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Working Toward Computer Roll-Ups

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02:00 AM Mar, 06, 2006 EST

One day you may roll up your computer and toss it in your bag -- no more rugged titanium cases. Today's visionaries are planning a world of flexible electronics that will make even your svelte new laptop look clunky.

The secret is in the silicon: the stuff electronic components are made of. Although silicon is a rigid and brittle material, scientists have discovered that when it is made into ultra-thin ribbons and wires -- 100 nanometers, or one-thousandth the diameter of a human hair -- the silicon becomes bendable. What's more, under the right conditions, it can even stretch.

The bendable silicon wires have been used in flexible computer displays and e-paper. Thin, lightweight and flexible components allow the displays to be larger, and at the same time more portable and less likely to be damaged. But for some applications, bendable isn't enough. The circuits must also expand and contract and conform to complex shapes.

"The next frontier is not only flexible but fully stretchable," says [John Rogers](#) a professor of Materials Science and Engineering at the University of Illinois Urbana Champaign. "Stretchability is different than flexibility or bendability, a sheet of paper is bendable but it's not stretchable."

Rogers and his colleagues have devised a technique, described recently in *Science*, which involves stretching a piece of rubber across a wafer of ultrathin silicon devices. When the rubber is peeled away it relaxes the silicon, which buckles and creates accordion-like waves that can expand and contract.

To their surprise, the researchers also found that wavy diodes and transistors fabricated this way could be repeatedly stretched and compressed as much as 20 percent without affecting their performance, compared to just 1 percent in a flat silicon device. That may be impressive but Rogers' goal is 100 percent.

"If you fold a sheet of paper in the right way you can make a pleated structure that looks like an accordion and achieve 100 percent stretchability in the paper. We are simply applying similar concepts to silicon."

The potential of "stretchy" circuits opens up a range of possible applications, including sensors placed in muscles and biological tissues, or wrapped around airplane wings.

According to [Chih-Hung Chang](#), Assistant Professor of Chemical Engineering at Oregon State University, the first flexible displays and e-papers could be commercially available within the next several years.

"There are a lot of people talking about wearable electronics, and also solar cells," Chang says. "If

they become efficient and cheap enough you will buy them in home depot and put them up like wallpaper."

In the same way, sensors, displays and lighting may also cover walls or other unconventional structures.

"This is real," Chang says. "It will happen."

Rants & Raves

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