RESEARCH **PROFILE**

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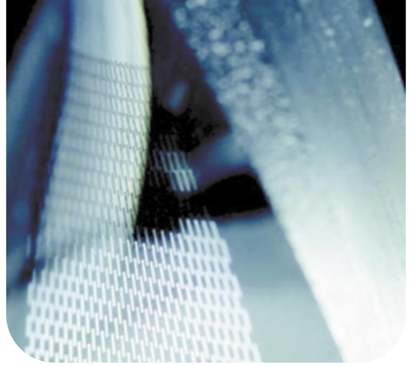
John Rogers
Beckman Institute Faculty Member in M&ENS
Professor of Materials Science and Engineering
Founder Professor of Engineering
Professor of Chemistry



Stamp-printable micro/nanostructures from Rogers' Research Group were featured in the January 2006 issue of *Nature Materials.*

John Rogers has gained national attention by using unconventional materials for applications in electronic structures and devices. So it came as no surprise that when an opportunity arose to use the most common material currently powering modern electronics, silicon, in a completely new way, Rogers took advantage.

A handling error by a postdoctoral researcher in the Rogers Research Group led to the realization that thin strips of silicon can form wavy geometries that buckle but don't break when stretched. They later built upon this discovery by attaching the wavy silicon strips to a rubber-like polymer substrate, and a little over a year after that lab processing slip-up, the Rogers Research Group introduced stretchable silicon to the world. The potential importance of this discovery can make the imagination run wild: stretchable silicon-based transistors could be used for a myriad of high-performance electronics, or for sensors placed along a hospital wall or into an artificial limb.

In other words, stretchable silicon-based electronic devices could expand and contract, or the electronics could be manufactured into a material that stretches to fit an airplane wing, for example, or a human hand. Freeing electronics from the rigidity now associated with items like digital music players or a medical monitor opens so many possibilities, Rogers prefers to leave those ideas to others. But one potential use intrigues him.

"We've had this concept of smart surgical gloves, a rubber glove that's similar to the type of latex glove that surgeons currently use while they are performing operations," Rogers said. "What if you could integrate waveguides and micro-fluidic channels, sensor electronics, readout systems, wireless communications capabilities, into the rubber glove? There you would need all those components to be stretchable because they need to fit and conform to the surgeon's hands. If you could do that then maybe you could enhance the ability of the surgeon to understand what's going on locally in the patient as he's doing the surgery."

Rogers has a history of making creative, groundbreaking discoveries in the areas of new materials and devices for electronics. In just the past two years, his work has been recognized as a top emerging technology, twice by MIT's *Technology Review* and in 2005 by *Scientific American.*

With degrees in chemistry and physics, a Ph.D. from MIT in physical chemistry, and a career as a researcher at Bell Laboratories, Rogers positioned himself well for his current research themes. He has explored the use of unconventional, "soft" materials like biological tissue and liquid crystals for their electronic and photonic responses.

Rogers' work with organic semiconductors has led to the development of flexible, paper-like displays for electronics, such as roll-up screens that fit inside a pen-like tube. Begun during his time at Bell Labs, this research could soon be seen in the form of "electronic newspapers" made from thin strips of plastic that display the news through a wireless Internet link. Rogers said his work with flexible displays is "intimately tied" to stretchable silicon.

"For the flexible displays, we are looking at printing techniques and flexible materials you can use to build circuits," Rogers said. "So a display consists of a circuit component as well as an optical component that allows you to view the information. We've always been focused on the circuit component of the flexible displays, so stretchable is the next frontier."

Rogers sees a research line going from rigid silicon wafers to flexible organic displays, to bendable circuits, to inorganic, stretchable silicon. While some of the unconventional materials Rogers works with inspire the imagination, they do not have the high-speed processing power needed for most of today's electronics. Stretchable silicon can provide that power and offer many of the same flexibility factors.

"With stretchable silicon you would have all the essential mechanical characteristics that you would ever probably want," Rogers said. "A lot of the work on flexible electronics happened here through an interdisciplinary group at Beckman and the silicon approach is conceptually related to that work as well."

While his work with "soft" materials has been fruitful, the new research line into stretchable silicon has obvious benefits in that silicon is widely used in applications and large amounts of funding are available for exploring its potential. And when it comes to stretchable silicon, the Rogers group is exploring new territory.

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