New material for stretchy electronics inspired by nature

Chris Wickham, Reuters

(Reuters) - Scientists in Switzerland have come up with a material mimicking the way tendons connect to bones, which could speed the development of stretchy, wearable electronic devices.

The stretchable electronics [1] industry is in its infancy but devices that are able to flex without breaking could revolutionize devices from smartphones and solar cells to medical implants.

Futurists have long predicted clothes with sensors that monitor the vital signs of the wearer, or smartphones and screens woven into the fabric of shirts or jackets.

But while circuits and wiring are quite happy on rigid surfaces like those in a tablet computer, they break easily when combined with materials that stretch.

"You have two materials with very different mechanical properties," Andre Studart, a researcher at the Swiss Federal Institute of Technology in Zurich, told Reuters. "The challenge is to bridge these different properties."

Studart and his team have overcome the problem with a stretchy material made from polyurethane that contains "islands" stiff enough to house and protect delicate circuits.

While the soft part can stretch by 350 percent, the stiff regions created by impregnating the material with tiny platelets of aluminum [2] oxide and a synthetic clay called laponite, hardly deform and can protect the electronics [1].

The material, presented in research published in the journal Nature Communications, is made from bonded layers and because the concentration of the platelets is gradually increased, the junction between the stretchy and stiff parts is also durable.

"There are many biological materials that have these properties as well, like the way tendons link muscle to bone," said Studart. "But there are not so many examples in synthetic materials."

MARKET POTENTIAL

One of the companies trying to commercialize stretchable electronics is MC10 Inc, a Massachusetts-based start-up born out of research by John Rogers and his team at the University of Illinois.

The firm recently announced plans to start selling a sensor-laden, flexible skullcap that monitors impacts to the head during sports. It was developed with Reebok and goes on sale next year.

Amar Kendale, the company's strategist, said the skullcap gives a level of contact with the head that previous attempts to put sensors in helmets or gum shields have not been able to achieve.

MC10 is using a different approach from the Zurich team. The company uses extremely thin silicon chips sandwiched in a stretchable polymer and connected by tiny wires in a concertina configuration that can stretch about 60 percent, about the same as the body's soft tissues.

MC10 has also developed a balloon catheter with built-in electronic sensors for heart patients, which researchers plan to start testing on people in the next year or so.

"Decorating the surface of the balloon with sensors or a mechanism that delivers energy gives a good way of delivering therapy to soft tissue, like the heart, to correct arrhythmia," Kendale said.

Market potential is difficult to estimate but Kendale said the technology could be applied to the monitoring and management of chronic diseases from diabetes to hypertension.

The Swiss researchers say their technique could also be used to build synthetic cartilage or false teeth with better matches to their natural counterparts.

Currently the ceramics used for dental fillings are so hard they can damage natural teeth if a patient bites too hard. And one treatment for women with crumbling vertebrae from osteoporosis involves injecting a stiff polymer that over time can damage the surrounding healthy vertebrae.

"The problem is that it is equally stiff everywhere," said Studart. "The vision is that you will be able to make materials that are as heterogeneous as the biological ones."

(Editing by David Holmes)

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