

Superconductor clue: Just keep it simple

Many superconductors — materials that put up no resistance to speeding electrons — exist as a result of the trial-and-error tinkering of lab chemists. Hoping for a future of ultra-efficient engines, computers, and other electronics, scientists are forever creating novel superconducting substances. The newest materials have been increasingly complex, but unfortunately their added intricacies haven't yielded big gains in superconductivity at temperatures greater than 125 kelvins.

A report in the March 18 *NATURE* suggests it may be time to go back to basics. An international team led by two chemists at Moscow State University in Russia reports it has discovered a new superconductor made with mercury that is refreshingly simple in structure and shows no resistance at temperatures up to 94 kelvins.

The new material, a mercury-barium-copper oxide called mercury-1201, doesn't beat the 125-kelvin record high temperature. But because mercury-1201 contains just a single mercury and copper oxide layer per unit cell of the crystal, it may have certain practical advantages over the champion material, constructed of two thallium and three copper oxide layers.

"The availability of a material with high transition temperature but only a single metal oxide layer may be important for technological applications, as it seems that a smaller spacing between copper oxide planes leads to better superconducting properties in a magnetic field," S.N. Putilin and his colleagues write.

Researchers are eagerly searching for superconductors that can work efficiently when bathed in the magnetic fields generated by engines, magnets, and imaging equipment, says Robert J. Cava of AT&T Bell Laboratories in Murray Hill, N.J. He speculates that magnetic fields may cause fewer disruptive vortices of current in single-layer materials like mercury-1201. "I think we're going to see a little explosion of activity in the chemistry of this particular compound," Cava predicts.

The new material must first prove it can carry high amounts of current in the 94-kelvin temperature range. "Unless it turns out to have some particularly useful property like high capacity to conduct current, I don't think it will get much attention, because it's more difficult to work with, it's still toxic, and it doesn't have a higher transition temperature," comments Art Sleight of Oregon State University in Corvallis.

The promises and pitfalls of mercury-1201 should be unveiled soon, since it can be easily synthesized for study.

— K.F. Schmidt

New probes of gas additive's toxicity

Drivers in U.S. cities where air in the mid-1980s exceeded the federal standard for carbon monoxide pollution may have noticed a change since last Nov. 1. In compliance with a new provision of the Clean Air Act, their fuel acquired higher concentrations of an oxygenating additive—MTBE—and a new stench.

But in Fairbanks, Alaska, people objected to more than their gasoline's smell. During the first two weeks that gas pumps dispensed the new "oxy-fuels," more than 200 area residents complained of fuel-related headaches, dizziness, shortness of breath, skin rashes, numbness, and nausea.

A city-wide protest ensued. In early December, Alaska Gov. Walter Hickel responded by suspending use of the methanol-based additive in Fairbanks, pending new toxicity studies.

Last week, officials at the Centers for Disease Control and Prevention (CDC) in Atlanta confirmed they had found MTBE (methyl tertiary butyl ether) and its metabolite in the blood of 18 Fairbanks residents they tested in November. All 18 had faced on-the-job exposure to gasoline fumes or motor-vehicle exhaust. Moreover, testified CDC Director William L. Roper at a Senate hearing last week, among these individuals, the 25 percent with the highest MTBE readings were most likely to have had health complaints on the day of their blood sampling.

Because other preliminary epidemiologic findings by CDC also "suggest a possible relationship between MTBE concentration and health complaints," Roper says, "we strongly recommend further investigation."

U.S. gasoline producers have blended MTBE into automotive fuels—primarily their premium grades—to boost octane during lead's phaseout as an antiknocking agent. Since 1979, they have sold more than 100 billion gallons containing 2 to 11 percent MTBE.

Gasoline must contain MTBE at 15 percent by volume to qualify as an oxygenate. The resulting oxygen increase improves gasoline's combustion efficiency, especially at cold temperatures, thereby cutting carbon monoxide emissions by 10 to 20 percent.

Though the vast majority of MTBE-related health complaints come from Fairbanks, "similar complaints have surfaced" in Montana, Colorado, and New Jersey, notes Sen. Tom Harkin (D-Iowa), who chaired last week's hearing before the Labor, Health, and Human Services Appropriations Subcommittee. "While MTBE is supposed to be cleaning the air, I'm concerned that it's actually polluting people's bodies," Harkin says. Indeed, he argues, "there is

enough evidence from the CDC to indicate that [MTBE] may be a serious public health threat."

Raymond A. Lewis, president of the Washington, D.C.-based American Methanol Institute, remains less convinced. It is more than coincidental, he charges, that most health complaints come from Alaska, where gas prices rose "excessively" at the start of the oxyfuels program. Moreover, he says, those health complaints "stopped immediately after the governor announced an end to the oxygenated fuel program, even though 70 percent of the gasoline [there] continued to contain MTBE" for several weeks.

Reports of headaches and nausea also "are inconsistent with our experience of safe use [of MTBE] during the past 13 years and in most parts of the country this year," notes John J. Kneiss, director of the Oxygenated Fuels Association (OFA) in Washington, D.C.

OFA has spent \$3.5 million on MTBE toxicity tests. Some of its 11 studies exposed animals to MTBE concentrations "tens of thousands of times greater than the levels measured in Fairbanks," Kneiss notes. While "research in laboratory animals cannot measure objection to odors or responses such as headaches and nausea," he says, the tests do suggest "MTBE does not cause adverse health risks in people at the exposure levels being measured in Alaska. . . ."

Bowing to pressure from Alaska and Congress, however, both the oxygenated-fuels industry and the Environmental Protection Agency (EPA) have vowed to conduct a host of human studies aimed at resolving MTBE's toxicity. Many should provide data before the next oxyfuels season.

Other EPA tests will attempt to identify whether Fairbanks' frigid winter climate might alter MTBE's chemistry, either by reducing its ability to limit carbon monoxide emissions or by increasing its presence in exhaust.

However, points out a February EPA report, health complaints linked to MTBE-treated gas may trace to something other than the additive. For instance, it notes, "increased formaldehyde emissions [typical of MTBE oxygenation] may be one of several factors contributing to . . . acute health complaints."

Last week, EPA reported the first data signaling success for its new program. In 20 regions using oxyfuels for the first time, carbon monoxide readings exceeded the standard just twice between Nov. 1 and Jan. 31—down from 43 times during the same period the previous year.

— J. Raloff