Hot Times for Buckyball Superconductors

As the pace of buckyball discoveries continues to accelerate, scientists report another major increase in the temperature at which compounds containing these soccerball-shaped molecules conduct electricity without resistance.

The 60-carbon buckyball is the most prominent member of a family of all-carbon molecules called fullerenes. By adding rubidium and thallium to a film of buckyballs, scientists at Allied-Signal, Inc., in Morristown, N.J., have now made a superconductor that works up to at least 42 kelvins. Just last month, Japanese scientists combined rubidium and cesium with buckyballs to create a compound that superconducts at 33 kelvins.

Physicist Zafar Iqbal of Allied-Signal described the latest increase last week at the University of Pennsylvania Workshop on Fullerites and Solid-State Derivatives. Another participant at the Philadelphia workshop, Paul W.C. Chu of the University of Houston, described growing large crystals of C_{60} and reported that buckyballs exerted unexpected and baffling effects on known superconductors.

The Allied-Signal team created several samples of the thallium-rubidium-buckyball material, which remained superconducting to between 42.5 and 45 kelvins. They have yet to determine the exact ratios of these elements in the different samples, says Iqbal, but previous research suggests that a superconducting C_{60} compound should contain three "dopant" atoms for every buckyball. This is the first report of a buckyball superconductor that incorporates elements other than alkali metals such as cesium and potassium, Iqbal and others note.

"It's a very encouraging result," says Robert C. Haddon, a chemist at AT&T Bell Laboratories in Murray Hill, N.J., who helped develop the first buckyball superconductor (SN: 4/20/91, p.244). "It broadens the scope of materials that have been shown to dope C_{60}."

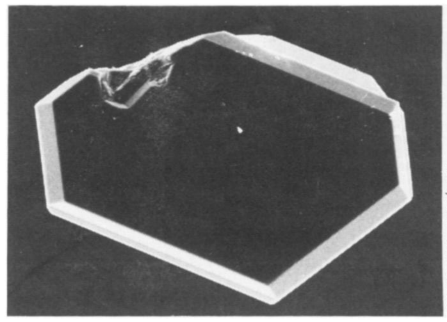
In the July 18 NATURE, K. Tanigaki and colleagues at NEC Corp.'s Fundamental Research Laboratories in Tsukuba, Japan, described a new superconductor that contained two cesium atoms and one rubidium atom for each buckyball. Their material maintained its superconductivity up to 33 kelvins, suggesting that the bigger the metal atoms, the higher the superconducting temperatures of the buckyball film.

In the same issue of NATURE, Charles M. Lieber, a Harvard University chemist, reported success in using alloys to make superconducting buckyball films that work up to 30 kelvins. This approach made it easier to combine cesium with buckyballs in the right proportions, he says. Unlike the the Allied-Signal scientists, Lieber and his co-workers added only one metal, cesium, into their buckyball lattice.

Chu, one of the pioneers in high-temperature ceramic superconductors, took a different tack in investigating C_{60}. While trying to create a new material, he put a niobium superconductor into a chamber filled with buckyballs and heated the two. Chu expected only a small amount of carbon to diffuse into the superconductor, and he thought that impurity might have a slight effect on the material's superconductivity. Such an effect would indicate that the buckyballs had entered the niobium.

But the buckyballs completely eliminated the compound's superconductivity, he reported at the workshop. The results were even more astonishing when he put the buckyball-niobium compound into a magnetic field. The field reinstated the compound's superconducting properties, Chu says. When he heated the material, the superconductivity vanished again – as expected – but lowering the temperature did not restore the property, as it does for most superconducting materials.

Chu repeated the experiment with a tiny niobium ring, which actually transported current with no resistance. This confirmed that something extraordinary occurred throughout the sample when he added buckyballs to the ring, he says. Furthermore, when he exposed the sample to air, it acted as if the buckyballs were not present.



Chu/Univ. of Houston

This single C_{60} crystal, grown by Paul C.W. Chu and his colleagues, measures 1.7 millimeters long.

"This really defies all the rules of physics and all the rules of chemistry," Chu told SCIENCE NEWS.

In his quest for a better understanding of buckyballs, Chu also spent three months trying to form a large single crystal of these carbon spheres. His 1.7-millimeter-long, nearly flawless specimen represents one of the biggest so far, he says. – *E. Pennisi*

NIH director faces congressional scrutiny

The continuing debate on scientific misconduct intensified last week with a dramatic confrontation between National Institutes of Health Director Bernadine P. Healy and Rep. John D. Dingell (D-Mich.), chairman of the House Subcommittee on Oversight and Investigations.

Dingell called the subcommittee hearing to address concerns about Healy's handling of the NIH Office of Scientific Integrity (OSI), which investigates allegations of scientific misconduct and fraud among NIH-funded researchers. At the hearing, he charged that Healy had "derailed" OSI investigations through several actions undertaken since she assumed the NIH directorship last April.

The brouhaha represents the latest eruption of a debate over whether scientists can adequately police their own ranks. Many scientists contend that Congress should not interfere with the scientific community's self-regulation. Many lawmakers argue that misconduct by federally funded researchers defrauds the agencies paying for the work, and that scientists too often have failed to investigate such cases rigorously.

Although the central aim of the hearing was to examine whether the new NIH director attempted to undercut OSI investigations, lawmakers started out by questioning her extensively on her own investigation last year of alleged scientific misconduct by a researcher at the Cleveland Clinic Foundation. Healy, who headed the clinic's research institute at the time, chaired an in-house panel that cleared the scientist of misconduct.

In a preliminary inquiry, Healy's panel found false statements in several grant applications written by the clinic scientist and sent to NIH. The scientist admitted that his applications contained descriptions of work he had not done, but he called those statements "honest mistakes," according to Healy's May 1990 report on the inquiry. The panel reprimanded him but concluded there was no evidence that he had intentionally misrepresented his research. "Rather, he exhibited a high level of carelessness and sloppiness that led to misstatements," Healy wrote in her report. She described those misstatements as "anticipatory writing."

At last week's hearing, Healy testified