CHEMISTRY

Supercompounds for superconduction

Scientists already have some great ideas for using superconductors: long-distance power transmission, energy storage, vastly improved computer technologies. All they need now are some workable compounds—compounds, preferably that will transmit electricity with zero resistivity, that can be easily shaped and molded into useful pieces and that do not require severely low temperatures.

DuPont chemists may have developed some compounds that are very close to this description. At the American Chemical Society in Chicago, Arthur W. Sleight reported the synthesis of barium/lead/bismuth oxide compounds, which act as high-temperature superconductors and can be easily molded. "High temperature" is a relative term. The materials superconduct below 13 degrees K., still incredibly cold, but several degrees higher than other super-conducting oxides. Because they are oxides, Sleight says they can be shaped by normal ceramic-molding techniques.

It had been thought that a transition element such as niobium was required for superconduction, but these oxides disprove the rule, and actually necessitate a new definition. DuPont is searching for practical applications now, Sleight says.

Nitrites, drugs and drinking water

It has been shown that nitrites such as the meat preservative sodium nitrite can react with amines under acidic conditions to form carcinogenic nitrosamines. This has ominous implications because the human stomach is a made-to-order acidic reactor.

Two teams reported to the ACS meeting the formation of nitrosamines in animals from the feeding of nitrites along with common drugs and a ubiquitous pesticide. G.S. Rao, a researcher for the American Dental Association in Chicago, reported that 20 amine-containing prescription drugs with a wide variety of chemical structures will react with sodium nitrite in the stomach to form several nitroso compounds. About half of the resulting nitrosamines are known carcinogens; the toxicity of the others is not yet known. This study has implications, Rao says, for the administration of amine-containing drugs to persons with diets high in nitrites.

N. Lee Wolfe and Richard Zepp of the Environmental Protection Agency's Athens, Ga., laboratory reported that atrazine, the most widely used U.S. pesticide, will react with nitrite under acidic conditions to form a nitrosamine. This finding is of immediate concern, Wolfe says, because atrazine residues have been found recently in drinking water in Iowa and Louisiana. Both teams urge further extensive study.

Tracking tumor treatment

An important part of cancer therapy is tracking the progress of the treatment—when, in other words, has the patient had enough? The National Cancer Institute has established a Biological Markers Program to answer that and other cancer questions.

Biochemist Charles W. Gehrke of the University of Missouri at Columbia, part of that NCI program, reported to the ACS new techniques for monitoring cancer therapy. He and co-workers Robert W. Zumwalt and Kenneth C. Kuo have developed high-resolution chromatographic and mass spectrometric techniques for tracing biological markers. These markers are certain biochemicals such as polyamines, nucleic acids and amino acids that are given off by tumors. With the new analytical techniques, physicians can monitor the effects of radio-therapy and chemotherapy on patient's tumors with much greater precision. The techniques are being applied clinically now, Gehrke says.

PHYSICAL SCIENCES

Quantum mechanical condensations

Late-19th-century studies determined that condensation of gases to liquids depends on the relation of two factors, a long-range attraction between molecules and a short-range repulsion. Since both of these forces are part of classical physics, it has been assumed that quantum-mechanical effects play no role.

Now in the Sept. 1 PHYSICAL REVIEW LETTERS, two physicists from the University of Maryland, H.D. Miller and L. J. Parish, and one from the National Science Foundation, L. H. Nosanow, present a theoretical argument that in some, rather exotic cases, quantum mechanics is important. It has to do with "gases" of elementary particles.

Quantum mechanics divides particles into two classes, fermions and bosons, according to the statistical laws they obey. Fermions have an exclusion principle that prevents any two of them with the same values of certain quantum-mechanically important properties (quantum numbers) from being in the same place at the same time. Bosons do not suffer that restriction.

Miller, Nosanow and Parish consider gases of bosons and of fermions with half a unit of spin and find a difference in how they condense at zero temperature. The basic finding is that a boson gas, when compressed, will not undergo a gas-to-liquid transition prior to crystallization into a solid, whereas a fermion gas will. The reasons for the difference lie in the exclusionary fermion statistics, and are truly a quantum-mechanical effect, the theorists say.

Neutrons and protons are fermions. The interior of a neutron star is supposed by astrophysical theorists to be a gas of neutrons and protons, so Miller, Nosanow and Parish suggest their finding may be of interest in such astrophysical models.

Infrared to trillion-cycle ultrasound

Ultrasonic pulses are important probes used in many scientific industrial and medical examinations of solid and liquid samples.

In the Sept. 1 PHYSICAL REVIEW LETTERS, W. Grill and O. Weis of the Institute for Applied Physics of the University of Heidelberg report a method of making terahertz (trillions of cycles per second) sound pulses directly from infrared laser light. The method uses the piezoelectric effect in a quartz crystal to accomplish for the first time, according to Grill and Weis, the transformation of a light pulse into a sound pulse without change of frequency. The piezoelectric effect causes deformation in a crystal when an electric field is applied. Apparently in this case the vibrating electric field of the light pulse causes acoustic vibrations at exactly the same frequency to occur in the crystal.

Watching water form

Following chemical reactions as they happen is one of the big new branches of chemistry made available by modern techniques. In the Sept. 1 PHYSICAL REVIEW LETTERS, D.M. Collins, J.B. Lee and W.E. Spicer of the Stanford Electronics Laboratories report a study of the catalytic formation of water by reaction of hydrogen with oxygen chemisorbed on platinum that opens a new technique for following catalytic reactions.

The new technique is to use ultraviolet photoelectron spectroscopy to monitor the progress of the reaction. The investigators feel this new use will be fruitful in future study of catalysis.

They find a high reaction rate (0.7 oxygen atom removed per incident hydrogen). They attribute it to a short-term adsorption of the hydrogen molecule on the platinum. This leaves it sufficiently mobile to have an easy time encountering an oxygen atom.