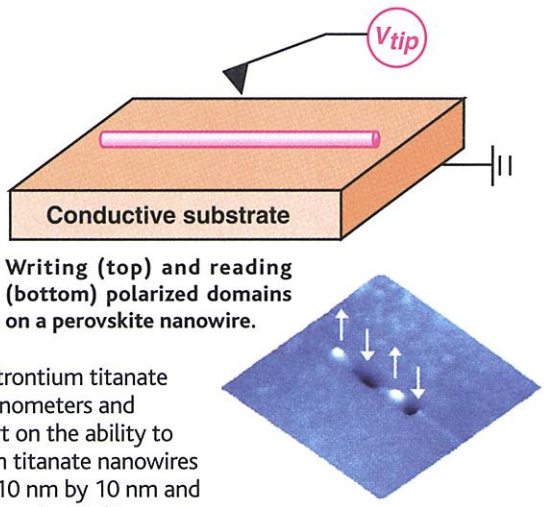
EDITORS' CHOICE

edited by Gilbert Chin

CHEMISTRY/PHYSICS

Perovskite Oxide Wires

Transition metal oxides with a cubic perovskite structure display a range of interesting and desirable properties such as piezoelectricity, ferroelectricity, and magnetoresistance. Although most studies have been of thin films or bulk single crystals, preparation of these materials in a one-dimensional form, like their silicon- and carbon-nanowire counterparts, could widen the range of properties and applications.



Writing (top) and reading (bottom) polarized domains on a perovskite nanowire.

Using a solution-based process, Urban *et al.* report the ability to prepare barium titanate and strontium titanate nanowires with diameters ranging from 5 to 60 nanometers and lengths in excess of 10 millimeters. Yun *et al.* report on the ability to write and read ferroelectric bits along these barium titanate nanowires using an atomic force microscope. Measuring just 10 nm by 10 nm and with a retention time greater than 5 days, these ferroelectric bits may provide the basis for a nonvolatile memory element with high information-storage density. — ISO

J. Am. Chem. Soc., 10.1021/ja017694b; *Nano Lett.*, 10.1021/nl015702g.

GEOCHEMISTRY

An Early Oxidized Mantle

Oxygen is the most abundant element in Earth, but its distribution and state (or fugacity) in the mantle and atmosphere have varied over time with important consequences for Earth's geologic and biologic history. For example, degassing of the mantle through melting and volcanism is thought to have affected the composition of the atmosphere.

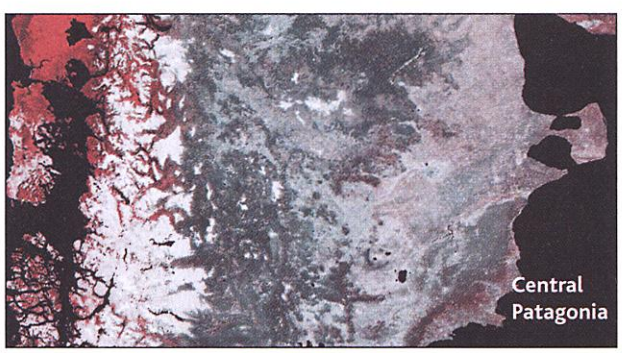
To examine the mantle aspect of this coupled evolutionary process, Canil studied the partitioning of vanadium in mantle minerals and melts and in a suite of mantle-derived igneous rocks stretching back to the Archean. Vanadium can exist in several oxygenation states and partitions differently in melts in response to the local oxygen fugacity and mineralogy. The vanadium data imply that Earth's mantle was just as oxidized in the Archean (about 3.5 billion years ago) as it is today. Previous studies have supported a later increase of atmospheric oxygen abundance; thus, this result challenges proposed mechanisms for producing a gradual and later oxidation of Earth's atmosphere that are based on an early reduced mantle. — BH

Earth Planet. Sci. Lett. **195**, 75 (2002).

ECOLOGY

Forecasting Grassland Production

Just like the weather, forecasting of ecological variables poses a formidable problem, because of the intricate interplay of multiple and often nonlinear factors. Jobbágy *et al.* apply remote sensing techniques to study the relationship between climate and grassland production in the steppes of Patagonia. A satellite-derived index of vegetation cover was used as a surrogate for net primary production and was related to patterns of precipitation and temperature over 11 years. Primary production was related to the start of the growing season, which in turn depended on the mean temperature in July, the Argentine winter. Forage production—important for livestock managers—was predictable on this basis for the first few months of the growing season. The forecasting of annual production, however, requires longer data sets and remains a longer term challenge. — AMS



Ecology **83**, 307 (2002).

PLANT SCIENCE

Get Off of My Cloud

In crowded situations, plants, like people, have to compete with their neighbors to get enough resources. Light that is reflected by plant leaves contains a higher proportion of the far-red wavelengths, and phytochromes enable a plant to discriminate between shade and white light. A plant that senses crowds might respond by growing taller and leggier or by flowering earlier, and the response can differ across various growing environments, such as shady forests or open fields.

Using a sample of more than 100 accessions, Botto and Smith show that *Arabidopsis* displays a range of shade-avoidance responses and that the predominant response to far-red light is accelerated flowering. The time to flower varied among populations collected from the same geographical region and was not correlated with latitude. The range of a second type of response, hypocotyl elongation, also was documented. The absence of a clear relation (either direct or inverse) between these responses suggests the existence of independently regulated signaling pathways that lie downstream from the phytochromes. — PJH

Plant Cell Environ. **25**, 53 (2002).

CHEMISTRY

Wringing Non-Shrink Gels

Silica gels are of technical interest because they are highly porous structures with large internal surface area and because they can be readily prepared as monoliths. The gels typically are made from a precursor material that hydrolyzes in aqueous solution to form silica particles. As the gels age, they tend to shrink because the silica particles are strongly attracted to each other and move

CONTINUED ON PAGE 1197

CREDITS: (TOP) YUN *ET AL.*, *NANO LETT.* 10.1021/NL015702G; (BOTTOM) NOAA

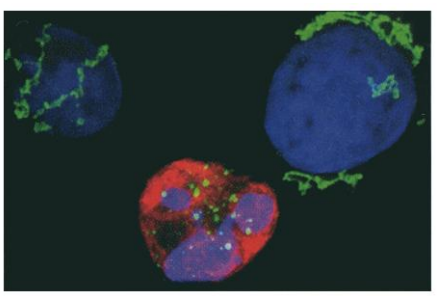
closer together. Meyer *et al.* show that if they incorporate a small amount (0.1 to 1.0 weight %) of cationic precursor, the resulting gel does not shrink, probably because the residual ionic charge of the silica particles keeps them apart. When the gels are struck, a ringing sound is heard; the storage modulus is high enough to produce vibrations in the audible range (200 to 1100 hertz), and the loss modulus is low enough that the vibrational energy takes a long time to be converted to heat. Varying the fraction of cationic precursor alters the ratio of the storage to loss moduli and changes the pitch. — MSL

J. Phys. Chem. B, 10.1021/jp013371q.

CELL BIOLOGY

GRASPing the Stack

In mammalian cells, the Golgi complex consists of a set of stacked cisternal membranes on one side of the nucleus. Lane *et al.* describe how, in cells undergoing programmed cell death (apoptosis), this ribbon of Golgi membranes can fragment, producing clusters of tubules and vesicles, which is reminiscent of the Golgi breakdown observed when cells divide during mitosis. The fragmentation process required the activity of an apoptosis-specific protease, caspase-3, and proteolytic cleavage of the Golgi protein GRASP65 promoted fragmentation. Cells expressing a caspase-resistant GRASP65 were able to maintain the integrity of the Golgi complex during apoptosis, suggesting that this protein contributes to the structural underpinnings of the stacked cisternae. — SMH



Golgi morphology (green) in apoptotic (red) and normal (blue) cells.

J. Cell Biol. **156**, 495 (2002).

ASTROPHYSICS

Floating Through a Cluster

Candidate extrasolar planets have been found in some unexpected places, principally as isolated objects (free-floaters) in globular clusters. Free-floaters are expected to be rare because the standard planet formation model requires that planets form in disks around stars. Furthermore, the relatively delicate disk of gas and dust would have been bombarded and shredded by stellar radiation from nearby stars, which would make planetary accretion within a cluster a rare event indeed.

Using a prototype GRAPE-6 computer (capable of half a trillion floating point instructions per second or 0.5 teraflops), Hurley and Shara have performed *N*-body simulations of the dynamical interactions between Jupiter-mass planets placed initially in circular orbits around stars in a globular cluster. The planets become gravitationally freed from their parent star if the star traverses near the cluster core. These drifters then float radially outward from the core over a time span of billions of years and do not appear to be destroyed by the cluster environment. Their simulations show that as many as 100 planets per star may form within a globular cluster, such as M22, where the presence of a large number of candidate extrasolar planets has been suggested by observations. Thus, these free-floaters may be more common than previously thought. — LR

Astrophys. J. **565**, 1251 (2002).

MOLECULAR BIOLOGY

Turning on a Helicase

One approach to dealing with the problem of cells that escape from the network of controls regulating development and differentiation is to attempt to direct such cells toward a terminally differentiated state, perhaps with the hope of encouraging them to undergo apoptosis voluntarily. A combination of interferon-β and a protein kinase C activator has been shown to shift human melanoma cells into such a state.

Kang *et al.* have carried out an analysis of a gene, *mda-5*, whose expression is increased by this treatment; it appears to encode a RNA helicase (which would unwind double helices of RNA) on the basis of sequence similarities and an RNA-dependent ATPase activity. Expression of this gene appears to mimic the effect of interferon, inhibiting growth of these melanoma cells in vitro. Two other attributes of this protein, although as yet unsubstantiated, offer tantalizing hints at linkages to other degradative pathways. First, MDA-5 contains a caspase–recruitment domain (CARD), which is common to many components involved in initiating and regulating apoptosis. Second, other helicases in the MDA-5 group contain RNase III motifs, a signature of the enzymes (such as DICER) involved in RNA interference—mediated gene silencing. — GJC

Proc. Natl. Acad. Sci. U.S.A. **99**, 637 (2002).

CREDITS: LANE *ET AL.*, *J. CELL. BIOL.* 156, 495 (2002)