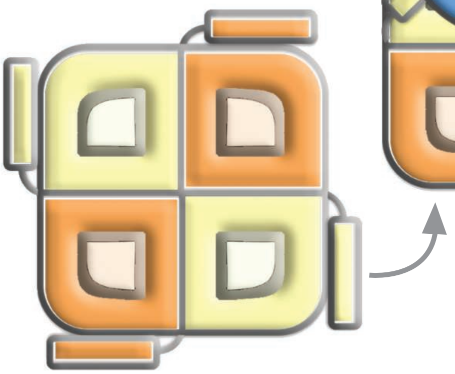
BIOCHEMISTRY

Four Closure

The Ca^{2+}-binding protein calmodulin (CaM) is involved in the regulation of many membrane channels, but how it modulates permeability remains unclear. Reichow *et al.* have combined electron microscopy, structural modeling, molecular dynamics, and mutagenesis to study the interaction of the aquaporin AQP0 and CaM. Each monomer in the tetrameric AQP0 contains a water-conducting pore. Fitting crystal structures of the AQP0 tetramer and CaM into a 25 Å electron microscopic reconstruction revealed that CaM bound to the C-terminal helices of adjacent AQP0 monomers. Initially, CaM binds to one helix, and its proximity to the neighboring monomer then allows it to capture the second one. Molecular dynamics simulations suggested that, although it only links two monomers, CaM restricts the dynamics of all four



monomers in the tetramer. The constriction site CSII at the cytoplasmic vestibule of the channel has been proposed to gate access. Interestingly, the AQP0 residues that were stabilized most by CaM mapped to the C-terminal helices, the base of the last transmembrane helix, and residues that form CSII. In AQP0, tetramerization is not required for water permeability; however, these results show that its quaternary structure facilitates cooperative regulation, and the regulation of other membrane channels by CaM may rely on similar mechanisms. — VV

Nat. Struct. Mol. Biol. **20,** 10.1038/nsmb.2630 (2013).

MATERIALS SCIENCE

Making Mg Magnificent

When crystalline materials are stressed, defects in the crystal planes become mobile once a critical stress is reached. The stress required for movement of these dislocations along different slip planes can vary considerably, leading to poor ductility. Magnesium is an example of a material with an extreme anisotropy: The critical stress required for deformation along nonbasal planes is 100 times larger than along basal ones. Yu *et al.* postulated that even though materials are known to be stronger when they are smaller, there are upper bounds to this enhancement, so that the critical anisotropy should decrease. They tested single-crystal Mg samples ranging from 850 to 80 nm in size inside a quantitative electron microscope. At sizes between 200 and 400 nm, significant strengthening of the samples was seen, but the ductility remained poor. Below 100 nm, there was a shift in the deformation behavior. As the local flow stresses approached 2 GPa, there was increasing activation of the nonbasal planes, leading to a large amount of plastic deformation. These size effects could be employed to make better use of other high plastically anisotropic materials. The use of grain boundaries could allow for larger overall samples, because the boundaries will act as stress concentrators and preferred sources for the nucleation and emission of dislocations, which is important during plastic deformation of a sample. — MSL

Proc. Natl. Acad. Sci. U.S.A. **110,** 13289 (2013).

APPLIED PHYSICS

Slowly Does It

The rise and fall of pitch of a passing police siren gives a familiar example of the Doppler effect. In such a case, the speed of the moving object is appreciable compared to the speed of sound, with fast-moving objects relatively easy to detect. The situation is somewhat more difficult for slow-moving objects, where the frequency shift can be very small. Detection typically requires complex interferometry. Bortolozzo *et al.* show that a slow light medium can be used to accentuate and detect tiny frequency shifts associated with slow-moving objects. Obviating the need for complex optics, they use a balanced detection scheme where they simply split a laser beam in two and measure the intensity difference between the two beams once they pass through the slow light medium. They can detect frequency shifts down to 1 μHz and suggest that the simple setup should allow for remote sensing of slow-moving objects. — ISO

Opt. Lett. **38**, 3107 (2013).