different secondary symbionts, to adult wasps. Two of the secondary symbiont types killed 25 to 41% of the developing parasitoid larvae a few days after oviposition. These aphids continued to reproduce and transmit the protective symbionts to their daughters, hence maintaining the symbiont population. But it's not a perfect partnership, as there seems to be a cost borne from pathogenic effects of the symbionts that ultimately compromises aphid fecundity and longevity. — CA

Proc. Natl. Acad. Sci. U.S.A. **100**, 1803 (2003).

MINERAL PHYSICS

Creepy Mantle

Periclase (MgO) is a minor component of Earth's lower mantle, yet it may be essential for understanding the rheological and chemical characteristics of solid-state creep (mantle convection) because of its elastic anisotropy and ionic conductivity. Van Orman *et al.* measured lattice and grain boundary diffusion of ^{25}Mg and ^{18}O in isotopically marked, synthetic periclase at 2273 kelvin and 25 gigapascals in a multianvil device, and then extrapolated to conditions (~4500 kelvin and 140 gigapascals) at the core-mantle boundary (CMB). A transition from dislocation creep to diffusion creep is predicted to occur near the CMB for grains smaller than 1 mm and shear stresses of 1 to 10 megapascals. Substantial chemical exchange near the CMB is allowed by the relatively fast rate of diffusion in periclase. In particular, grain boundary diffusion is very efficient, and over the 4.5 billion years of Earth's history, a mixed layer of 100 kilometers in thickness could have formed. Thus, the rheological and chemical properties of the mantle are consistent with the seismically observed D'' layer at the CMB. — LR

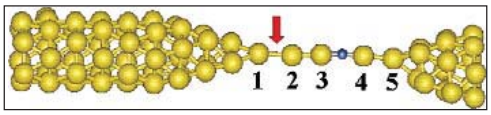
Geophys. Res. Lett. **30**, 1056, 10.1029/2002GL016343 (2003).

MATERIALS SCIENCE

A Bit of a Stretch

Gold is a malleable metal, but just how far can it be stretched before breaking? In a diatomic gold molecule, the Au-Au bond length is 2.48 Å. On the other hand, for mechanically stressed, single atom–thick Au nanowires, Au-Au distances as large as 4.0 Å have been measured by transmission electron microscopy and cluster around 3.6 Å, yet calculations for pure Au wires have yielded a maximum of 3.1 Å.

Using total energy density functional theory, Novaes *et al.* calculated the effect of impurity atoms on stressed gold nanowires. Single H, B, C, N, O, or S



Stretching a simulated gold nanowire containing an H atom (blue).

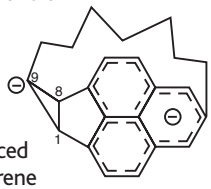
atoms, which probably would not have been observable in micrographs of nanowires due to insufficient contrast, were inserted at various positions. The relaxed wires were then pulled until they ruptured, which always occurred at an Au-Au bond. The addition of a carbon atom led to a Au-C-Au distance of 3.7 Å for the unstressed wire, which increased to 3.9 Å just prior to breaking; wires containing B, N, and O displayed even larger distances when stretched. However, the addition of H produced a distance of 3.6 Å, consistent with the experimentally observed cluster, and an anomalously large distance of 4.8 Å could be explained as the separation between gold atoms in an Au-S-Au nanowire. — MSL

Phys. Rev. Lett. **90**, 036101 (2003).

CHEMISTRY

The Strain of Fusing

One way to generate an "anti-aromatic" system, in which the overall π-bonding network is destabilizing, is to add two electrons to an aromatic network. Aprahamian *et al.* have done that in two strained pyrene systems; a large ring bridges the ends of pyrene and bends the π-bonded network out of a single plane without disrupting aromaticity. Nuclear magnetic resonance spectroscopy revealed that adding two electrons did not yield an anti-aromatic molecule. Instead, a new σ bond formed across one of the six-membered rings, creating fused cyclopropyl and cyclopentyl rings. This alternative not only diminishes the induced ring strain in the pyrene network, but it also allows the two added electrons to localize and distance themselves. Thus, although strain does not reduce aromaticity in these pyrenes, it does affect their reactivity. — PDS



J. Am. Chem. Soc. 10.1021/ja0291991 (2003).

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