1-2-3 contact: A new superconducting film

Using high-temperature superconductors for magnetically levitated trains and loss-free transmission of electricity remain dreamy prospects. But researchers have had success in depositing working thin films of the poorly understood superconductors onto silicon and other materials. New microwave communications technologies and faster computers made with denser, speedier chips may emerge as the first practical payoffs of the new superconductors, they say.

In new studies that complement and build on earlier ones, materials scientist Jagdish Narayan and his graduate students at North Carolina State University in Raleigh have developed a relatively low-temperature technique for depositing thin films of the now famous "1-2-3" superconductor – composed of one part yttrium (as counted by atoms), two parts barium, three parts copper and roughly seven parts oxygen – onto several materials including silicon, the basic substrate for most electronic devices.

The Raleigh researchers first vaporize small portions of a 1-2-3 pellet with laser pulses. An electrically charged ring between the pellet and the heated substrate, such as silicon or strontium titanate, steers vaporized ions to the substrate and homogenizes their speeds to ensure a smooth layering, Narayan says. A nozzle near the substrate adds oxygen, resulting in a 1-2-3 superconducting film thoroughly aligned with the underlying substrate's crystal structure. At the highest processing temperature his group studied, 650°C, "these films are defect free," Narayan told SCIENCE NEWS. At the lowest temperature, 500°C, the films and alignments are less pristine, he notes.

In a paper scheduled to appear in the June 5 APPLIED PHYSICS LETTERS, the scientists claim their crystalline films are near-perfect, stable and capable of carrying record-high currents, although other researchers point out that no standards have been established for measuring the currents and temperatures. Narayan's group also reports depositing its films at temperatures roughly 100°C cooler than previously reported by his group and others. Lower processing temperatures minimize chemical reactions and physical movements that can disrupt the substrate/film interface. But since lower temperatures also reduce the films' crystalline quality, choosing processing conditions is a delicate balancing act.

Getting the 1-2-3 films onto silicon has proved difficult because the two materials' crystal structures do not exactly match and they expand and contract at different rates as the temperature changes. After such hybrid structures are cycled through temperature ranges, "the films begin to look like the bottom of a riverbed," remarks physicist Venky Venkatesan of Bell Communications Research (Bellcore) in Red Bank, N.J. Moreover, silicon cannot withstand the higher processing temperatures typically used for making bulk 1-2-3 superconductors.

To overcome these incompatibilities, researchers can use expensive strontium titanate as a sort of material diplomat. Even at lower processing temperatures, strontium titanate's crystal structure can accommodate silicon on one side and the 1-2-3 superconducting films on the other to form a less stressed and more stable three-layer structure. Still, for commercial applications, Narayan and others continue to seek cheaper processes that do not require the extra layer.

In the past months, researchers at Bellcore, Hitachi and elsewhere have reported progress. High-quality 1-2-3 superconducting films are nearing practical applications in hybrid superconductor-semiconductor chips and in military and consumer communications devices that operate at extremely high frequencies in the microwave region of the electromagnetic spectrum, Venkatesan says.

– I. Amato

Analgesics can harm kidney

U.S. scientists have found that adults taking long-term, daily doses of the nonprescription painkillers phenacetin and acetaminophen – but not aspirin – run an increased risk of kidney disease. This study and one from Germany, which yielded similar results, provide the first epidemiologic data on the effects of long-term, daily use of acetaminophen, says study leader Dale P. Sandler at the National Institute of Environmental Health Sciences in Research Triangle Park, N.C. Phenacetin was taken off the U.S. market in the late 1970s because of its suspected link to kidney disease.

Beginning in 1980, Sandler's team conducted telephone interviews with 554 North Carolina adults newly diagnosed with renal disease and 516 matched controls, asking about their history of analgesic use. In comparing the two groups, they found daily phenacetin use associated with about a fivefold increased risk of kidney disease and daily acetaminophen use with about a threefold increase, the researchers report in the May 11 NEW ENGLAND JOURNAL OF MEDICINE. No increased risk stemmed from aspirin use.

The work should be repeated in other regions, Sandler says, but in the meantime, people who take acetaminophen every day should do so only with medical supervision. Occasional users need not worry, she emphasizes. □

Fraud debate aired on Capitol Hill

In two days of heated testimony, Rep. John Dingell (D-Mich.), the powerful chairman of the House Energy and Commerce Subcommittee on Oversight and Investigations, grilled a cast of witnesses including Nobel laureate David Baltimore, a bevy of Secret Service agents and Margot O'Toole, the postdoctoral student who triggered the most recent debate in the nation's capital regarding scientific fraud and misconduct.

The drama was played out May 4 and May 9 in the Rayburn House Office Building with a standing-room-only crowd of scientists, administrators, government officials, lobbyists and journalists. At the center of the uproar: an April 25, 1986 scientific paper published in CELL by a team of researchers led by Thereza Imanishi-Kari, formerly with the Massachusetts Institute of Technology and now at Tufts University School of Medicine in Boston. The team included Baltimore, director of the Whitehead Institute for Biomedical Research in Cambridge, Mass. The CELL paper claimed that foreign genes inserted into immune-system cells in mice generally are not expressed but instead affect production of antibodies directed by the animal's own genes.

It is this very conclusion that O'Toole continues to question. O'Toole, who worked in Imanishi-Kari's MIT laboratory, first raised objections to the CELL paper in May 1986 when she stumbled onto data pertaining to a crucial portion of the experiment described in CELL. "An examination of these records convinced me that the findings had been presented in a misleading fashion, and that a central claim of the paper might not be supported by experimental evidence," O'Toole told the subcommittee. She never accused Imanishi-Kari of fraud.

Dingell's staff scheduled the latest round of hearings to air forensic evidence suggesting that laboratory pages supposedly written in 1984 and 1985 were actually prepared in 1986 – after the CELL report appeared. John W. Hargett of the Secret Service testified that an analysis of Imanishi-Kari's laboratory notebooks showed that more than a dozen pages contained altered dates.

Imanishi-Kari steadfastly denied any implication that she had gone back and altered her lab books. "I do keep my notes in what seems to others a messy condition. But I know my notes. I know where they are and how to read them – that's what is important," she told the subcommittee, adding she had strong personal motives to be accurate. The CELL paper's results may help scientists understand lupus erythematosus, a disorder caused by a malfunctioning immune system. "Mr.