

ENGINEERING

Spies Inside

A new generation of electrodes is small and flexible enough to fit inside the heart or brain

Electricity controls much of the human body: consider the electrical firing of neurons and the current transmitted by the heart. Yet historically the electrodes that have been used in medicine to monitor and regulate essential activity have been biologically incompatible because they are stiff, big and water-sensitive.

Now scientists are setting new standards with their designs for flexible, stretchable and waterproof circuits and electrodes that mimic the properties of human tissues. These new methods can also monitor and control biological electrical activity more naturally and easily. John A. Rogers, a materials scientist at the University of Illinois at Urbana-Champaign, has developed a technique that thinly slices silicon wafers or LEDs with a chemical etcher. Then, to make them stretchy as well as flexible, he

bends them into wave-like shapes and attaches them to rubber platforms. Finally, Rogers waterproofs them by encapsulating them in a polymer. The resulting electrodes “can wrap onto the surface of a tissue almost like a sheet of Saran Wrap,” he says.

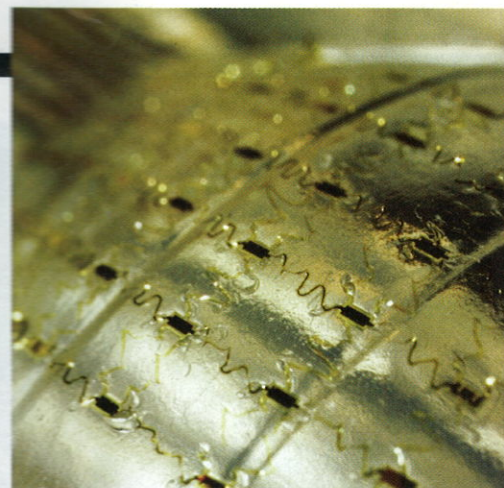
He recently used this technique to develop a tool for treating atrial fibrillation, a cardiac arrhythmia that afflicts two million Americans. The research was published in March in *Nature Materials* (a journal of Nature Publishing Group, which owns *Scientific American*). To identify the location of an arrhythmia, surgeons typically insert a catheter containing a single electrode into a vein and coax it up to the heart. There it tracks electrical activity in a process that can take up to an hour. Finally, with a separate catheter, they fix the arrhythmia by burning the malfunctioning tissue.

“That mapping and

zapping procedure is time-consuming, has limited accuracy and requires a lot of skill in the surgeon,” Rogers says.

He has developed a simpler solution: a balloon catheter covered in stretchy electrodes that can be inserted into a vein in the leg or chest, moved up inside the heart and inflated. There it simultaneously takes dozens of electrical readings and also monitors blood flow, tissue contact and body temperature. In Rogers’s latest models, the balloon can also perform the curative ablation itself.

“It would be a real advantage to be able to take measurements using a large number of electrodes at one time,” says cardiologist Matthew Reynolds, associ-



Multitasker: The surface of one of Rogers’s balloon catheters is covered with electrodes.

ate director of electrophysiology at the Boston VA Healthcare System. “And if you can layer on top of that the ability to measure other things, then that would be unique.” Rogers and his colleagues, who have just launched a start-up company to commercialize the technology, plan to begin human testing within nine months.

Rogers is now turning his attention to other areas of medicine. In work he has just submitted for publication, Rogers used plastic wrap-like electrode sheets to

pinpoint seizure-causing brain regions in severe epileptics. He was able to collect data in real time, covering a larger surface area with improved sensitivity as compared with current techniques. He is also working on skin devices that monitor temperature, pulse rate and blood oxygenation in sports or military applications. The hope is that they will fuse so well with the body as to go completely unnoticed, like a second skin.

—Melinda Wenner Moyer

STAT

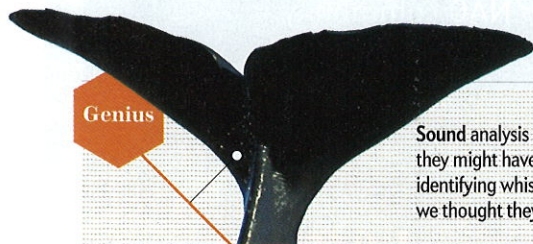
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The estimated number of big brown bats it takes to eat 1.3 million pest insects in one year

4 to 8 grams: The amount of insects that one little brown bat can devour in a night

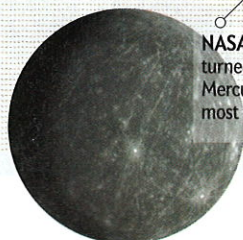
NEWS SCAN

Genius



Sound analysis of sperm whale “clicks” suggests they might have names, similar to the individual, identifying whistles that dolphins display. And we thought they just sang to one another.

Illinois’s Tevatron accelerator lab, set to close later this year, finds possible evidence of what may be a new elementary particle or force of nature. Talk about going out with a bang.



NASA’s MESSENGER spacecraft returned the first close-up pictures of Mercury taken from orbit. The innermost planet is pockmarked with craters.

PETA urged San Francisco to rename its seedy Tenderloin district to something that did not “evoke the horrors of the meat trade.” “What, am I going to say, ‘Yo, I’m headed down to the Mixed Salad?’” one resident told the *San Francisco Examiner*. —George Hackett

A study showed that social rejection affects the same part of the brain as physical pain, bringing new meaning to the lyrics of “Love Hurts.”

Folly