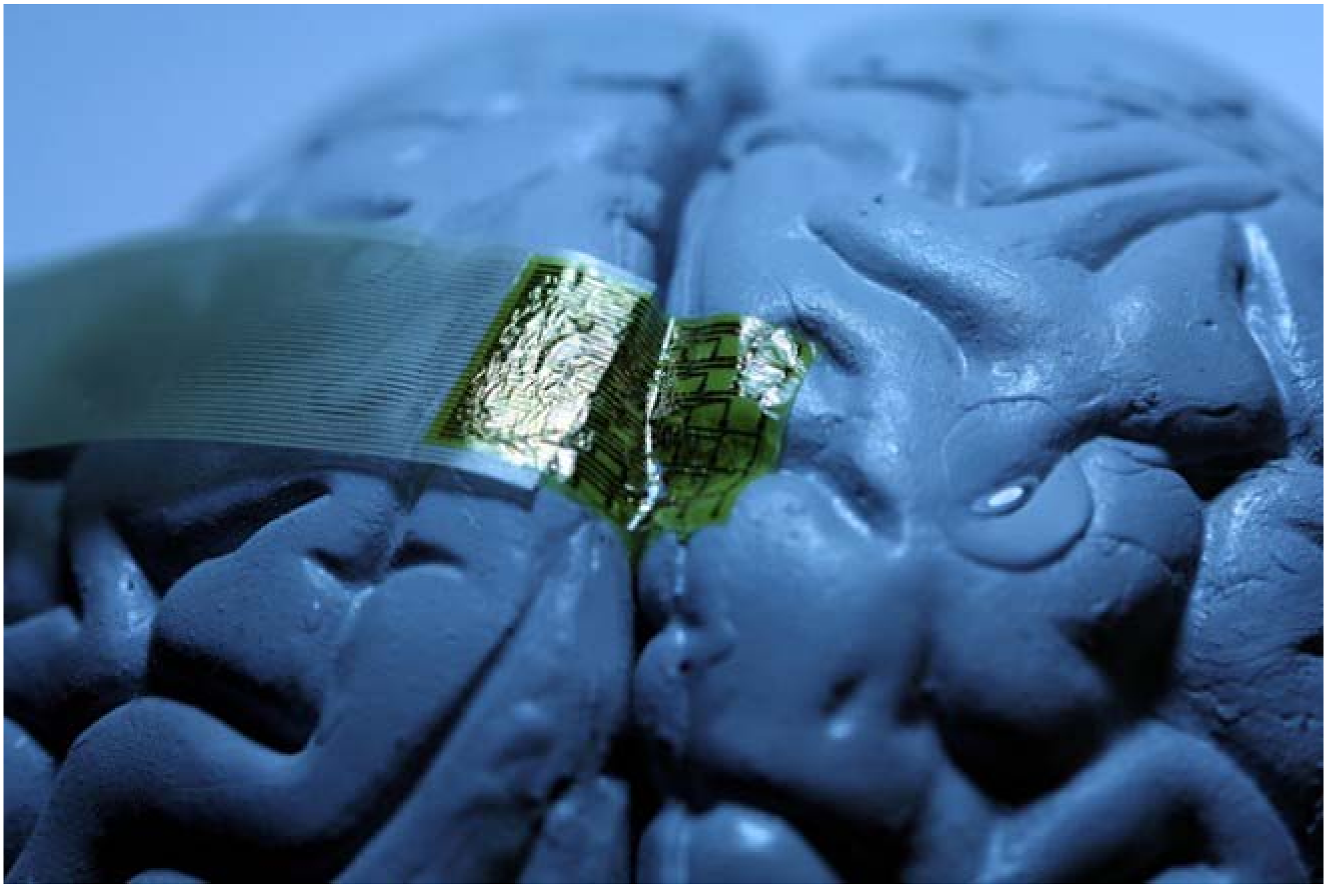
Ultrathin Silk-Based Electronics Make Better Brain Implants

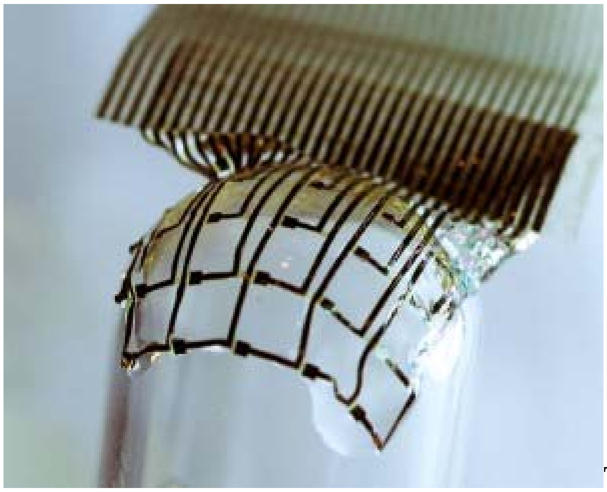
By Janelle Weaver April 19, 2010 | 6:00 am | Categories: Brains and Behavior



Silk has made its way from the soft curves of the body to the spongy folds of the brain. Engineers have now designed silk-based electronics that stick to the surface of the brain, similar to the way a silk dress clings to the hips.

The stretchable, ultrathin design would make for better brain-computer interfaces (BCIs), which record brain activity in paralyzed patients and translate thoughts into movements of computer cursors or robotic arms. Because it's so thin and flexible, a silk-based device could reach regions of the brain that were previously inaccessible.

"This development heralds a new class of implantable devices, not just for the brain, but for many other tissues," said neurologist Brian Litt of the University of Pennsylvania who co-authored the study published April 18 in *Nature Materials*.

The research team printed electrode arrays onto silk films that disintegrate after they are placed on the brain's surface and flushed with saline. They're just 2.5 microns thick, so thin that they need to rest on a platform so they don't fall apart during fabrication or implantation. After the silk film dissolves, the array wraps around the curves on the brain.

"This will significantly improve recording by conforming the electrode array to the surface of the brain," said biomedical engineer Barclay Morrison of Columbia University. "It will move forward the field of flexible electronics."

The team found that the mesh-like device conforms perfectly to the contours on a model of the human brain. When tested on the visual processing area of the cat's brain, the flexible array—about one 40th of the thickness of a sheet of paper—faithfully recorded neural activity for about a month without causing inflammation. By increasing the contact between the electrodes and brain tissue, the system produced better signals compared with more rigid electrode arrays, which are about 30 times thicker.

Some BCIs made of silicon pierce through and damage brain tissue during implantation. But even BCIs that sit on the surface of the brain have problems: The electrodes are often so widely spaced that it's difficult to obtain high-resolution neural signals, and the systems tend to cause immune reactions that compromise their lifespan. BCIs often fail after a short period of time, in some cases only a few months, and patients have to undergo multiple surgeries to replace the devices. The new system, consisting of stable, finely spaced electrodes, may overcome all of these problems and lead to the development better neural prosthetics, Morrison said.

"Its full potential remains to be seen in long-term BCI studies," Morrison said. "Currently, there are no BCIs that use such compliant mesh electrodes, and the potential is pretty big that the implant array will provide a neural interface that is stable over a long period of time."

The scientists would like to extend their findings by making fully dissolvable implantable electronics for monitoring and stimulating tissue growth. They have also developed rolled-up devices, which they could deliver to the brain without making large holes in the skull during surgery. Eventually, they hope to adapt the technology for retinal and cochlear implants and to treat patients with a wide range of psychiatric and neurological diseases.

Images: 1) Conformal, neural electrode array wrapped onto a model of the brain. The wrapping process occurs spontaneously, driven by capillary forces associated with dissolution of a thin, supporting substrate of silk./John Rogers/Nature Materials. 2) Conformal, neural electrode array wrapped onto the hemispherical tip of a glass rod./John Rogers/Nature Materials.

See Also:

- The Next Hacking Frontier: Your Brain?
- Twitter Telepathy: Researchers Turn Thoughts Into Tweets
- Wireless Brain-to-Computer Connection Synthesizes Speech
- Video: Paralyzed People Control Computers with Their Minds

Tags: brain-machine interfaces, Materials Science, Nature, Nature Materials
Post Comment | Permalink

Comments (0)