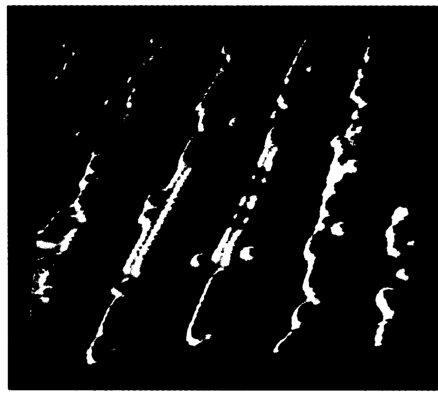
System breaks individual molecular bonds



University of Illinois/IBM Research

A scanning tunneling microscope image showing lines of broken hydrogen bonds on a silicon surface.

For scientists seeking the ultimate control of matter—the ability to manipulate one atom at a time—molecular bonds have long presented a formidable obstacle.

How, researchers wonder, does one make or break a specific chemical bond? Or energize a molecule precisely enough to disrupt one bond and no others?

Tsung-Cheng Shen, a physicist at the University of Illinois at Urbana-Champaign, and his colleagues describe a method for achieving this long-sought goal. They have devised a system, using a scanning tunneling microscope, that enables them to break individual chemical bonds between silicon and hydrogen atoms. Their report appears in the June 16 SCIENCE.

"This is the first time that bond breaking has been achieved with this level of accuracy," says coauthor Joseph W. Lyding, an electrical engineer at the University of Illinois. "We can actually get down to individual rows of molecules on a silicon surface and selectively remove hydrogen along those rows. That hasn't been demonstrated before."

Starting with a thin film of silicon coated with a single-atom layer of hydrogen, the researchers fine-tuned a scanning tunneling microscope to pluck single hydrogen atoms off the surface in neat rows. They achieved this delicate feat using a narrow beam of low-energy electrons, which emanate from the microscope's single-atom tip as it hovers over the silicon-hydrogen surface.

The electrons "pump" energy into the hydrogen atoms, causing them to vibrate at just the right rate to fracture the bonds holding them in place on the silicon surface.

Once the bonds have broken, the atoms settle into a stable state at room temperature, the scientists note. The technique has proved relatively simple, requires no special conditions—such as low temperatures—and moves fairly briskly, despite its exacting nature. Robert E. Walkup, a physicist at IBM's Thomas J. Watson Research Center in Yorktown Heights, N.Y., says the team has reached "the limit of control of silicon surface chemistry."

"In the long run, we'd like to make small, electronic devices on the nanometer scale," says Lyding. "Or at least pieces of devices, the simplest being a metal conductor.

"When you're making electronic structures below one-tenth of a micrometer in size, you need to use a different strategy. The conventional techniques of microlithography just don't work well at that scale."

While stressing that their results represent the earliest stages of this work, Lyding sees potential applications down the road for the manufacture of transistors, computer chips, and electronic memory devices. "We've already made extremely small features on silicon that are similar to those seen in state-of-the-art microprocessor chips." —*R. Lipkin*

Hormone mimics fabled fountain of youth

When Ponce de Leon set out to find the fountain of youth in the 16th century, his search took him to the swamps of what we now know as Florida.

Today, his scientific counterparts explore the intricacies of the human body in search of life-preserving medicines. As yet, they've had little success. But preliminary results from a study of a plentiful, though poorly understood, hormone could provide the first clues to the whereabouts of that elusive fountain.

A team of scientists from the University of California, San Diego, treated 16 middle-aged to elderly people for a year with either the hormone dehydroepiandrosterone (DHEA) or a placebo. Although the researchers pleaded with attendees at a conference on DHEA and aging in Washington, D.C., this week not to call the hormone "the fountain of youth—it's not a miracle," their results are tantalizing.

The eight study participants receiving DHEA saw a 75 percent increase in their overall well-being, compared to the other volunteers. "It is a small study," says project leader Samuel S.C. Yen. "But there was a marked increase in psychological well-being and ability to cope among these patients."

DHEA, a steroid hormone produced by the adrenal glands, appears in increasing amounts at puberty, reaching its peak between the ages of 25 and 30. Because the hormone slowly declines with age, some scientists refer to it as a biological clock of aging (SN: 6/14/86, p.375).

Animal studies of DHEA suggest that it helps protect against viral infections, heart disease, cancer, and AIDS (SN: 11/2/91, p.277).

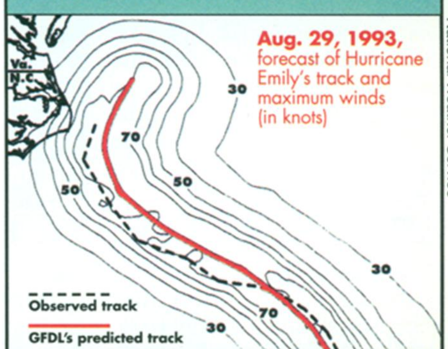
The researchers gave DHEA recipients enough hormone to equal the amount found in the average 30-year-old. The participants filled out questionnaires to record their physical and psychological well-being.

At the end of the study, volunteers taking DHEA reported improved ability to cope with stress, greater mobility, improved quality of sleep, and less joint pain. Men, but not women, experienced an increase in lean muscle mass and a decrease in fat. Neither group perceived any change in libido, and no one reported side effects.

The DHEA group also had higher concentrations of insulin growth factor, a compound that spurs the immune system and normally dwindles with age.

Teasing out the potential risks and benefits of taking DHEA would require "an extensive study in a large population," Yen cautions, adding that there is no evidence to indicate that DHEA increases longevity. He and Etienne-Emile Baulieu of INSERM in Paris have initiated such a project. —*L. Seachrist*

Better hurricane forecasts



National Weather Service

Hurricane forecasts have been improving by about 1 percent a year, says Ron McPherson, director of the National Weather Service's environmental prediction center in Camp Springs, Md. But beginning this month with the weather service's reliance on an improved storm model (SN: 6/4/94, p.357), predicting the track of a hurricane's eye should improve by at least 20 percent in one blow, he says.

This new Geophysical Fluid Dynamics Laboratory (GFDL) model should prove particularly useful in anticipating where storms will turn. Notes Jerry Jarrell, deputy director of the National Hurricane Center in Miami, it's also the first model "with some skill" at offering 3-day forecasts of a hurricane's intensity—or wind speeds—and the area to be pummeled by damaging winds (both depicted above).

—J. Raloff