

STM technique yields tiniest battery

Electrochemists looking to apply their skills to the nascent field of nanotechnology have created an itty-bitsy battery, 100 of which would fit into a single human red blood cell.

The record-small battery consists of pillars of copper and silver laid down on a graphite surface with a scanning tunneling microscope (STM), says Reginald M. Penner of the University of California, Irvine. Penner calculates that the battery generates one-fiftieth of a volt during its 45-minute lifespan. He and his colleagues describe how to make the battery in the Aug. 6 *JOURNAL OF PHYSICAL CHEMISTRY*.

Although other scientists have used STMs to move or deposit one kind of atom in lines or piles on a surface, the Irvine group is the first to succeed in placing different metal atoms close to each other, Penner told *SCIENCE NEWS*.

"That he was able to deposit different materials in a controlled fashion is significant," says Bruce Parkinson, an electrochemist at Colorado State University in Fort Collins. "There are new experiments that you can do now that you can deposit different materials."

To site a pillar, Penner and his colleagues first turn up the STM voltage, which digs a small pit in the very smooth graphite surface. During this step, the graphite and the STM tip are immersed in a dilute solution containing silver ions. At the pit, a few silver ions lose their positive charges and come out of solution. Then

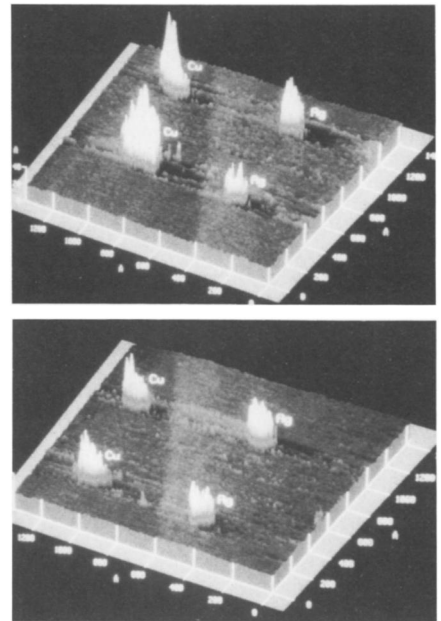
more silver naturally gathers at this site. The technique works at room temperature, Penner says.

Next, the researchers replace the silver solution with a copper sulfate solution and use voltage pulses from the STM to make pillars of copper near two silver piles. When they first did this experiment, they expected to have to switch the copper solution for a silver solution in order to discharge the battery. That's the way silver-copper batteries typically function.

"But this battery didn't work the way we expected it to," Penner recalls. Even before the researchers switched solutions, they noticed the copper pillars shrinking and the silver ones growing. These changes indicated that a voltage existed in the tiny battery.

In this case, "the copper wants to deposit on silver more than it wants to deposit on itself," Penner explains. On the basis of a macroscopic version of this battery, the researchers conclude that once a two-atom layer of copper coats the silver pillar, dissolution and deposition cease, and the battery dies. Overall, about 75,000 copper atoms dissolve.

Because of its size, the 500,000-atom battery will never generate very much current for very long, but the small size means that it does produce a large electric field, says Penner. He hopes to use the battery to study how proteins, such as muscle's actin, orient in this field.



Top: STM-produced battery consists of two silver (Ag) and two copper (Cu) pillars. Bottom: Discharging has caused copper pillars to shrink and silver ones to grow.

UC Irvine

The battery will also let researchers study corrosion — another electrochemical reaction — on a nanometer scale, he says.

Penner plans to try other combinations of metals, and he expects that cadmium-silver nanobatteries will discharge much faster and be much more powerful.

—E. Pennisi

Lethal weapons: Gun access and suicide

Theories about the influence of easily available firearms on suicide rates provoke considerable controversy. Some investigations suggest that populations with easy access to guns experience more suicides. Others indicate that in areas with strict gun-control laws, suicidal persons simply use other means.

Two new reports support the former argument.

"Our results offer strong evidence that the ready availability of guns increases the risk of suicide in the home," asserts a research team led by physician Arthur L. Kellermann of the University of Tennessee in Memphis.

Kellermann and his co-workers studied all home suicides — a total of 565 — in the most populous counties of Tennessee and Washington over a recent 32-month period. They gathered their data from police or medical examiners and in interviews with 442 "proxies," each of whom had been close to one of the suicide victims. They also interviewed 438 randomly recruited individuals matched with proxies for age, sex, and race.

Suicides committed with firearms

made up 56 percent of the sample, they report in the Aug. 13 *NEW ENGLAND JOURNAL OF MEDICINE*. After statistically controlling for distinguishing characteristics of the suicide group—a greater likelihood of living alone, taking prescribed psychoactive drugs, having an arrest record, abusing alcohol or illicit drugs, and failing to graduate from high school—the researchers found that suicide victims were still much more likely than controls to have kept one or more guns at home.

Two-thirds of the suicide victims kept firearms at home, and half possessed handguns. Among controls, slightly fewer than half had firearms at home, and about one-quarter owned handguns. In homes with firearms, 86 percent of those who killed themselves used guns. In homes that did not normally harbor firearms, only 6 percent of suicides involved guns.

Serious mental illness is the strongest risk factor for suicide, the researchers note. But gun ownership showed a strong link with elevated suicide rates among those with and without a history

of mental illness, they argue.

A separate study, led by psychiatrist Peter M. Marzuk of Cornell University Medical College in New York City, suggests that differences in suicide rates among communities stem largely from differences in access to various means of killing oneself.

From 1984 to 1987, the five counties of New York City had similar suicide rates among persons using methods equally available to all residents, such as guns, Marzuk and his co-workers report in the June *ARCHIVES OF GENERAL PSYCHIATRY*. Overall differences in suicide rates among counties, they contend, resulted mainly from varying access to lethal means other than firearms, which are subject to strict local gun-control laws. For example, fatal jumps off buildings occurred most often in the two counties with many tall residential structures.

Firearms are the most common method used in U.S. suicides, but they accounted for only 17 percent of New York City suicides, the scientists note. Gun-control laws probably suppress the city's suicide rate, particularly among white males and young black males, they assert.

—B. Bower