



**ATMOSPHERIC SCIENCE: Detox Strategy for NO_x
and VOCs**

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Science **304**, 173b (2004);

DOI: 10.1126/science.304.5668.173b

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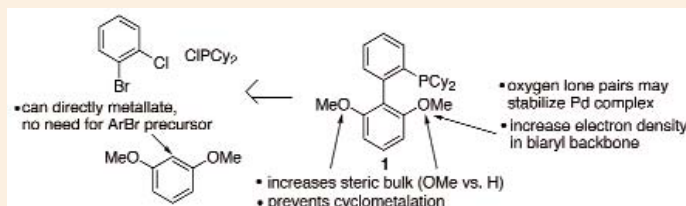
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edited by Gilbert Chin

CHEMISTRY

Catalytic Coupling

One of the most useful tools for forming carbon-carbon bonds is the Suzuki-Miyaura coupling, in which compounds such as aryl halides are cross-coupled to organoboronic acids, in part because the boronic acids are readily handled in air or water without special precautions. However, steric hindrance around the carbon atoms is not always tolerated, and catalyst loadings or reaction temperature or both may need to be high. Walker *et al.* have designed a new Pd ligand (**1**) bearing methoxy groups that not only stabilize the Pd complex but also avoid the deactivating effect of cyclometalation. They report yields in excess of 95% for a wide variety of couplings, including hindered and heteroatom halide substrates at temperatures near 100°C and unhindered substrates at room temperature. In many cases, Pd loadings of well below 0.1 mole % suffice for efficient catalysis. — PDS



Retrosynthesis and properties of ligand **1** (top) and its complex with Pd⁰(dibenzylideneacetone).

Angew. Chem. Int. Ed. **43**, 1871 (2004).

ATMOSPHERIC SCIENCE

Detox Strategy for NO_x and VOCs

Tropospheric ozone is a ubiquitous pollutant that is harmful to human health, crops, and ecosystems. The two main precursors of surface ozone are nitrogen oxides (NO_x) and volatile organic compounds (VOCs), but uncertainty about their precise roles in ozone production—mainly due to the lack of observational information—has prevented the development of more effective air pollution control strategies. Martin *et al.* report a technique with the potential to lessen this uncertainty, a space-based remote sensing method for measuring the ratio of tropospheric formaldehyde to nitrogen dioxide. This ratio is a good indicator of the relative sensitivity of surface ozone formation to emissions of NO_x versus VOCs. They find that most of the Northern Hemisphere is more sensitive to NO_x than to VOCs, with the exception of Los Angeles and the industrial areas of Germany. These results suggest that satellite remote sensing can contribute to air pollution management by re-

vealing the spatial and temporal sensitivity of surface ozone production to reductions of NO_x and VOC emissions. — HJS

Geophys. Res. Lett. **31**, 10.1029/2004GL019416 (2004).

CELL BIOLOGY

Pretzel Factory

The mammalian neuromuscular junction contains a post-synaptic arborization of acetylcholine receptors (AChRs) that map precisely onto the motor nerve terminal, forming a pretzel-shaped array. Kummer *et al.* investigated how this complex architecture is generated by monitoring in vitro the elabo-

ration of neuron-free myotubes on a laminin substrate. The branched structures arose as newly synthesized AChRs added to the circumference of AChR-rich plaques and as perforations in the plaques coalesced to form AChR-poor regions—a sequence of events mirroring the development of neuromuscular junctions in vivo. Thus, even though the neuronal and muscle-derived structures appear to be built in parallel, the muscle can make pretzels on its own. — SMH

J. Cell Biol. **164**, 1077 (2004).

APPLIED PHYSICS

Negative Refraction Hits the Spot

Our familiarity with optical effects has generally been confined to materials with a positive index of refraction; i.e., lenses are curved, and imaging of an object is limited by the diffraction limit. A set of recently developed materials, or metamaterials, that can be designed with electrical and magnetic properties spanning the entire plane of positive and negative permeability (μ) and permittivity (ϵ) have been predicted to give rise to a number of somewhat

counterintuitive optical effects.

Two groups present experimental data confirming some of these predictions using a flat slab of metamaterial designed to have a negative refractive index in the microwave regime. With $\mu = -1$ and ϵ positive, Smith *et al.* demonstrate the ability to focus *s*-polarized light by a planar slab. With μ and ϵ both negative, Grbic and Eleftheriades demonstrate focusing by their planar slab of material, and moreover, that the image formed can beat the diffraction limit. By decreasing the length scales of these materials down to optical wavelengths, it should be expected that our field of familiarity with optics will become greatly expanded. — ISO

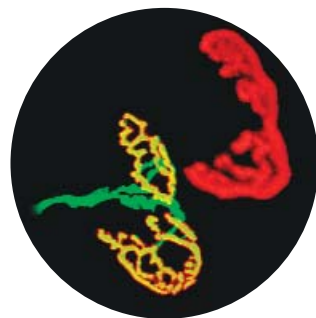
Appl. Phys. Lett. **84**, 2244 (2004); *Phys. Rev. Lett.* **92**, 117403 (2004).

IMMUNOLOGY

Losing Control

Although maintenance of T cell regulation is generally accepted as an important factor that helps to prevent autoimmunity, most of the direct evidence for this belief has come from studies in mice. Thus, in several autoimmune models a subset of CD4⁺CD25⁺ T cells can impede the activity of autoreactive T cells, but similar evidence in humans has been hard to obtain. Viglietta *et al.* observed that CD4⁺CD25⁺ T cells from patients with multiple sclerosis were considerably less capable of suppressing T cell responses when compared to those from healthy controls. Rather than a decrease in the overall number of CD4⁺CD25⁺ T cells, this appeared to reflect an intrinsic defect in the suppressive ability of the cells. Such a shortfall in regulatory T cell

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Comparison of AChRs (red) at a muscle-nerve (green) junction (left) and on a neuron-free myotube (right).

activity could underlie the onset or progression of a number of autoimmune conditions. — SJS

J. Exp. Med. **199**, 10.1084/jem.20031579 (2004).

BIOMEDICINE

Before the First Breath

Childbirth begins with the onset of uterine contractions, but the signals that initiate this event have not been clearly identified. Maturation of the fetal lung is completed just before term. Alveolar cells in the lung secrete surfactant, a mixture of lipids and proteins that reduces surface tension and prevents the lungs from collapsing during normal breathing. Condon *et al.* observed the presence of surfactant protein A (SP-A) from the fetal mouse lung in the amniotic fluid (AF) late in gestation. This correlated with migration of AF macrophages to the uterine wall, an inflammatory response associated with normal term labor in humans. SP-A treatment activated isolated macrophages, stimulating their produc-

tion of proinflammatory cytokines, and injection of SP-A into the amniotic fluid induced delivery. Macrophage migration was associated with activation of the transcription factor nuclear factor-kappa B (NF- κ B) in the uterine muscle, suggesting that SP-A triggers a signaling cascade in the uterine wall that stimulates contraction, leading to parturition.

Many human infants that are born prematurely suffer from respiratory distress due to lack of lung surfactant. Shulenin *et al.* have identified inactivating mutations in a gene encoding a putative lipid transport protein in neonatal newborns with severe surfactant deficiency. The ATP-binding cassette transporter A3 (ABCA3) is located in intracellular lamellar bodies of alveolar type II cells where surfactant is produced, stored, and secreted. Other ABC proteins are known to function in lipid transport, and ABCA3 may transport lipids critical for lamellar body formation and surfactant metabolism. — LDC

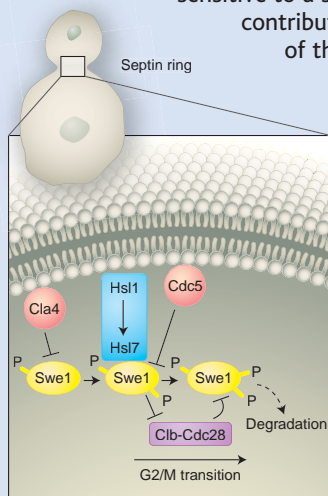
Proc. Natl. Acad. Sci. U.S.A. **101**, 4978 (2004); *N. Engl. J. Med.* **350**, 1296 (2004).

HIGHLIGHTED IN SCIENCE'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT



Integration of Cell Cycle Signals

Cell division in budding yeast depends on the formation of a filamentous collar containing septin proteins. This collar forms at the base of the emerging bud, marking the place in the membrane that constricts during cytokinesis, giving rise to mother and daughter cells when mitosis is complete. Protein complexes formed with septins are critical in coordinating morphogenesis with cell division. Sakchaisri *et al.* show that yeast cells use the status of multiple phosphorylation sites on the protein kinase Swe1 to keep track of cell cycle progression and of the assembly of complexes at the bud neck. Genetic analysis and use of a designed form of protein kinase Cla4 sensitive to a specific inhibitor showed that the Cla4 protein contributes to phosphorylation of Swe1 during S phase of the cell cycle. Depletion of another protein kinase, Cdc5, prevented the further phosphorylation of Swe1 that normally occurs right before entry into mitosis. Thus, accumulation of highly phosphorylated Swe1 provides the cell with an indicator that the cycle is progressing properly and that the necessary components are assembled in septin complexes. These phosphorylation events tag Swe1 for ubiquitin-dependent degradation, which in turn relieves Swe1's inhibitory phosphorylation of the critical cyclin-dependent kinase (Cdc28) that controls the initiation of mitosis.



Model of stepwise phosphorylation of Swe1.

Watanabe *et al.* show that similar regulation occurs in human cells where degradation of the human Swe1 homolog Wee1A by the Cdc5 homolog polo-like kinase 1 is also critical for regulation of mitotic entry. — LBR

Proc. Natl. Acad. Sci. U.S.A. **101**, 4124; 4419 (2004).