

## Make Way for "Electroceuticals"

John Rogers, Ph.D., at the University of Illinois, is working on a biodegradable battery that could eventually lead to a new kind of implantable drug-delivery device.



Dr. John Rogers

Imagine a programmable drug-delivery system controlled by radio signals that can release medication at the disease site — and then is able to dissolve in the body, avoiding the need for additional surgery to remove the device.

### Bioelectronics and GSK

One company interested in the field of electroceuticals is GlaxoSmithKline. Bioelectronic medicine is a field where nano-scale devices connect to groups of individual nerve fibers and change patterns of electrical signals to restore health to organs and biological functions. Company visionaries believe that one day, bioelectronic medicines could potentially coax insulin from cells to treat diabetes, regulate food intake to treat obesity, and correct balances in smooth muscle tone to treat hypertension and pulmonary diseases.

GSK is offering a \$1 million prize to stimulate innovation in the field, as well as funding up to 20 projects working in external laboratories. The company also has created a \$50 million strategic venture capital fund to invest in companies researching bioelectronic medicines and technologies.

Action Potential Venture Capital (APVC) focuses investments in three areas: new start-up companies that aim to pursue the vision of bioelectronic medicines; existing companies with technologies that are interacting with the peripheral nervous system through first-generation devices that can stimulate or block electrical impulses; and companies advancing technology platforms that will underpin these treatment methods.

John Rogers, Ph.D., at the University of Illinois, is working on a biodegradable battery that could power such a delivery system. Unlike typical batteries that use toxic materials to create electrical current and a stainless-steel casing, Dr. Rogers' battery creates electrical current using thin sheets of magnesium and iron encased in a biodegradable plastic polymer.

The metal foils are used with a water-based electrolyte that generates an electro-chemical current in the cell. This is coupled with a water-salt solution and a biodegradable polymer that, over

time, dissolves in fluids or water. Dr. Rogers has created a model that is able to power an LED light. The battery has not yet been tested in animal models — testing in mice will begin later this year — but he says each component of the battery has been studied separately for biocompatibility.

"We see utility of this battery in a couple of contexts," he says. "One is in use as a power supply for biomedical devices that can go in the body and perform monitoring or therapeutic function for a finite time frame, such as a wound healing process or drug delivery. Over longer periods of time, when the device is no longer used, it will be resorbed into the body."

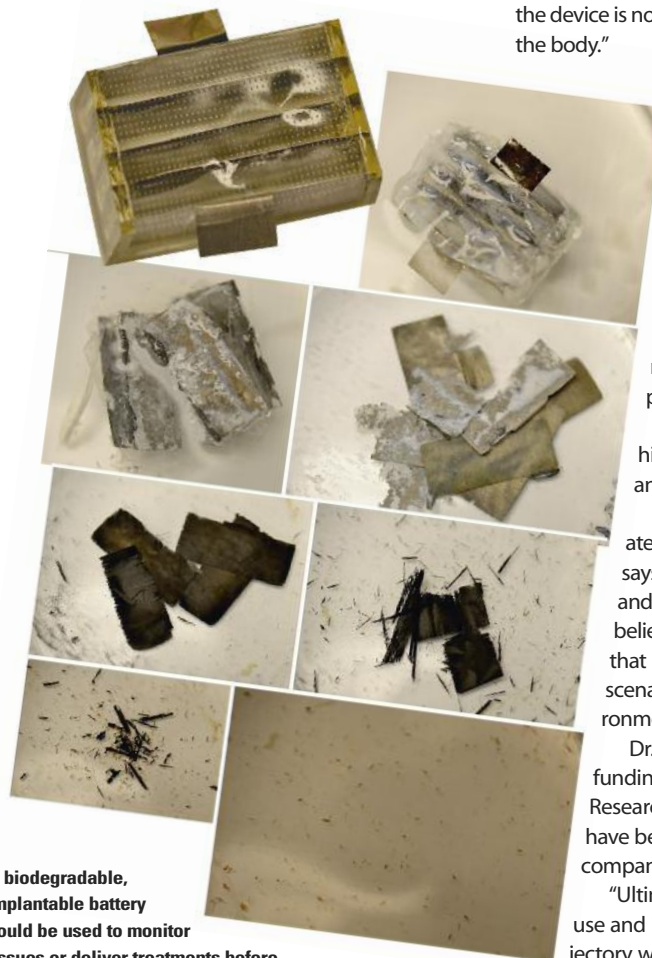
Dr. Rogers says his research will look at this technology to power a programmable drug-release system that could open "trap doors" on reservoirs for dispensing therapeutics. This, however, requires a power source and a wireless interface to control the drug release. This platform technology could also be used for nerve stimulation, to monitor temperature, and sensing stress on cells.

Dr. Rogers also sees potential for his battery in powering electronics and other devices that use LEDs.

"There is a waste stream associated with electronics and batteries," he says. "Batteries are often used one time and are thrown away. In this context, we believe there could be value in a battery that has the capacity to be used in this scenario and then dissolves into the environment in a benign fashion."

Dr. Rogers and his team have received funding from the U.S. Defense Advanced Research Projects Agency (DARPA) and have been in discussions with life-sciences companies for medical applications.

"Ultimately, we want to see it in clinical use and in humans," he says. "This is the trajectory we are on. We are open to talking to potential partners." **PV**



A biodegradable, implantable battery could be used to monitor tissues or deliver treatments before being reabsorbed by the body.