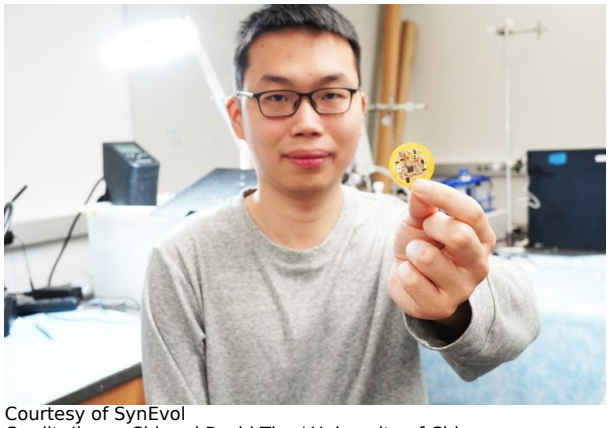
Researchers Create "Living Bioelectronics" Capable of Skin Repair

Posted by Okachinepa 06/10/2024



Courtesy of SynEvol
Credit: Jiuyun Shi and Bozhi Tian/ University of Chicago

The goal of Professor Bozhi Tian's lab has been to combine the soft, flexible, and delicate characteristics of the human body with the usually bulky, metallic, and stiff world of electronics for a long time. They have developed a prototype for "living bioelectronics," a hybrid of gel, electronics, and living cells that can interact with living tissue, as a result of their most recent research.

The patches consist of bacterial cells, starch and gelatin gel, and sensors. In tests on mice, the gadgets were able to continuously track and enhance symptoms similar to psoriasis without causing skin irritation.

The co-first author of the study and a former PhD student in Tian's lab, Jiuyun Shi, remarked, "This is a bridge from traditional bioelectronics, which incorporates living cells as part of the therapy" (now with Stanford University).

Having worked on it for a decade and a half, we're quite excited, Tian said.

It is the goal of the researchers that these concepts can be extended to other areas of the body, such cerebral or cardiovascular stimulation.

Connecting technology to the human body has never been easy. Even though gadgets like pacemakers have saved many lives, they do have certain disadvantages. For example, electronics can irritate people and are often heavy and inflexible.

However, the focus of Tian's group is on understanding the basic principles underlying the interactions between artificial materials and biological cells and tissue. One example of their prior work is a small pacemaker that can be operated by light, robust, and flexible materials that may eventually be used to create bone implants. This study employed a novel methodology. Bioelectronics often comprises of the electronics themselves combined with a soft covering to reduce its irritability to the human body.

However, Tian's team questioned whether they could incorporate living cells as a third component to offer additional capabilities. The researchers was fascinated by the ability of some bacteria, such S. epidermidis, which is a naturally occurring microorganism on human skin and has been demonstrated to reduce inflammation, to have healing qualities.

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They developed a three-component gadget. The framework is a flexible, thin, sensor-equipped electronic circuit. It is covered in a remarkably soft gel made of tapioca starch and gelatin that resembles tissue itself. Lastly, the gel contains S. epidermidis bacteria. The microorganisms on the gadget release substances that lessen inflammation while the sensor senses signals from the skin, such as humidity and temperature.

There was a noticeable decrease in symptoms in experiments conducted on mice predisposed to skin disorders similar to psoriasis.

The system, which the researchers refer to as the ABLE platform, for Active Biointegrated Living Electronics, was tested for a week, but they anticipate that it will be useful for at least six months. They claimed that the device could be simply rehydrated when needed and freeze-dried for storage, making the treatment more practical.

According to Saehyun Kim, a current PhD student in Tian's lab and another co-first author of the article, "it's like a living drug—you don't have to refill it" because bacteria are the source of the therapeutic effects.

Apart from managing psoriasis, the researchers foresee envision using patches to expedite the healing of wounds in individuals with diabetes.

They also intend to apply the method to different cell and tissue types. "Is it possible, for instance, to develop a gadget that produces insulin or communicates with neurons?" asked Tian. "There are a lot of possible uses."

Tian stated that he has had this objective since he started experimenting with "cyborg tissues" approximately 15 years ago while working as a postdoctoral researcher.

"We've learned so much about the fundamental questions since then, which allows us to make this leap," he added, referring to the chemistry and physics of hydrogels and the interfaces between cells and materials. "Watching it come to pass has been amazing."

Shi remarked, "I've always been passionate about pushing the limits of what science can achieve." "I hope that the next generation of electronic designs will be inspired by our work."
