Chemistry

Hot time for polymer magnet

Magnetic polymers took a giant step toward technological usefulness with the discovery of one that works at room temperature and higher. After searching for such compounds for more than a decade, chemist Joel S. Miller says he was astonished when he and his colleagues mixed a vanadium compound into tetracyanoethylene, a carbon-nitrogen-based polymer, and found that it remained magnetic at temperatures much higher than any previous organic-based magnet.

Miller, of Du Pont in Wilmington, Del., and physicist Arthur J. Epstein at Ohio State University in Columbus report that the amorphous black solid shows magnetic properties from 1.4 to 350 kelvins (2.6°F to 170°F), at which point the material breaks down. The higher temperature far exceeds the 8.8-kelvin record set earlier this year by the same team.

Polymer magnets appeal to engineers because they should prove more amenable for use in information storage systems and lightweight motors than iron or metal alloys. And even though this particular compound slowly disintegrates when exposed to air, "such a high critical temperature enables us to envision practical applications," says Miller. He and Epstein describe their findings in the June 7 SCIENCE.

New wardrobe against X-rays

Although the hefty lead aprons worn by patients undergoing X-ray procedures can make them feel more securely shielded, such garments can tire and strain medical professionals who must wear them all day. Now, medical physicists at the University of Toronto have developed a lighter alternative. Substituting barium and tungsten powders for some of the lead creates a material that shields as well but weighs less, Martin J. Yaffe, Gordon E. Mawdsley and their colleagues report in the May HEALTH PHYSICS.

Manufacturers of the protective garments typically combine about 6 kilograms of lead powder with about 3 kilograms of rubber or vinyl per square meter of material. Yaffe notes, however, that lead absorbs some kinds of X-rays less well than others. By mixing in barium and tungsten, which effectively absorb those types of X-rays, "you get better absorption over a whole range of energies," he explains. The material thus shields more efficiently, offering the same protection as an all-lead apron but with 20 to 30 percent less weight, he says.

Profiling popcorn's perfume

A German chemist has identified the most alluring scents in freshly popped popcorn and discovered that this snack contains aromatic hints of many other favorite foods.

Peter Schieberle of the Deutsche Forschungsanstalt für Lebensmittelchemie in Garching froze about a pound of popcorn in liquid nitrogen and ground it to a fine powder, which he soaked in a solvent overnight. He then separated out the various compounds and compared their compositions and odors with those of known substances. Of the 23 key odor compounds he identified, four ranked as the strongest in the popcorn's bouquet: one fatty component, one with a spicy aroma, one with a roasty and popcorn-like scent, and one with a roasty, coffee-like scent.

Schieberle, who reports his findings in the June JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY, suggests that one of these, 2-acetyl-1-pyrroline, imparts the touch of popcorn odor in cooked rice and bread crust. The compound may form during cooking when the amino acids proline and ornithine react with breakdown products of sugar, he says.

His analysis revealed two other roasty odors that seem important to popcorn's appeal. In addition, Schieberle picked up fragrances reminiscent of cloves, mushrooms, caramel, vanilla, roast potatoes, cooked apples and fried fat.

Health Physics

Carol Ezzell reports from Salt Lake City at the annual meeting of the Bioelectromagnetic Society

Zapped insomniacs catch some Z's

An experimental device that emits a low-energy electromagnetic field beats counting sheep as a sleep aid, according to researchers who tested the novel technique in a double-blind study.

The month-long study, led by Milton K. Erman of the Scripps Clinic and Research Foundation in La Jolla, Calif., involved 60 insomniacs who held the device in their mouths for 20 minutes three times a week. Half the volunteers used the 27-megahertz instrument, while the remainder used inactivated devices. Neither group felt any sensations during these sessions, says study coauthor Boris Pasche of Brigham and Women's Hospital in Boston.

On average, he reports, insomniacs using the active device nodded off 52 minutes faster than the controls and stayed asleep 1.5 hours longer.

Pasche speculates that the device stimulates sleep-inducing areas of the brain. He and his colleagues are now investigating its effect on melatonin, a hormone secreted by the brain's pineal gland in sync with the sleep-wake cycle.

An Environmental Protection Agency (EPA) report issued last year concluded that weak, but steady electromagnetic fields constitute "a possible but not proven cause of cancer in humans." Because the device tested by Erman's group does not emit a steady magnetic field, Pasche says he and his colleagues were not concerned about adverse effects.

Electromagnetic commute

Epidemiologists investigating possible health effects of steady, weak electromagnetic fields usually measure people's exposures at home, school or work. But a new study suggests this approach overlooks a major source of such exposures: the daily commute.

Participants in the study wore electromagnetic-field detectors for 24 hours on a normal workday. EPA analyst Lynne M. Gillette, who directed the study, reports that riding in cars or electric subways exposed the volunteers to electromagnetic fields of 200 to 300 milligauss—four to eight times stronger than those generated by computer terminals at work.

"People receive significant exposures during transport," she says. "So measurements made at schools, workplaces or homes may not be the best indicators of an individual's overall exposure."

The detectors also revealed that most electric alarm clocks generate 10-milligauss fields, which might possibly add up to a hazard over years of nighttime slumber, Gillette says.

Field effects: No membrane needed

Pulsed magnetic fields can speed up protein synthesis even in cells stripped of their outer membranes, report biophysicists who demonstrated this effect with bacteria. The finding challenges the theory that the purported health risks of electromagnetic fields arise from changes in those membranes.

The researchers, led by Ben Greenebaum at the University of Wisconsin-Parkside in Kenosha, exposed membrane-lacking bacteria to a 10-gauss pulsed magnetic field for one hour. The stripped bacteria synthesized 22 to 55 percent more of a certain enzyme than did similar bacteria not exposed to the field.

"This is the first report of an *in vitro* electromagnetic field effect in the absence of an intact membrane," says Greenebaum. "It means that the models that depend on an intact membrane are incomplete."

Martin Blank, a biophysicist at Columbia University in New York City, calls the finding "intriguing." Blank is among those who propose that electromagnetic fields disrupt cell activity by perturbing molecules in cell membranes, potentially leading to cancer or other health problems.