RELATED WEB SITES

* Babak Ziaie

* IEEE MEMS 2009 conference

SHARE

January 22, 2009

New stretchable electrodes created to study stresses on cardiac cells

WEST LAFAYETTE, Ind. - Engineers at Purdue and Stanford universities have created stretchable electrodes to study how cardiac muscle cells, neurons and other cells react to mechanical stresses from heart attacks, traumatic brain injuries and other diseases.

"Stretchable" electrode
Download photo
caption below

The devices are made by injecting a liquid alloy made of indium and gallium into thin microchannels between two sheets of a plastic polymer, said Babak Ziaie, a Purdue associate professor of electrical and computer engineering.

Cell cultures are grown on top of the new "stretchable cell culture platform."

"We designed a simple and cost-effective process for fabricating these stretchable platforms," said Ziaie, who is working with Beth L. Pruitt, an assistant professor of mechanical engineering at Stanford, along with graduate students and other researchers at both universities. "What's special about this technology is that it allows you to electrically stimulate or monitor the cell population using electrodes while you are applying stress to the cells."

Stretching the cell cultures causes mechanical stresses like those exerted on tissues during heart attacks and traumatic brain injuries. The researchers have grown mice cardiac muscle cells on the platform and may grow cell cultures of neurons in future work. Cultures of stem cells also could be tested using the system to determine how mechanical stresses prompt the cells to differentiate into specific types of tissues, Ziaie said.

"You cannot stretch solid metal beyond a few percent because it will break, but we've been able to stretch these liquid platforms more than 40 percent of their original size," Ziaie said.

Findings are detailed in a paper being presented Monday (Jan. 26) during the 22nd IEEE International Conference on Micro Electro Mechanical Systems. The conference, sponsored by the Institute of Electrical and Electronics

Engineers, will be in Sorrento, Italy.

"We demonstrated that the platform is biocompatible with human aortic muscle cells and mice heart cells," Ziaie said. "The cells adhered well to the polymer surface during mechanical strain and survived near and on the electrodes after two days of incubation. The platform also maintained its electrical capabilities after being stretched 100 times."

Purdue researchers designed and fabricated the platform at the Birck Nanotechnology Center in Purdue's Discovery Park. Stanford researchers grew cardiac muscle cell cultures on the device and tested the platform.

"We now hold the record for how much you can stretch an electrical conductor," Ziaie said.

The paper was written by Purdue electrical and computer engineering doctoral student Pinghung Wei, Stanford mechanical engineering doctoral student Rebecca Taylor, Purdue physics doctoral student Zhenwen Ding, Stanford mechanical engineering graduate student Gadryn Higgs, Stanford pediatrics postdoctoral research fellow James J. Norman, Pruitt and Ziaie.

Writer: Emil Venere, (765) 494-4709, venere@purdue.edu

Sources: Babak Ziaie, (765) 494-0725, bziaie@purdue.edu

Beth L. Pruitt, (650) 723-4559, pruitt@stanford.edu

Purdue News Service: (765) 494-2096; purduenews@purdue.edu

Note to Journalists: An electronic copy of the research paper is available from Emil Venere, (765) 494-4709, venere@purdue.edu

PHOTO CAPTION:
Babak Ziaie, a Purdue associate professor of electrical and computer engineering, demonstrates a new "stretchable" electrode created in research with Stanford University to study how cardiac muscle cells, neurons and other cells react to mechanical stresses from heart attacks, traumatic brain injuries and other diseases. The devices are made by injecting a liquid alloy made of indium and gallium into thin microchannels between two sheets of a plastic polymer. (Purdue News Service photo/Andrew Hancock)

A publication-quality photo is available at http://news.uns.purdue.edu/images/+2009/ziaie-electrode.jpg

---

ABSTRACT

A Stretchable Cell Culture Platform with Embedded Electrode Array

P. Wei 1, 2, R. Taylor4, Z. Din 2,3, G. Higgs4, J.J. Norman4,5 , B.L. Pruitt4, B. Ziaie 1,2

1School of Electrical and Computer Engineering; 2Birck Nanotechnology Center; 3 Department of Physics, Purdue University; 4Department of Mechanical Engineering, Stanford University; 5Department of Pediatric Cardiology, Stanford Medical School

In this paper, we present a stretchable electrode array for

studying cell behavior subjected to mechanical strain. The electrode array consists of four gold nail-head pins (250µm tip diameter and 1.75mm spacing) inserted into a polydimethylsiloxane (PDMS) platform (25.4x25.4mm2). Fusible indium alloy (liquid at room temperature) filled microchannels are used to connect the electrodes to the outside, thus providing the required stretchability. The electrode platform is biocompatible and can withstand strains of up to 40%. We tested these electrodes by repeatedly (100 times) subjecting them to 35% strain and did not notice any failure. We also successfully cultured mice cardiomyocytes onto the platform and performed electrical pacing.

To the News Service home page