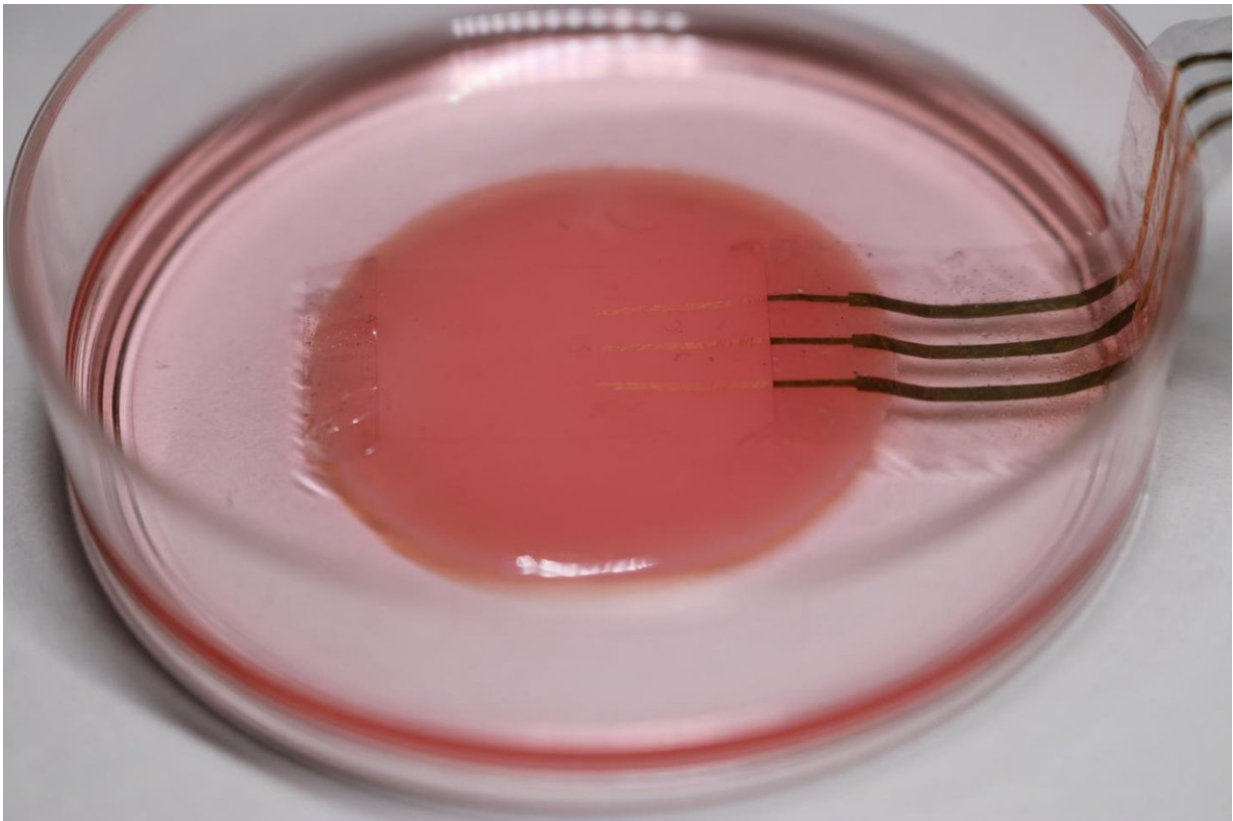


Engineers create delicate sensor to monitor heart cells with minimal disruption

January 2 2019



The layer of cardiomyocytes is only a few tens of micrometers thick and contracts with a force of just a few millinewtons. Credit: 2018 Someya Group.

For the first time, engineers have demonstrated an electronic device to monitor beating heart cells without affecting their behavior. A

collaboration between the University of Tokyo, Tokyo Women's Medical University and RIKEN in Japan produced a functional sample of heart cells with a soft nanomesh sensor in direct contact with the tissue. This device could aid study of other cells, organs and medicines. It also paves the way for future embedded medical devices.

One way or another, cardiac research is fundamentally important everyone. Sunghoon Lee, a researcher in Professor Takao Someya's group at the University of Tokyo, came up with the idea for an ultrasoft electronic sensor that could monitor functioning cells, and his team jumped at the chance to use this sensor to study [heart cells](#), or cardiomyocytes, as they beat.

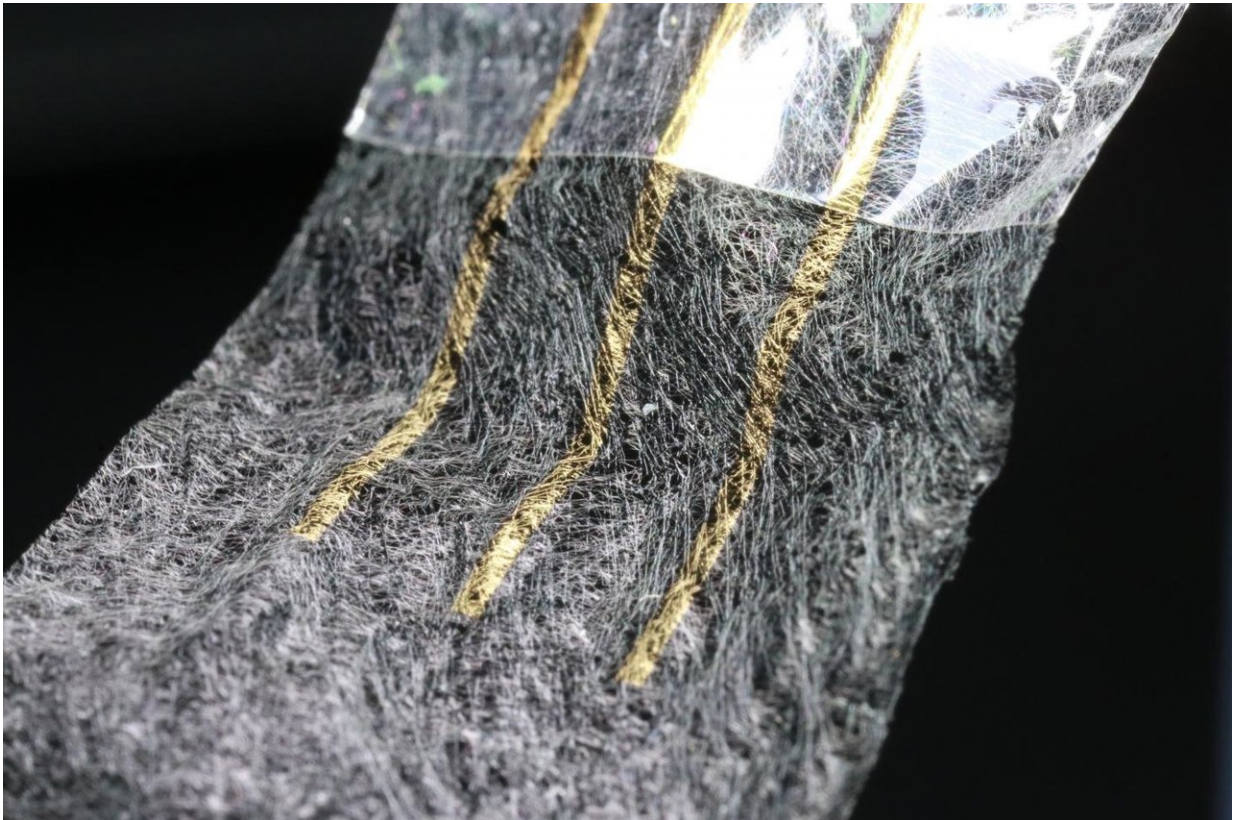
"When researchers study cardiomyocytes in action, they culture them on hard petri dishes and attach rigid sensor probes. These impede the cells' natural tendency to move as the sample beats, so observations do not reflect reality well," said Lee. "Our nanomesh sensor frees researchers to study cardiomyocytes and other [cell cultures](#) in a way more faithful to how they are in nature. The key is to use the sensor in conjunction with a flexible substrate, or base, for the cells to grow on."

For this research, collaborators from Tokyo Women's Medical University supplied a healthy culture of cardiomyocytes derived from human stem cells. The base for the culture was a very soft material called fibrin gel. Lee placed the nanomesh sensor on top of the cell culture in a complex process, which involved removing and adding liquid medium at the proper times. This was important to correctly orient the nanomesh sensor.

"The fine mesh sensor is difficult to place perfectly. This reflects the delicate touch necessary to fabricate it in the first place," continued Lee. "The polyurethane strands which underlie the entire mesh sensor are 10 times thinner than a human hair. It took a lot of practice and pushed my

patience to its limit, but eventually I made some working prototypes."

To make the [sensors](#), first a process called electro-spinning extrudes ultrafine polyurethane strands into a flat sheet, similar to how some 3-D printers work. This spiderweb-like sheet is then coated in parylene, a type of plastic, to strengthen it. The parylene on certain sections of the mesh is removed by a dry etching process with a stencil. Gold is then applied to these areas to make the sensor probes and communication wires. Additional parylene isolates the probes so their signals do not interfere with one another.



The sensor probes are formed by a 100 nanometer thick layer of gold as it is resilient and does not interfere with cell chemistry. Credit: © 2018 Someya Group.

With three probes, the sensor reads voltage present at three locations. The readout appears familiar to anyone who's watched a hospital drama, as it's essentially a cardiogram. Thanks to the multiple probes, researchers can see propagation of signals, which result from and trigger the [cells](#) to beat. These signals are known as an action or field potential, and are extremely important when assessing the effect of drugs on the heart.

"Drug samples need to get to the cell sample and a solid sensor would either poorly distribute the drug or prevent it reaching the sample altogether. So the porous nature of the nanomesh sensor was intentional, and a driving force behind the whole idea," said Lee. "Whether it's for drug research, heart monitors or to reduce animal testing, I can't wait to see this device produced and used in the field. I still get a powerful feeling when I see the close-up images of those golden threads."

More information: Sunghoon Lee et al, Ultrasoft electronics to monitor dynamically pulsing cardiomyocytes, *Nature Nanotechnology* (2018). [DOI: 10.1038/s41565-018-0331-8](https://doi.org/10.1038/s41565-018-0331-8)

Provided by University of Tokyo

Citation: Engineers create delicate sensor to monitor heart cells with minimal disruption (2019, January 2) retrieved 28 April 2024 from <https://medicalxpress.com/news/2019-01-delicate-sensor-heart-cells-minimal.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--