Signs of a New High in Ceramic Superconductivity

By systematically altering the proportions of several key elements in a ceramic material, a physicist at the Georgia Institute of Technology in Atlanta has observed signs of superconductivity at temperatures substantially higher than the boiling point of water. A variety of measurements on several different samples of copper oxide compounds suggest that these materials may lose all resistance to the flow of electrical current at temperatures as high as 500 kelvins.

"The compounds seem to be stable and reproducible," Georgia Tech's Ahmet Erbil told SCIENCE NEWS. "We have made them several times in the lab. We have observed many properties of the material that are consistent with superconductivity." Erbil reported his results this week in Boston at a meeting of the Materials Research Society.

Like many researchers, Erbil started with a mixture of compounds containing the elements yttrium, barium, copper and oxygen. After processing these powdered compounds into a ceramic, he noticed that certain samples seemed to show superconductivity near room temperature. Under an electron microscope, the material appeared to have a granular structure. Erbil identified five different grain types, each of which contained somewhat different proportions of the constituent elements.

"We reproduced each grain type by starting with the right composition," Erbil said in a telephone interview. One of the compositions seemed to show properties characteristic of superconductivity at a high temperature. Analyzing those particular samples again showed various grain types. By successively duplicating the composition of components that appeared to show the greatest superconducting potential, Erbil step by step came up with a material that has superconducting properties at 500 K.

Erbil's findings are so far the most convincing evidence that it may be possible to create superconducting materials capable of operating at room temperature – which would make possible a wide range of inexpensive electrical applications. Earlier reports of room-temperature superconductivity were not reproducible, and researchers failed to follow up systematically the clues offered by these tantalizing glimpses (SN: 7/4/87, p.4). Meanwhile, efforts to develop a theory to explain the findings continue (see p.359).

"The composition range we have is very different from previously reported composition ranges," says Erbil. However, even the new copper oxide ceramic is granular and made up of a mixture of phases. The superconducting fraction is still probably small, he says. The material is also sensitive to moisture. Samples must be encapsulated to protect them from water vapor.

"The key question is whether or not the superconducting phenomenon exists at those high temperatures," says Erbil. "We have many types of measurements, all pointing in the same direction – that it is indeed a superconductor. If it exists, then the next question is how the material can be improved for practical application."

"At this point, I don't know whether this 500 K superconductor is real or not," says Robert C. Dynes of AT&T Bell Laboratories in Murray Hill, N.J. "I've seen the data. Obviously, there are some questions that [Erbil] doesn't know the answers to, and so it's got to be aired out. But it's not nonsense." He adds, "One never believes these things until they're reproduced."

At the same meeting, a group of Bell Labs researchers reported devising a way to prepare flexible superconducting wires that can carry more than 100 times as much current as any similar ceramic material even in the presence of a large magnetic field. "We've broken through a critical current barrier," says Dynes.

The wire, says Sungho Jin, leader of the Bell Labs team, was created by melting an yttrium-barium copper oxide ceramic, then letting it solidify. The change in grain structure allowed the material to conduct electrical current more efficiently. *– I. Peterson*

Herpes latency makes 'anti-sense'

A backwards genetic message may be the reason why herpes simplex viruses lie dormant between occasional attacks on their human hosts, scientists reported this week. Because such latency periods are characteristic of genital herpes and cold sores, as well as some other viral diseases like AIDS and shingles, the researchers say that further studies on the unusual gene may suggest a way to keep inactive those viruses that persist in the human body.

It is well established that once a person is infected with herpes simplex type 1 viruses, the viruses "rest" – or at most grow very slowly – somewhere in the nerves throughout life, waiting to reactivate and ambush the host with painful attacks. Why and how the viruses remain inactive is of considerable interest in terms of public health: Between 65 and 80 percent of the general U.S. population has been exposed to these herpes viruses.

Scientists at the National Institute of Allergy and Infectious Diseases (NIAID) in Bethesda, Md., hunted for dormant herpes simplex viruses in facial nerve tissue taken from cadavers that did not have signs of active herpes infections. The NIAID group found large amounts of RNA similar in structure to a previously identified viral gene that forces infected host cells to produce a viral protein called ICP0 and helps regulate subsequent steps in viral replication. But there was a twist: The new RNA was a mirror image of the ICP0 gene, and therefore is what geneticists call "anti-sense" RNA.

The NIAID researchers, with collaborators from the Office of the Chief Medical Examiner in Baltimore, say in the Dec. 3 NEW ENGLAND JOURNAL OF MEDICINE that the anti-sense RNA may cause latency by either blocking activity of the normal viral RNA, or coding for a protein that interferes with virus growth. Kenneth D. Croen of NIAID said in an interview that the current results may suggest "the ideal therapy" for the millions who suffer from herpes infections. "It really depends on whether the anti-sense [RNA] is a regulatory [message] itself, or whether there is a regulatory protein produced," he explains. "In either case, one could devise therapeutic approaches" that essentially duplicate either action. If the RNA turns out to be a regulator, it would be the first time such a mechanism would be demonstrated outside bacteria.

The current study is an extension of work in laboratory mice reported earlier this year by University of California researchers in Los Angeles and Irvine. Results from human tissues, however, should accelerate herpes research by providing "a uniform model of herpes simplex latency," says Croen. "In the animal models for herpes, it's less clear what latency is," he says. "It is not known whether the viral [genetic machinery] is shut off in animals."

More experiments must be done, says Croen, to prove whether the anti-sense RNA is really the key factor in establishing and maintaining latency, and whether it comes from the virus. The approach also may be useful in studying factors like stress, which is known to reactivate the herpes virus (see p.360), and in studying latency in other viral infections. *– D.D. Edwards*