CELL BIOLOGY

A New Way in

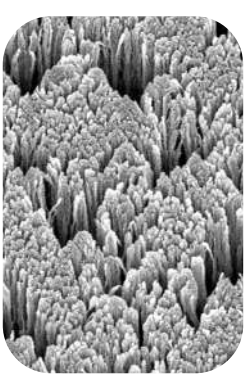
Many cellular stimuli induce signaling cascades that terminate with a protein entering the nucleus to activate transcription of target genes. Most of these proteins contain a conserved stretch of amino acids known as a nuclear localization signal (NLS), which binds to the nuclear import factor importin alpha, and the complex translocates into the nucleus through the nuclear pores. However, the absence of an NLS in some signaling proteins suggested that they access the nucleus via alternative mechanisms. Now, Chuderland *et al*. find a new signal in the extracellular signal–related kinase 2 (ERK-2). A three–amino acid domain is phosphorylated upon stimulation, allowing the protein to bind to a different nuclear import factor, importin7, and enter the nucleus. A similar domain was found in other cytonuclear shuttling proteins, and the same phosphorylation-dependent mechanism was shown to occur for nuclear accumulation of SMAD3 and MEK1. Thus, this domain acts as a general nuclear translocation signal and represents a new mechanism whereby proteins can enter the nucleus. — HP*

Mol. Cell **31**, 10.1016/j.molcel.2008.08.007 (2008).

CHEMISTRY

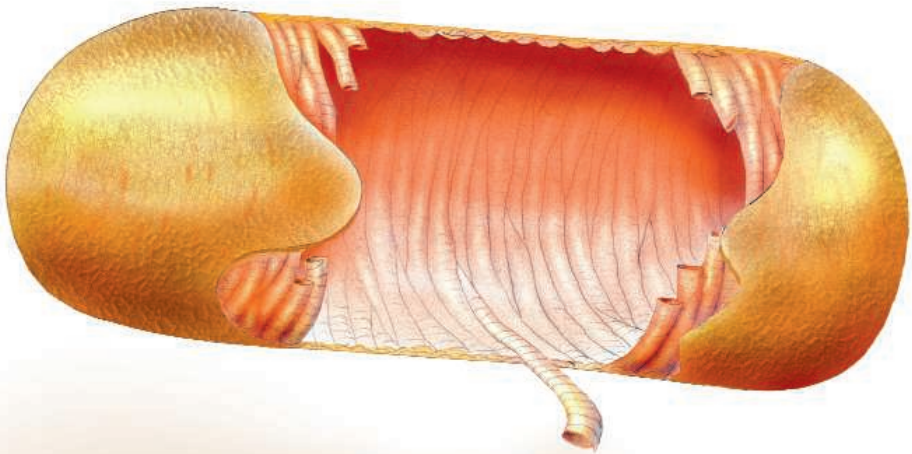
More Surface, More Reactivity

To gain a better understanding of palladium's reactivity as a hydrogenation catalyst, many model studies that use well-defined single-crystal surfaces have focused on what should be the simplest substrate, ethylene. Although this reaction is facile for reactant pressures near ambient, at very low pressures (ultrahigh-vacuum conditions), the reactivity on close-packed surfaces is low (yields of ethane <1%), and not much greater on supported nanoparticles (<5%). This difference is attributed to a lack of surface hydrogen caused by absorption into the bulk. Dohnálek *et al*. have prepared model catalysts through ballistic deposition of Pd atoms at cryogenic conditions (22 K) and glancing angles such that one-quarter of the atoms are surface exposed. The as-prepared nanoporous films showed much higher reactivities (50%), which decreased when the films were densified by reaction cycles that went to room temperature (with ethane desorbing by 250 K) or after annealing to higher temperatures. The authors note that although surface roughening treatments can also create a large number of active sites, the low fraction of bulk atoms in the nanoporous films limits removal of hydrogen from the surface and boosts overall reaction rates. — PDS



J. Phys. Chem. C **112**, 10.1021/jp803880x (2008).

*Helen Pickersgill is a locum editor in *Science*'s editorial department.



CELL BIOLOGY

Growing Through a Wall

In bacteria, the cell wall must be firm enough to define cell shape and allow a high internal osmotic pressure, while at the same time sufficiently dynamic to allow cell growth and division. Hayhurst *et al.* provide insight into how the cell wall in the rod-shaped organism, *Bacillus subtilis*, is structurally organized to achieve these functions. The main structural component of the cell wall is peptidoglycan, comprising glycan strands cross-linked by peptides. Atomic force microscopy (AFM) on purified glycan revealed individual strands up to 5 μm long (5000 disaccharides). Fluorescence microscopy in whole cells showed that *B. subtilis* displays very few terminal *N*-acetyl glucosamine (GlcNAc) residues and that internal peptidoglycan-associated GlcNAc residues exhibit a pattern suggestive of a helical structure. AFM imaging of *B. subtilis* peptidoglycan sacculi revealed little indication of structural features on the outer surface, probably because surface layers are hydrolyzed during cell wall turnover. However, the inner surface exhibited 50-nm-wide cables running across the short axis of the cell with cross striations consistent with a helical structure. The authors suggest that during biosynthesis, glycan strands are polymerized and cross-linked and then coiled to form the inner-surface cables. New helices are likely inserted into the cell wall by being cross-linked between two existing cables, while the external surface is cleaved to allow cell growth. — VV

Proc. Natl. Acad. Sci. U.S.A. **105**, 14600 (2008).

DEVELOPMENT

Protected by a Maelstrom

Germ-line cells could be considered the most precious in the body, because they are the only cells to contribute directly to the next generation. Hence, special mechanisms should be in place to protect them from damaging agents such as transposable elements. Cells in many species silence these elements by using small noncoding RNAs. The RNA interference factors localize to perinuclear structures called nuage in germ cells. Soper *et al.* focus on a murine homolog of *Drosophila* maelstrom (*mael*), a gene that functions in the production of interfering RNAs, repression of transposable elements, and specifi-

CREDITS (TOP TO BOTTOM): HAYHURST *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* **105**, 14600 (2008); DOHNÁLEK *ET AL., J. PHYS. CHEM. C* **112**, 10.1021/JP803880X (2008)

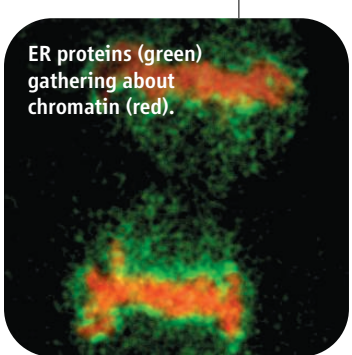
cation of the *Drosophila* oocyte axis. Similarly, the murine *Mael* gene is localized stage-specifically to the nuage structures in male germ cells. Eliminating *Mael* from mice resulted in defective meiosis due to abnormal chromosome synapsis and massive DNA damage. A mechanism for meiotic failure is demonstrated through *Mael*'s function in transcriptional repression of transposable elements via a DNA methylation mechanism. — BAP

Dev. Cell **15**, 285 (2008).

CELL BIOLOGY

NE-ER Shape Shifting

Mitosis in metazoans involves the wholesale disruption of normal cellular architecture to allow for successful partitioning of cellular components to each daughter cell. During most of the cell cycle, the nucleus is surrounded by a double-membraned nuclear envelope (NE) that is contiguous with the endoplasmic reticulum (ER), an intracellular labyrinth of interconnected tubules and sheets. Anderson and Hetzer have examined the processes involved in the dramatic rearrangements of the NE and ER at the end of mitosis. The NE is disassembled at the beginning of mitosis and, after the partitioning of chromosomes, must be reassembled to form two daughter cells complete with their own NE-enclosed nuclei. By quantifying images produced using time lapse microscopy, the authors were able to observe the recruitment of ER tubules to chromatin, which went on, within ~12 min, to produce membrane-enclosed daughter nuclei capable of performing nuclear import. Increasing the expression of ER tubule–promoting proteins interfered with the formation of new nuclei, whereas reducing their expression sped up the process, which may suggest that it is the transition of ER from tubules to sheets that limits NE assembly and nuclear expansion. Thus, ER architectural proteins play a key role in nuclear reconstruction and NE assembly after mitosis. — SMH



ER proteins (green) gathering about chromatin (red).

CREDIT: ANDERSON AND HETZER, *J. CELL BIOL.* **182**, 911 (2008)

J. Cell Biol. **182**, 911 (2008).

CLIMATE SCIENCE

A Hurricane History

One problem in assessing whether recent climate change has significantly influenced either the strength or frequency of hurricanes and tropical storms is that in general, these factors have been measured systematically only recently. Thus, establishing a reliable baseline to compare with present trends has been difficult. In the Lesser Antilles—one of the first areas settled heavily in the New World, and a focus of early trade—British ships' logs, newspaper accounts, official colonial correspondence, and other sources provide a variety of data over the past 300 years or so. Chenoweth and Divine used these sources to derive a historical record of hurricanes, tropical storms, and tropical depressions in this region, which is along the main track of storms that eventually develop and hit the United States and Mexico. The authors identified 550 tropical storms and hurricanes passing through these islands, about half of which were not previously detected, including in more recent records. Overall, there seems to be no discernable trend in activity since 1690, though the period from 1968 to 1977 had notably few storms. — BH

Geochem. Geophys. Geosyst. **9**, 10.1029/2008GC002066 (2008).

BIOCHEMISTRY

SH2 Uninhibited

Src-homology 2 (SH2) domains of cytoplasmic tyrosine kinases have an important and well-defined role in keeping such kinases in an autoinhibited conformation. Filippakopoulos *et al*. studied the human cytoplasmic tyrosine kinase Fes, which lacks this autoinhibitory interaction, and uncovered molecular details of how SH2 domains can alternatively act to enhance activity. The authors solved crystal structures of a portion of Fes containing the SH2 domain and kinase domain, with and without phosphorylation of the kinase activation segment. This fragment was bound in complexes with a substrate peptide and an ATP-mimetic kinase inhibitor. Mutagenesis experiments confirmed that the visualized interaction of the SH2 domain with the kinase domain was necessary to stabilize the active conformation of the enzyme. Analysis of synthetic substrates with or without phosphorylated SH2 domain–binding sites also showed the importance of the SH2 domain in substrate recruitment. Extending the analysis to the proto-oncogenic tyrosine kinase c-Abl showed that a similar mechanism occurs in other members of the cytoplasmic tyrosine kinase family. The authors point out that such coupling of substrate recognition to kinase activation may contribute to selectivity of such kinases so that they act only on the appropriate substrates in vivo. — LBR

Cell **134**, 793 (2008).

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