2010.10.17 / NovaScience

Stretchable Light-Emitting Sheets Could Form the Basis of Implantable Optoelectronics

October 17, 2010 – Scientific American

A LIGHT READ: A flexible array of LEDs on a folded sheet of paper.
Image: COURTESY OF JOHN A. ROGERS

An international team of researchers has devised a way to embed tiny light emitters and light sensors into stretchable, bendable, twistable sheets. The flexible systems might someday find use as implanted sensors to keep tabs on biological processes.

Many approaches to developing flexible electronics have targeted a class of light emitters known as organic LEDs, which can be assembled using electrically conductive polymers and deposited on bendable plastic substrates. Conventional, inorganic LEDs are a more mature technology, with their own distinct advantages, but they are generally tethered to semiconductor wafers that limit their elasticity.

Now researchers have bridged the gap between organic and inorganic LEDs by harnessing the light of conventional electronics in an elastic system with biomedical potential. "The applications we're interested in mostly include interfaces with the human body," says John Rogers, a materials scientist at the University of Illinois at Urbana–Champaign and a co-author of a paper published online October 17 in *Nature Materials* describing the advance. For some biological applications, he adds, a conventional LED's brightness, reliable operation and suitability for waterproof implementation make it a more attractive option than an organic LED. (*Scientific American* is part of Nature Publishing Group.)

Rogers and his colleagues printed an interlaced array of tiny light-emitting diodes, or LEDs, on a rigid wafer, then dissolved the top layer of the substrate to release a thin network of LEDs that can be transferred to a flexible, waterproof polymer sheet. "We can lift off from the wafer just the active layers," Rogers says, describing the process as a rubber stamp that picks up the LED array as if it were solid ink. Each LED is just 100 microns across (about the width of a human hair) and 2.5 microns thick—a micron is one millionth of a meter—and is connected to its neighbors by serpentine strands that can accommodate the deformation of stretching and twisting.

As a demonstration of the technology the researchers put LED arrays through any number of experimental implementations. They deposited LEDs on aluminum foil, the leaf of a tree, and a sheet of paper; they wrapped arrays around nylon thread and tied it in a knot; and they distended LED arrays by inflating the polymer substrate or stretching it over the tip of a pencil or the head of a cotton swab. "Eventually the students just got tired" of devising new tests for the light-emitting sheets, Rogers says. "There was nothing that we tried that we couldn't do."

The researchers also integrated light sensors alongside the LEDs and embedded the assembly in the fingertip of a vinyl glove. As the glove drew closer to a surface, the light sensors registered progressively more reflected light from the LEDs, producing a sort of proximity sensor that could be used to guide a surgeon's hand during a procedure or to form an artificial sensory system for robots.

But ultimately the use of LED arrays may be most attractive for implantable biomedical devices. "You can build systems that very naturally integrate with the tissues of the human body, because these systems are flexible and soft," Rogers says. Optical, spectroscopic measurements of tissue could alert physicians to the presence and location of infections after a surgical procedure. "Photoactivated drug delivery is another area that we think LEDs could be useful," he adds. As a demonstration, the researchers built light-emitting sutures and an implantable sheet of LEDs that they tested in vivo with an anesthetized laboratory mouse. (The mouse was later euthanized.)

A researcher in biomedical engineering whose company has collaborated with the researchers sees promise if not immediately clear-cut uses for the deformable electronic arrays. "We like flexible electronics," says Georgios Bertos, a senior R&D principal engineer at Baxter Healthcare Corporation. But this is new technology, he adds, "and I don't think the applications have emerged yet." Bertos says that systems based on the new research are probably five to 10 years from implementation.

"I think we're going to collaborate more" with Rogers's group to make the technology more market-specific, Bertos says. He notes that the practicality of the devices will rest on tailoring them to uses in which implantability conveys enough of an advantage over traditional external devices to justify the added cost and complication. "You have to find the application where you can't live without having it integrated in the body," he says. "Otherwise it's just another sexy technology, which is cool but maybe is not needed for that particular application."

Share this: StumbleUpon Digg Reddit

Ads by Google

Prototype PCB Assembly

24hr Full-service, IPC Class 2 & 3 New customer discount

www.screamingcircuits.com

Filed under BIOTECHNOLOGY, Flexible electronics, Implantable electronics, Implants

← MSNBC Video: Doctor claims cell phones can damage health

Leave a Reply

Your email address will not be published. Required fields are marked *

Name *

Email *

Website

Comment

You may use these HTML tags and attributes: `<a href="" title=""> <abbr title=""> <acronym title=""> <b> <blockquote cite=""> <cite> <code> <pre> <del datetime=""> <em> <i> <q cite=""> <strike> <strong>`

Post Comment

☐ Notify me of follow-up comments via email.

☐ Notify me of site updates

- ## Search

  Type and press enter

- ## Quick Navigation

  - Biotechnology
  - Brain & Neuroscience
  - Civilization
  - Climate Change
  - Evolution
  - Genetics
  - Health
  - Human Origins
  - Life in the Universe
  - Psychology
  - Scientific Discoveries
  - Sun Activity
  - Technologies
  - Tsunami, Earthquakes

- ## Categories

  Select Category

- ## Archives

  Select Month

- ## Email Subscription

  Enter your email address to subscribe to this blog and receive notifications of new posts by email.

  Sign me up!

- ## Blog Stats

  - 14,523 hits

- ## Links

  - Admin Login

- ## Pages

  - Astrobiology News Links

- Climate Change Links
- Evolution & Genetics Links
- Neuroscience links
- Science Links
- Space News Links

Paperpunch Theme by The Theme Foundry. Blog at WordPress.com.