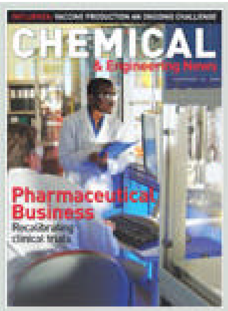

Science Concentrates

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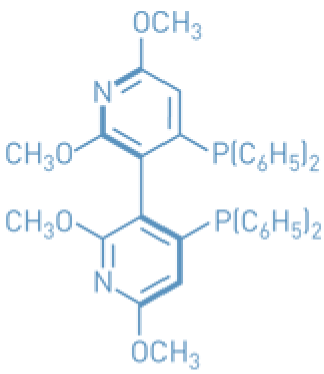
How smog may trigger allergies

If smog leads to allergies, as many epidemiological studies suggest, how? A group of scientists in Germany offers the first plausible molecular explanation: protein nitration by traffic pollution. Ulrich Pöschl, Michael G. Weller, and coworkers at the Technical University of Munich found that one of the most common allergens, a birch pollen protein, is readily nitrated when exposed to either urban outdoor air or a laboratory mixture of NO_2 and O_3 [*Environ. Sci. Technol.,* **39,** 1673 (2005)]. Nitrous oxide and ozone likely react with each other, Pöschl says, to form highly reactive NO_3 radicals, which in turn mediate nitration of exposed tyrosines in atmospheric proteins. Because nitrated proteins are known immune stimulators, the researchers suggest that pollutant nitrated proteins are the chemical link between allergies and pollution. In support of the hypothesis, they found nitrated proteins in window dust, road dust, and airborne dust. Pöschl and his colleagues believe that protein nitration alone likely does not account for rising allergies in industrialized nations, but "everything we have found up to now indicates that it may play a central role."

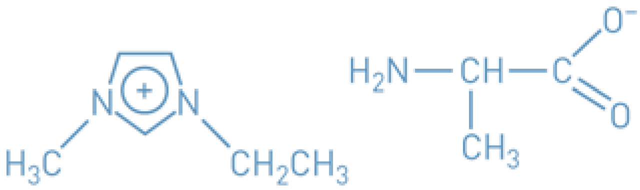
Effective route from ketones to chiral alcohols



Air-stable chiral dipyridylphosphine ligands such as that shown, when combined with copper(II) fluoride in catalytic amounts, create a highly reactive base-free catalytic system for the asymmetric hydrosilylation of ketones with phenylsilane as the hydride donor. Albert S. C. Chan and colleagues Jing Wu and Jian-Xin Ji at Hong Kong Polytechnic University use the catalytic system under mild conditions (normal atmospheric pressure and ambient temperature to –20 °C) to prepare secondary alcohols from aryl alkyl ketones and biaryl ketones in enantiomeric excesses of up to 97% and 98%, respectively [*Proc. Natl. Acad. Sci. USA,* published Feb. 22, http://www.pnas.org/cgi/doi/10.1073/pnas.0409043102]. Substrate-to-ligand molar ratios are as high as 100,000. Because the catalytic reaction is accelerated by air, it is likely that air plays a role in forming the active catalyst. The copper(II)-dipyridylphosphine catalyst system "is among the most effective systems reported thus far for hydrosilylation of simple ketones with inexpensive metal" and is "highly attractive for potential commercial applications," the authors write.

Amino acid ionic liquids

Novel room-temperature amino acid ionic liquids may prove valuable as intermediates for peptide syntheses and a variety of other applications in pharmaceutical and industrial chemistry, say researchers at Tokyo University of Agriculture & Technology. Hiroyuki Ohno and coworkers prepared the compounds by adding an aqueous solution of 1-ethyl-3-methylimidazolium hydroxide ([emim][OH]) to aqueous solutions of alanine [Ala] and 19 other natural amino acids [*J. Am. Chem. Soc.*, **127,** 2398 (2005)]. The team then removed the water and confirmed the structures of the ionic liquids by NMR spectroscopy and elemental analysis. The transparent, nearly colorless ionic liquids dissolve natural amino acids and are miscible with a variety of organic solvents. "These amino acid ionic liquids are scientifically good models for the study of the relationship between anion structure and the physical and chemical properties of ionic liquids," Ohno says. The group showed, for example, that the glass-transition temperature, the ionic conductivity, and the miscibility with organic solvents of ionic liquids such as [emim][Ala] (shown) are directly related to the structure of the side chains on the amino acid anions.



Uranium sticks together with quintuple bonds

Using advanced quantum chemical calculations, Laura Gagliardi of the University of Palermo, in Italy, and Bj örn O. Roos of Lund University, in Sweden, find that uranium atoms in diuranium compounds are held together with five covalent bonds--the equivalent of a quintuple bond [*Nature,* **433,** 848 (2005)]. Complex binding is expected when many atomic orbitals and valence electrons are available to participate in bonding. For example, quadruple metal-metal bonds have been observed for transition metals. The new results show that metal-metal multiple bonding involving actinide metals, where f orbitals can participate, is even more complex. The few known diuranium compounds have been observed only spectroscopically, and theoretical studies have been limited. Gagliardi and Roos examined U_2, where each uranium atom has six valence electrons and 16 atomic orbitals available for bonding. They find that 10 electrons form three traditional two-electron bonds and four single-electron bonds, which translates to a quintuple bond. The two remaining valence electrons are in nonbonding orbitals, one on each uranium atom, and their electron spins couple to provide additional bonding.

Tooth paste repairs cavities

Synthetic tooth enamel developed by Japanese researchers could make it easier to repair the tiny lesions in teeth that mark the start of tooth decay [*Nature,* **433,** 819 (2005)]. Because these early cavities are smaller than 50 µm, conventional filling materials tend not to stick to them. Dentists have had to treat them by either removing a large amount of healthy tooth so that the filling sticks or by fortifying the decayed area with fluoride rinse. Now, Kazue Yamagishi of Tokyo's FAP Dental Institute and coworkers have prepared a paste that can seamlessly repair the early lesions via nanocrystalline growth without the need for painful drilling. The material is made from hydroxyapatite--the same material that makes up natural tooth enamel--that has been treated with fluoride. Although they recommend keeping the acidic paste away from gums, Kazue and coworkers reckon that the synthetic enamel not only repairs early cavities but also strengthens natural enamel and prevents lesions from recurring.

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