LEMELSON-MIT
Celebrating innovation, inspiring youth

2011 Winner of the $500,000 Lemelson-MIT Prize
Dr. John A. Rogers

Flexible, Biointegrated Electronics

Realizing a need for healthcare tools that can better integrate with the human body, Rogers developed an innovative form of electronics, referred to as biointegrated. Transforming traditional technologies based on rigid and brittle silicon wafers, Rogers engineers the mechanical characteristics to allow the circuits to be bent, twisted, folded and stretched like a piece of latex. In these systems, thin silicon is bonded with a rubber substrate, creating an accordion-like structure that can expand and contract without fracturing. These qualities allow the devices to conform to the curvatures of internal organs, giving medical professionals the ability to map electrical activity with unprecedented spatial and temporal resolution. This new approach is aiding in procedures designed to treat cardiac and neurological problems.

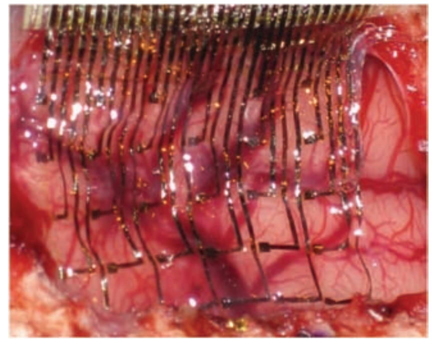
Figure 1. Stretchable electronics wrapped onto the surface of the brain.

In cardiology, the stretchable electronics can be mounted onto the elastic surface of a balloon catheter and inserted into the heart to map the electrical properties of cardiac tissue. The direct contact can assist surgeons in non-invasively identifying abnormalities in the heart that cause arrhythmias and then eliminate their cause.

In neurology, Rogers applies a substrate made of bioresorbable and dissolvable materials with thin sheets of silicon to address the folds and other curved features of the human brain. Once the device is mounted onto the surface of the brain, using a saline solution, surgeons are able to wash away the backing enabling the electronics to drop down into the crevices of the brain. This intimate contact can then be used to locate regions of the brain responsible for epileptic seizures with unparalleled temporal and spatial resolution. In 2008 Rogers launched the company mc10 to pursue commercialization of these technologies for the medical, military and consumer markets.

Electronic Eye Cameras


Figure 2. Electronic 'eyeball camera', consisting of a hemispherical photodetector array integrated with a simple imaging lens.

Applying his passion for biology-inspired electronics, Rogers developed an electronic eye camera, bringing new engineering design options to digital cameras. Configured with arrays of photodetectors – or sensors of light – on a hemispherical surface similar in size and shape to the human eye, Rogers' camera is able to achieve a wide-angle field view with low aberrations and uniform illumination. An alternative to conventional digital camera technology, the electronic eye cameras can be used where the size, cost or weight of a typical lens system would otherwise restrict application possibilities. Currently Rogers is pursuing commercial opportunities for this innovation through MC10 with industrial partners, initially in night-vision systems.

Microconcentrator Photovoltaics

Building from his work on stretchable electronics, combined with an interest in finding a better solution to the world's energy crisis, Rogers developed a photovoltaic module technology for the direct translation of sunlight into electrical energy. This process yields greater conversion efficiencies than any other existing or anticipated practical technology. Rogers' solar power innovation involves high-performance semiconductors in microscale form spread out in a low aerial coverage on a plate of glass with tiny ball lens optics mounted on top of each to tightly focus incident sunlight onto the cells. When wired together, electrical power can be generated at exceptionally high efficiencies, cost effectively. The technology is well suited for deployment at large scales for real-world utility power generation. Cost models indicate the technology could become cost-competitive with coal within five years. Rogers is pursuing commercialization of his photovoltaic module technology through Semprius, a company he co-founded in 2006.

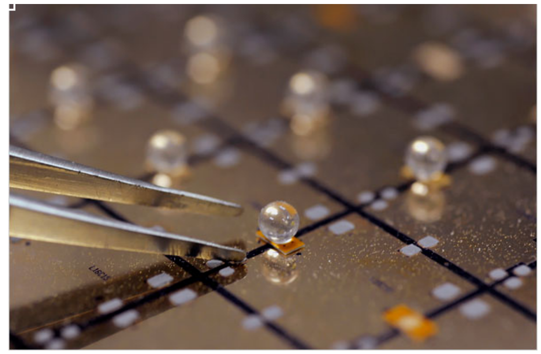

Figure 3. Spherical glass lenses focus sunlight onto a collection of tiny solar cells