protein might, for example, inhibit uptake into cells of the AIDS virus or prevent the cell migrations needed to build the new blood vessels required for tumor growth. "These are targets that [companies] have identified for a while, and they have been playing with them, but without any structural basis," says Arnaout.

Indeed, researchers say that the $\alpha V\beta 3$ structure is sure to inject new energy into the integrin field. "In a lot of ways, it's really just a starting point," says cell biologist Jeffrey W. Smith of the Burnham Institute in La Jolla, California. But, he adds, "it changes the level of research that we can do."

–JENNIFER COUZIN

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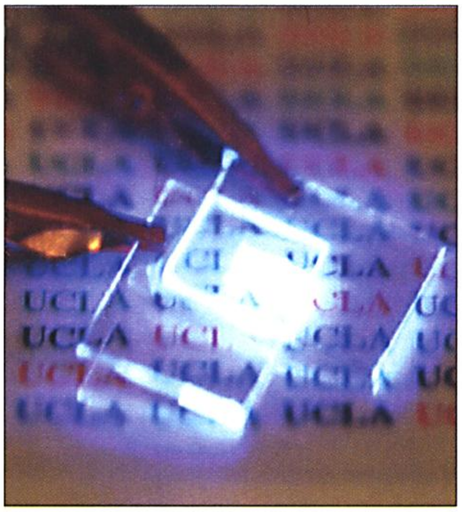
ELECTRONICS

Organic Device Bids to Make Memory Cheaper

CHICAGO—Beware, silicon engineers: Organics are at the gate. Researchers have already turned electrically conducting organic compounds into light-emitting displays and flexible circuits (*Science*, 12 June 1998, p. 1691; 21 January 2000, p. 415). Now they're laying claim to one of silicon's remaining strongholds: memory. Last week, materials chemist Yang Yang of the University of California, Los Angeles (UCLA), told the American Chemical Society* that his group has devised an organic-based digital memory.

The new devices work similarly to flash memory, a relatively expensive silicon-based technology that retains its data even when power to a device is turned off. An organic version has the potential to be much cheaper because it could be far simpler to produce, says Edwin Chandross, an organic-electronics expert who runs a consulting firm in Murray Hill, New Jersey. "It's impressive," Chandross says of the new work. "A lot of people have been talking about trying to do this."

Talk hasn't gotten them very far. No one has yet found a way to make an organic device that has two stable states, which can encode the 0's and 1's of computer lingo.



New trick. Conducting organic materials similar to this light-emitting diode can store data.

Yang's group was struggling with this problem as well. The researchers first tried to make organic memory devices by putting a layer of conducting organic molecules between two electrodes and applying a voltage. That caused the conductivity of the organic material to rise, a signal that potentially could encode bits of information. But it dropped again when the voltage was turned off, so the chance to store information was lost.

On a hunch, one of Yang's postdocs, Liping Ma, suggested following the lead of compact-flash devices, in which tiny strips of metal act like batteries to store electronic charges. Yang gave him the green light, and Ma sandwiched a thin metal layer between layers of conducting organic molecules. To their surprise, it worked splendidly. The device could not only write and read bits of data but erase and rewrite them as well.

To write a bit of data, Yang's team simply applies a potential of 3 volts between a pair of electrodes bracketing the organic-metal-organic sandwich. The voltage makes the material between the electrodes more conductive, a quality it retains even when the voltage is turned off. That high-conductivity state acts as the 1. To read the bit, the UCLA team applies a second voltage of 1 volt. The highly conductive material produces a rush of electrons between the electrodes, signaling that the device is in the 1 state. Applying a third voltage of –0.5 volt returns the cell to its original low-conductivity state, a 0, which the team can read by applying another voltage of 1 volt.

Yang says his team has run through this write-read-erase cycle about 1 million times without seeing any signs of degradation. That track record leaves other researchers both impressed and scratching their heads, because just what causes the material in the device to change its conductivity when different voltages are applied remains a mystery. "It's intriguing," says Alan Heeger, a physicist at UC Santa Barbara, who won the Nobel Prize in chemistry last year for his work on conducting polymers. "I'd like to know what is going on."

In earlier devices that claimed similar properties, it turned out that metal from the electrodes was migrating into the organic layers and giving rise to some of the effect. Although such devices seemed to work for a short while, they were difficult to reproduce and eventually stopped working when the small metal fragments broke down, Yang says.

To test whether similar metal reactions were behind the properties of the new device, the UCLA team replaced its aluminum metal layer with layers of less reactive silver, copper, or gold. All worked similarly to the aluminum, Yang says. "It was the right experiment to run," Chandross notes; gold, in particular, is fairly inert and shouldn't react as aluminum does.

Whatever causes the change in conductivity, organic memory devices could move into applications quickly, Chandross and others say. Manufacturers can make the devices simply by evaporating different materials through a mask in a vacuum. UCLA has granted an exclusive license to a Boston-based start-up company interested in commercializing the technology. If the effort flies, it could result in ultracheap flash memory–based computers that turn on instantly, without the minutes-long boot-up that a standard computer needs to reload its working memory with data that get lost whenever the power goes off.

No doubt silicon is safe for a while. But it may soon be under siege.

–ROBERT F. SERVICE

NEUROSCIENCE

New Route to Big Brains

Never mind the bipedal posture, relative lack of fur, or opposable thumbs. What really sets humans apart from other animals is our oversized brain. But building a bigger brain is an evolutionary challenge. In addition to all the extra neurons and other brain cells that have to develop, somehow all those cells have to be wired together correctly. Now, researchers report that in humans—but apparently not in other species—some neurons in the developing brain travel along an unexpected route. This detour allows them to link to and serve the most overgrown and recently evolved parts of the human brain—those involved in higher functions such as memory and problem solving.

"The exciting point here," comments developmental neurobiologist Gord Fishell of New York University, is that the study identifies a "fundamental difference in the way human brains develop." Neuroscientists still don't understand, he says, "what it is about the human brain that allows it to become more complex than [in other] primates." The newfound pathway, which is described in the September issue of *Nature*

* 222nd ACS Annual Meeting, 26–30 August.

CREDIT: YANG YANG/UCLA