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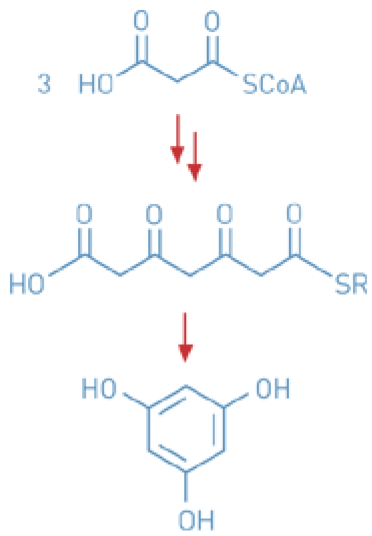
Phloroglucinol biosynthesis charted



Recent charting of the biosynthesis of phloroglucinol could pave the way to its production from glucose, a new study shows (*J. Am. Chem. Soc.* **2005,** *127,* 5332). Phloroglucinol is a substituent in many natural products, but its biosynthesis has not been described. A team led by John W. Frost at Michigan State University has identified the enzyme from Pseudomonas fluorescens that strings three molecules of malonyl coenzyme A (top) into what is possibly an activated diketoheptanedioate (middle, R = an active-site residue or CoA), which is subsequently cyclized. Aromatization to phloroglucinol (bottom) would occur spontaneously, Frost says. By expressing the enzyme in *Escherichia coli,* the team has produced phloroglucinol from glucose in fermentors in yields of up to 10 g per L, Frost says. Phloroglucinol is a starting material for 1,3,5-triamino-2,4,6-trinitrobenzene, a thermally stable energetic material of interest to the U.S. military, Frost says. At present, phloroglucinol production is extremely hazardous, he adds. The new findings could enable production from glucose.

Venus flytraps for proteins

A new type of nanotube-based biosensor acts as a sort of Venus flytrap for detecting proteins. It consists of cone-shaped gold nanotubes embedded in a polymer membrane derivatized with a protein-specific molecular recognition agent. An ion current runs through each nanotube. When analyte protein is present, it binds to the specific agent and gets stuck in the conical channel, blocking the ion current. The change in current is what is sensed. The reagentless biosensors have up to 100-femtomolar sensitivity. Charles R. Martin of the University of Florida and his coworkers developed them and demonstrated their use on three proteins, including the bioterror agent ricin (*J. Am. Chem. Soc.* **2005,** *127,* 5000). "They have potential medical and defense applications," comments Hagan Bayley of the University of Oxford, England. The new biosensors are currently single-use because the analyte-binding process is irreversible. "Nanopore sensors of this type for continuous sensing would also be desirable," Bayley notes.

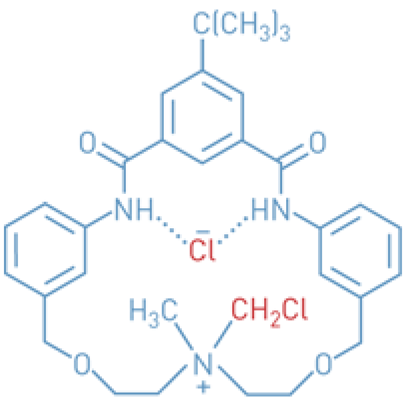
Fuel-cell design boosts efficiency

A new design for solid oxide fuel cells (SOFCs) may lead to simpler yet more efficient versions of the power generators. One of the goals of fuel-cell research is to increase the overall efficiency by taking advantage of the heat generated by fuel cells to convert (reform) hydrocarbons to hydrogen. The idea is to make hydrogen directly at the fuel cell from readily available materials such as gasoline and diesel fuel. Researchers have had little success with the design, because hydrocarbon reforming typically causes a debilitating layer of coke to accumulate on the Ni-based anodes commonly used in SOFCs. Now, Scott A. Barnett and Zhongliang Zhan of Northwestern University have shown that coke buildup can be avoided by combining a thin, porous catalyst layer consisting of ruthenium-ceria with a conventional anode (*Science*, published online March 31, http://dx.doi.org/10.1126/science.1109213). The team reports that in test runs using isooctane-air mixtures, the newly designed SOFCs provide stable power densities.

Cell fragments add to aerosols in atmosphere

A lack of details about the composition and sources of atmospheric aerosols is hampering the development of accurate climate models, according to Ruprecht Jaenicke of Johannes Gutenberg University, Mainz, Germany. In particular, he notes that "knowledge about 'dead' or fragmented biological particles in the atmosphere is greatly limited." Conventional wisdom holds that these cellular particles form a minor source of atmospheric aerosols. But Jaenicke has found that particles such as fur fibers, dandruff, plant fragments, pollen, bacteria, viruses, and protein crystals compose a surprisingly substantial fraction of aerosols in the atmosphere (*Science* **2005,** *308,* 73). In samples collected in Mainz, for instance, biological fragments accounted for from 5% to almost 50% of aerosol particles with a radius greater than 0.2 µm, depending on the time of year. These particles may attract water and trigger cloud formation and precipitation.

Macrocyclic amine snags and holds CH_2Cl_2



A macrocyclic amine has been found to attack methylene chloride (CH_2Cl_2) with unprecedented high reactivity to form a quaternary ammonium salt (shown) and effectively trap the widely used volatile organic solvent (*J. Am. Chem. Soc.* **2005,** *127,* 4184). The discovery could lead to air-sensing systems for protecting industrial workers from CH_2Cl_2, which is listed by EPA as a probable human carcinogen. Jung-Jae Lee and Bradley D. Smith of the University of Notre Dame and coworkers were investigating the reaction of tertiary amines with CH_2Cl_2 when they observed that the macrocyclic amine reacts with a half-life of about two minutes at room temperature. This rate compares with half-lives of weeks to months for linear tertiary amines or small cyclic amines. The researchers believe one of CH_2Cl_2's chlorine atoms first associates with the macrocycle's NH groups, and CH_2Cl_2's two hydrogen atoms interact with the macrocycle's ether oxygen atoms via weak hydrogen bonds. The macrocyclic nitrogen then attacks CH_2Cl_2's carbon atom, a carbon-chlorine bond breaks, and the chloride leaving group remains associated with the macrocycle as a counterion.

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