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PRESS RELEASE

Source: Toyohashi University of Technology, Japan, Committee for Public Relations

Title: Super small needle technology for brain

Subtitle: Dissolvable material expands opportunities of flexible microneedles for brain penetrations

Full text:
Microscale needle-electrode array technology has been enhancing brain sciences and engineering such as electrophysiological studies, drug and chemical delivery systems, and optogenetic applications.

However, one challenge is reducing the tissue/neuron damage associated with needle penetration, particularly for chronic studies and future medical applications. A way to solve the issue is to use microscale diameter needles (e.g., < 5 μm) along with a flexible property, but such physically poor needles cannot penetrate into the brain and other biological tissues due to needle buckling or fracturing before penetration.

Now, a research team at Department of Electrical and Electronic Information Engineering and Electronics-Inspired Interdisciplinary Research Institute (EIIRIS) at Toyohashi University of Technology develop a methodology to temporarily enhance the stiffness of the long, high-aspect-ratio flexible microneedle (e.g., < 5 μm in diameter and > 500 μm in length), without affecting the needle diameter and flexibility in a tissue. The approach is realized by embedding a needle base in a film scaffold, which dissolves upon contact with a biological tissue. Here silk fibroin is used as the dissolvable film because it has a high biocompatibility and is known as a biomaterial used in bio-implantable devices.

"We investigated how to prepare the silk base scaffold for microneedle, quantitative analysis of the needle stiffness, and the penetration capability using mouse brain in vitro/in vivo. In addition, as an actual needle application, we demonstrated particle depth injection into the brain in vivo", explained the first author Master student Satoshi Yagi and PhD candidate Shota Yamagiwa.

The leader of the research team, Associate Professor Takeshi Kawano said "Preparation of the dissolvable base scaffold is very simple, but this methodology promises powerful tissue penetrations of numerous high-aspect-ratio flexible microneedles, including recording/stimulation electrodes, glass pipettes, and optogenetic fibers." He also added, "This way has potential to reduce the invasiveness and provide safer tissue penetration than conventional approaches."

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Satoshi Yagi, Shota Yamagiwa, Yoshihiro Kubota, Hirohito Sawahata, Rika Numano, Tatsuya Imashioya, Hideo Oi, Makoto Ishida, and Takeshi Kawano (2015). Dissolvable base scaffolds allow tissue penetration of high-aspect-ratio flexible microneedles, Advanced Healthcare Materials, Article first published online: 2 AUG 2015 | DOI: 10.1002/adhm.201500305

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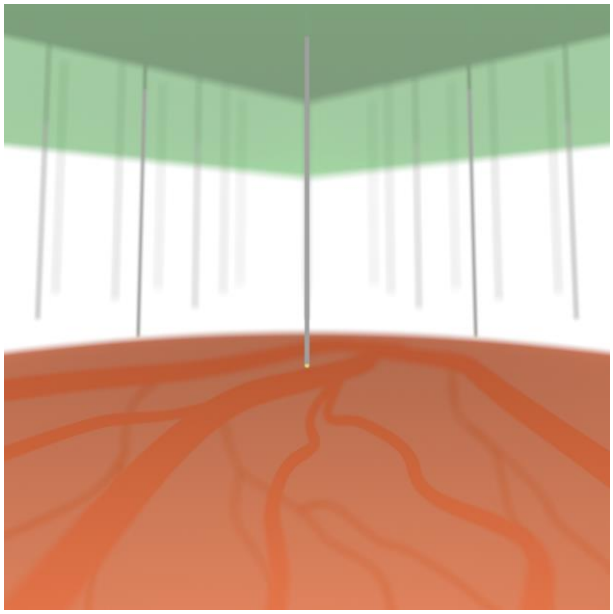

Figure 1:
Flexible high-aspect-ratio microneedles penetrate a brain tissue

Keywords:
NANOTECHNOLOGY/MICROMACHINES, TECHNOLOGY/ENGINEERING/COMPUTER SCIENCE