First electronic skin with a mesh structure for long-term attachment with no discomfort

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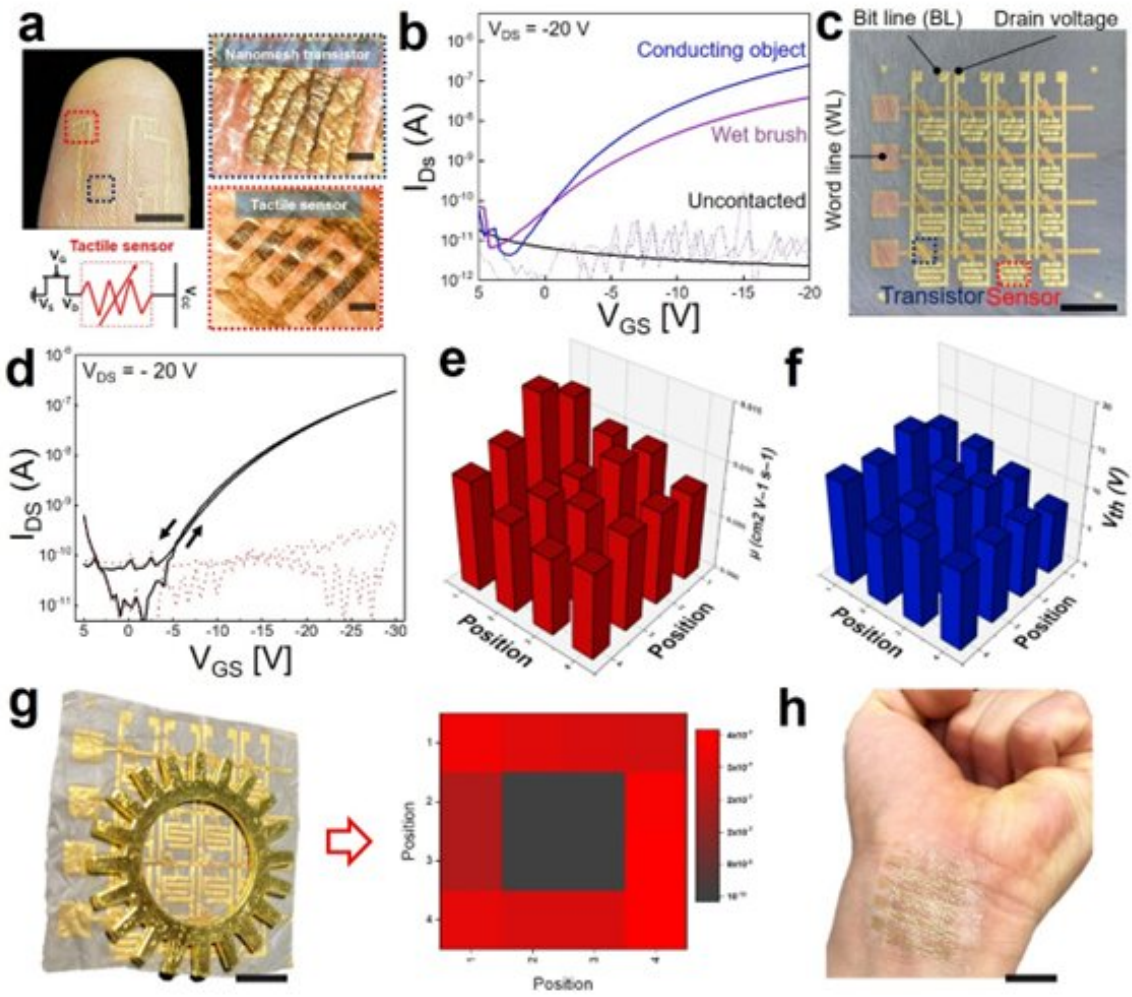

Credit: DGIST (Daegu Gyeongbuk Institute of Science and Technology)

A research team led by Professor Lee Sungwon from DGIST succeeded in developing the world's first nanomesh-structured electronic skin device (organic field-effect transistor). This electronic skin device, comprising only a nanomesh structure that can measure and process bio-signals for a prolonged period, is a big step toward integrated systems for electronic skin devices.

The research team, led by professor Lee Sungwon from the Department of physics and chemistry at DGIST, succeeded in developing the world's first ultrathin and breathable nanomesh organic field-effect transistor (OFET) that can be applied to electronic skin devices. Nanomesh OFET, in combination with various sensors, is expected to enable direct measurement of physiological data from the skin surface and optimize data processing.

Electronic skin refers to electronic wearable devices worn on the skin to collect biosignals, such as temperature, heart rate, electromyogram, and blood pressure, and transfer the data. In response to the recent increase in interest in smart health care systems with wearable devices, related technologies are being actively developed. A soft sensor that can attach to smooth and constantly moving skin surfaces is required to accurately measure physiological signals using a real-time health care system. As a result, most electronic devices worn on the skin surface have been manufactured using substrates with flat surfaces such as plastic and rubber.

However, long-term attachment of substrate with flat surface structure and low liquid and vapor permeability to biological skin can cause unexpected diseases to occur (such as atopy, metabolic disorders, among others). Hence, it is necessary for electronic devices that come in contact with biological tissues to achieve high permeability to ensure long-term use. Accordingly, research on polymer nanofiber-based nanomesh devices with good permeability has been attracting considerable

attention.

The research team led by Lee Sungwon at DGIST developed an ultra-thin nanomesh OFET that causes almost no discomfort for the users and can be combined with various sensors. In particular, the developed OFET device showed consistent functions even when folded or curved, with almost no performance degradations, even in severe environments such as 1,000 deformations and high humidity.

Manufacturing nanomesh transistors was difficult due to the rough surface and lack of mechanical robustness and thermal and chemical stability. Professor Lee Sungwon's team solved these problems simultaneously by using a material called Parylene C as a biocompatible coating. In addition, the conventional vacuum deposition method was used for simpler processing instead of synthesizing or high-temperature processing.

Professor Lee Sungwon from the Department of physics and chemistry at DGIST said, "We have successfully developed a nanomesh organic field-effect transistor for the first time and demonstrated an integrated active-matrix tactile sensor. The development of transistors was essential for building a complex circuit, and now with the nanomesh electronic skin device, long-term measurement and processing of physiological data in real time is possible."

This research has been published in *Advanced Functional Materials*, an international journal in the field of Nanoscience and Nanotechnology.

More information: Gihyeok Gwon et al, An All-Nanofiber-Based Substrate-Less, Extremely Conformal, and Breathable Organic Field Effect Transistor for Biomedical Applications, *Advanced Functional Materials* (2022). DOI: 10.1002/adfm.202204645

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