Computer Chips Take a Leap Forward

IBM introduced a new technology this week that can more than triple the speed of computer chips, paving the way for improved electronic devices. The company announced that it has found a practical way to make connections on integrated circuits with copper instead of aluminum. Copper connections will allow circuits to be packed together more densely, leading to smaller and faster chips.

"This is a very advanced technology," says Harry T. Weaver, manager of microelectronics fabrication at Sandia National Laboratories in Albuquerque, N.M.

In the most advanced chips now available commercially, the aluminum wires connecting various features can be as little as 0.35 micrometer (μm) wide. The electrical resistance of aluminum prevents those features from becoming much smaller, however.

Copper conducts electricity much better than aluminum, making wires as thin as 0.2 μm possible. "There's nothing on the market like that," says Weaver. "It's more than a generation beyond what you can buy today."

The advance should keep chip technology in step with an empirical rule, according to which the capacity of integrated circuits doubles roughly every 18 months, says Weaver.

Despite its superior electrical properties, copper has several features that have prevented it from being used in silicon computer chips until now. Most troubling was copper's tendency to diffuse into silicon, "poisoning" features that had already been deposited, says William O'Leary, spokesperson for the IBM Microelectronics Division in Hopewell Junction, N.Y. To overcome this obstacle, IBM inserted a barrier between the copper and silicon.

The company is patenting several parts of the manufacturing process and keeping others as trade secrets, O'Leary says.

An advantage of the technology, he adds, is that "it can be introduced rather painlessly into existing [fabrication] facilities." What's more, the new chips will probably cost only 70 to 80 percent as much to make, even though copper is a more expensive material. Making chips with copper requires fewer processing steps, which translates into lower cost.

Other research teams have been trying to deposit copper on silicon wafers, and a few have succeeded. However, those techniques still remain experimental, while IBM is already manufacturing chips in limited quantities. "IBM has always been a leader in taking advanced concepts and converting them into a process," Weaver says.

The first products to run on the new chips will probably be high-end computers, like those used as Internet servers. IBM also plans to work with companies that need custom-made chips.

The new chips demand less power than those currently available, which opens the door to more efficient electronic devices. A laptop computer that's less power-hungry, for example, could run longer between recharging or require a smaller, lighter battery. The chips should find their way into consumer electronics by next year, says O'Leary.

The technology is expected eventually to move integrated circuits into the gigahertz speed range—well beyond the 300 megahertz in today's top-of-the-line personal computers. O'Leary says the technology should keep engineers productively occupied for the next 10 to 15 years. —*C. Wu*

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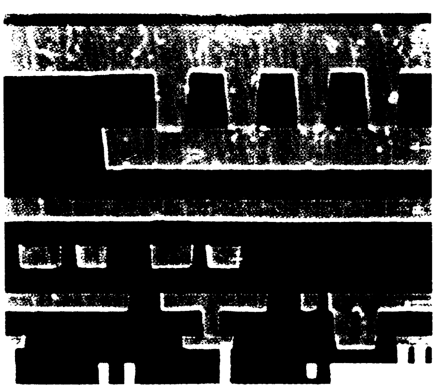

A scanning electron micrograph shows a cross-section of a computer chip made with six layers of copper.

New chemistry from tropical corals

It's a long way—geographically and taxonomically—from a shrub in the forests of the Pacific Northwest to a coral on a reef off western Australia, but the two share some unusual chemistry. Like the anticancer drug Taxol, derived from the Pacific yew, a compound manufactured by the rare *Eleutherobia* coral gums up the internal scaffolding of a cell.

The coral compound, eleutherobin, joins a select class of chemicals known to exert such an effect. Researchers from the Scripps Institution of Oceanography in La Jolla, Calif., and Bristol-Myers Squibb in Princeton, N.J., describe the compound's structure in the Sept. 17 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY. Although eleutherobin's basic structure is built of five-carbon rings, as is Taxol's, the compounds have no further similarities, says William H. Fenical of Scripps.

Eleutherobin is the latest of numerous new drug candidates that have been extracted from marine organisms in recent years (SN: 4/8/95, p. 212; 11/27/93, p. 358). The diverse organisms that have coevolved on a coral reef are prime targets in biochemical prospecting. Many can't flee from predators, so they ward them off with chemicals that may be adapted for therapeutic uses.

So far, eleutherobin has been tested only on human cell lines grown in the laboratory, but it seems to be extremely potent against breast, renal, ovarian, and lung cancer cells, says Fenical. Details of its biological activity are slated for publication in CANCER RESEARCH, he adds.

Fenical collected the yellow or red pinkie-size coral on a 1993 trip to study chemical defenses. "We weren't looking for cancer drugs," he says, but a routine screening indicated that something in the corals could kill cells. Corals are a known source of anti-inflammatory agents—one is marketed in a skin cream. Patented in 1995, eleutherobin is licensed to Bristol-Myers Squibb, which markets Taxol.

Eleutherobin's ability to gum up a cell's microtubules and thereby stop it from dividing is a "very intriguing activity," says David J. Newman of the National Cancer Institute in Frederick, Md. However, few of the natural compounds that show promise in the lab make it through animal and human testing onto the market. Eleutherobin, says Newman, "has overcome a major hurdle, but it's got a long way to go."

Rarely is a specific natural product of pharmaceutical interest, says Newman: "We're not looking for drugs, we're looking for structures." The basic structure of the AIDS drug AZT, for example, was identified in a sponge, he notes.

Marketability may be a gamble, but the novelty of coral chemistry is a sure bet. Researchers from Vanderbilt University in Nashville and their colleagues report the unusual structure and function of another chemical, from a Caribbean sea whip, in the Sept. 26 SCIENCE. That enzyme may be involved in the coral's synthesis of compounds resembling prostaglandins, hormones that exist in minute amounts in people but make up 2 to 3 percent of the coral's dry weight. Their function in coral is unknown. —*C. Mlot*