Researchers Advance & Improve Capabilities in a Novel Sweat Sensor. **By Kathlyn Swantko**

Wearable Tech

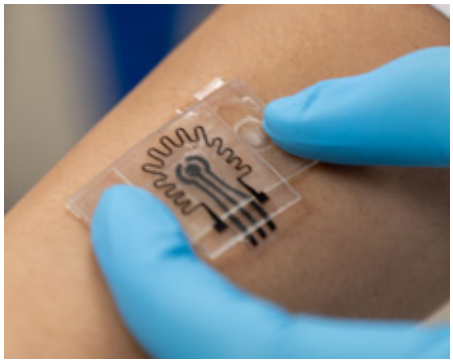
The researchers at Penn State have designed the fabrication for an innovative, flexible, wearable sweat-patch that may now out-perform and outlast the shortcomings of previous sweat sensors.

"This new low-cost, wearable platform offers convenient, accurate, and continual analysis of sweat under diverse conditions, which has great potential for both individual and population health, as well as for personalized medicine, and precision nutrition," says Larry Cheng, principal investigator on the Penn State project, and a James L. Henderson, Jr. Memorial Associate Professor of Engineering Science and Mechanics.

Penn State's initial electrochemical sensor is based on a nanocomposite-modified porous graphene superficial laser treatment that detects biomarkers, such as glucose, in the wearers' sweat. According to Cheng, sweat is ideal for real-time, as a noninvasive biomarker detection. The use of fibers could further improve the material's accuracy and analysis.

"Our laser-induced graphene (LIG) can also come in the form of fibers for increased surface area and enhanced sensitivity," explains Cheng. "It is also possible that fiber-based, laser-induced graphene substrates and encapsulation layers, in a variety of fabric constructions, will provide increased surface area and enhanced sensitivity for the wearer."

Initially, research used PEG-PDMS (polyethylene glycol-polydimethylsiloxane), due to its excellent biocompatibility, flexibility, and permeability. Cheng explains, "The integration of PEG enhances the hydrophilicity



A new wearable sensor monitors glucose levels in sweat over multiple weeks.

of PDMS, allowing efficient sweat collection and transport through microchannels, thereby improving the overall performance and reliability of the device for monitoring sweat biomarkers."

Cheng adds, "Our nanocomposite material, facilitated by laser treatment, can be conveniently performed within the domestic U.S. market. In addition, the material achieves enhanced stability and repeatability, compared to traditional nanocomposite modification methods."

Gaining Momentum

According to Cheng, LIG's are beginning to gain momentum for creating electrochemical biosensors and electrical platforms. The Penn State team enhanced a simplistic laser treatment to pattern the porous LIG electrode into a 3D network of highly conductive noble metal alloys and carbon-based nanocomposite materials, which can easily be created on the LIG electrode. This treatment not only patterns the porous LIG electrode, but also establishes a durable 3D network of highly conductive metal alloys and carbon-based nanocomposite materials.

The laser-reduced, patterned LIG nanocomposite graphene electrode material creates a highly stable sensitive platform for dual non-enzymatic glucose and pH measurements. The sensor can detect pH levels, maintaining more than 91 percent sensitivity over a 21-day period under a variety of surrounding environmental conditions. The wearable device can calibrate glucose detection, based on simultaneously measured temperature and pH levels, which can demonstrate a high potential to conveniently, accurately, and continuously analyze sweat in diverse conditions for practical use. ■

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