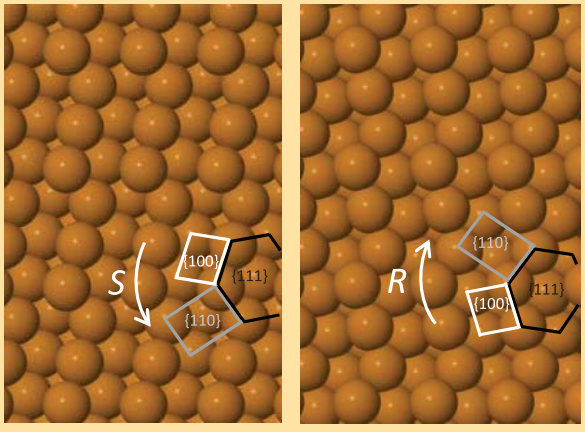
physics update

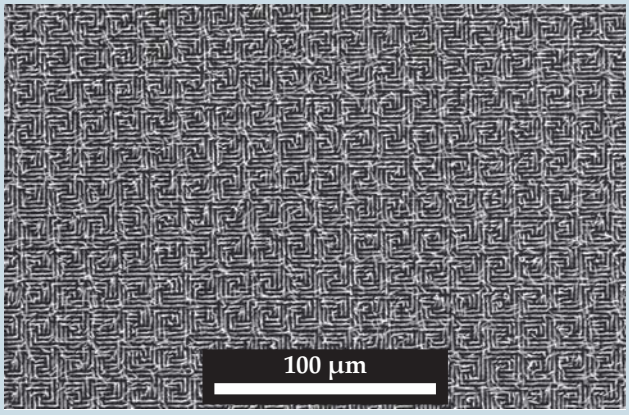
These items, with supplementary material, first appeared at http://www.physicstoday.org.

Shedding light on chiral substrates. Most biological molecules naturally occur as either left-handed (S) or right-handed (R) nonidentical mirror images known as chiral enantiomers. Many drugs come in chiral pairs; therefore, pharmaceutical companies are keen to produce chirally pure medicines that bind to their intended target without subjecting the body to the other, unwanted, and in some cases harmful,



enantiomer. One novel technique for separating drug mixtures is to pass them over a chiral substrate, typically a metal oxide, that selectively adsorbs specific enantiomers. But in order for researchers to understand the adsorption dynamics, they must first elucidate the substrate's chiral orientation. Low-energy electron diffraction techniques can be used, but they cannot easily distinguish orientation if the unit cell of the surface is itself achiral. Now, researchers at the Australian Synchrotron, La Trobe University, and the University of Newcastle have shown that chiral orientation can be identified by photoemission techniques. The researchers used 600-eV x rays to excite photoelectrons from a chiral copper substrate, whose S and R orientations are modeled in the images. After measuring the photoemission from multiple angles, they were able to identify the chiral orientation by overlaying the emission distribution, which reflects the substrate's bulk symmetry, onto geometric lattice projections of the two possible chiral structures. The researchers also showed that chiral orientation can be determined by measuring the photoemission from the Fermi level of substrates that were excited at 200 eV. (A. Tadich et al., *Phys. Rev. Lett.*, in press.) —JNAM

Meniscus lithography and Moiré patterns. Bottom-up pattern formation at the micro- and nanoscale is being actively studied for a better understanding of self-organization and for such applications as data storage and sensors. One low-energy approach relies on the evaporation of liquids to produce patterns of nanoparticles across multiple length scales. In one variation, the local rate of evaporation can be controlled by placing a mask over the liquid. Additionally, capillary forces not only form menisci between the particles but can also organize the particles into patterned clusters. Random imperfections and instabilities, though, make achieving long-range order difficult. In a new approach, Joanna Aizenberg and colleagues at Harvard University have found a simple, scalable way for masked evaporation to produce complex patterns and long-range order. The researchers place two



arrays of vertical nanopillars—one the substrate and one the mask—face to face with a liquid sandwiched between them. In an example of mutual feedback, the liquid forms menisci between the substrate and mask, and as the liquid evaporates, capillary forces bend the substrate's pillars toward the mask's. The technique yields a deterministic pattern completely controlled by the mask geometry. In particular, when the mask and substrate are identical and at a slight angle to each other, the misalignment produces a Moiré pattern that is preserved by the bent pillars, as shown in the figure, even after the two arrays are separated. The periodicity and chirality of the Moiré pattern are easily tunable by changing the angle between the surfaces. (S. H. Kang et al., *Phys. Rev. Lett.*, in press.) —RJF

Tiny, tangled wires keep photons from reflecting. The predominant material in most solar panels is shiny, crystalline silicon coated with an efficiency-improving antireflective substance. Because the Sun moves across the sky from dawn to dusk, the best antireflectors are effective for a wide range of incidence angles and for all colors of visible light. Yasha Yi and colleagues have recently devised a novel antireflecting structure with those desirable qualities. As shown in the scanning electron microscope image, the antireflecting layer consists of nanometer-thin wires that attach to the crystalline Si surface (lower edge of the figure) at random angles. The wires have a core of Si (white) and are clad with silicon oxide (gray). The varying index of refraction from cladding to core gives the wires their antireflecting properties; the random orientation of the wires makes the structure effective over a wide range of angles. To generate their tangled nanowires, the researchers heated a Si crystal and Si powder for several hours at pressures as low as 8 Pa; they then allowed the sample to cool at atmospheric pressure. Oxygen and chemistry did the rest of the work. Yi and coworkers are optimistic that their simple procedure may one day be applied to fabricate large-scale photovoltaic devices. In the short term the group hopes to create ordered structures to help them better understand the behavior of the random layers they already have in hand. (P. Pignalosa et al., *AIP Adv.* **1**, 032124, 2011.) —SKB ■