A health monitoring wearable that operates without a battery

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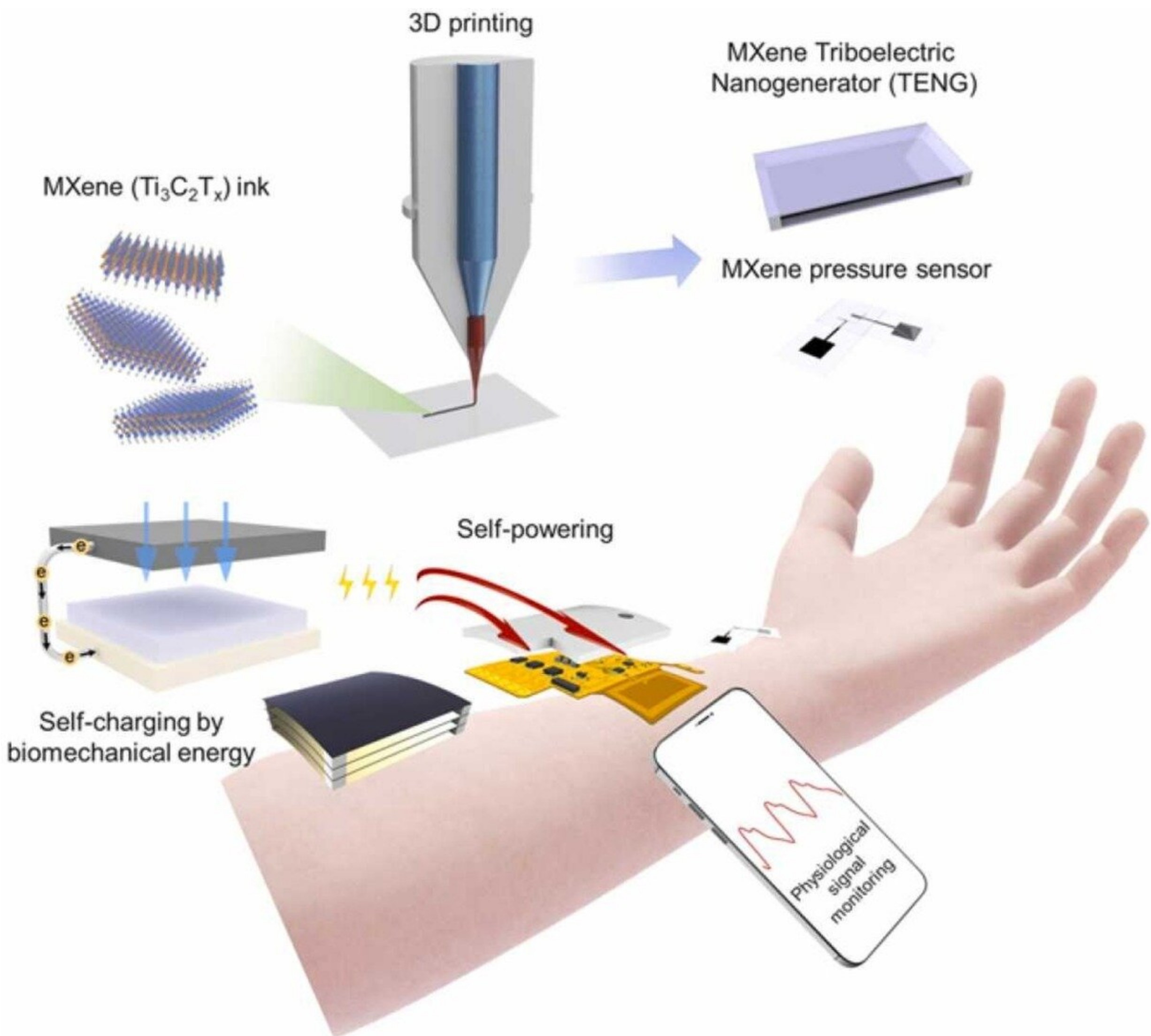

Graphical abstract. Credit: *Nano Energy* (2022). DOI: 10.1016/j.nanoen.2022.107511

A new self-powered, wristwatch-style health monitor invented by researchers at the University of California, Irvine can keep track of a wearer's pulse and wirelessly communicate with a nearby smartphone or tablet—without needing an external power source or a battery.

In a paper published recently in the journal *Nano Energy*, team members in UCI's Henry Samueli School of Engineering describe their invention, built via 3D printing of nanomaterials on flexible substrates for real-time and wireless monitoring of vital signs. The current prototype serves as a self-powered radial artery pulse monitor, but other aspects of health—such as heart rate, body temperature or blood pressure—can be gauged by simply changing the sensor circuitry, according to the paper's authors.

"Imagine you're out working in a remote location—anywhere, the desert on a mission, in mountains hiking or even a space station, for example—and you need to keep track of your health information on demand, or there's an incident, and you need to monitor someone's vital signs urgently and accurately. This self-powered and wireless device allows you to do that without relying on a battery that can lose its charge and has the thermal runaway issue [overheating of lithium-ion batteries that can lead to combustion]," said senior co-author Rahim Esfandyar-Pour, UCI assistant professor of electrical engineering and computer science and biomedical engineering.

The device delivers health information in two ways. In one mode, the energy created by tapping the wristband's nano energy generators powers up the sensor circuitry, and soon the wearer's pulse rate appears as flashing signals on an LED display. The second mode works when a smartphone or similar device is held near the wearable. Embedded near-field communication technology facilitates the wireless exchange of both power and data between the wristband and the mobile device, and biophysical information is plotted and displayed on the smartphone's screen.

The on-demand and self-powered characteristics of the invention are made possible by triboelectric nanogenerators that produce voltage through mechanical thumping or pressure. The TENGs are fabricated using titanium-based MXenes, a relatively new class of ultrathin 2D material with unique electrical and mechanical properties. Only a few atoms thick, MXene layers are bendable, are stretchable and can be printed onto the surface of flexible, bandage-like material or a wearable arm- or wristband.

"This innovation achieves many significant outcomes in one package," Esfandyar-Pour said. "It enables continuous, battery-free, wireless and on-demand health monitoring anytime and anywhere. It's made with low-cost and flexible materials and can be tailored to meet a variety of wearable bioelectronic sensors' requirements. It's a flexible, completely configurated system."

Additional authors on the paper are Prativa Das and Sang Won Lee, UCI postdoctoral scholars in electrical engineering and computer science; and UCI Ph.D. students Qian Yi, Xiaochang Pei and Huiting Qin.

More information: Qian Yi et al, A self-powered triboelectric MXene-based 3D-printed wearable physiological biosignal sensing system for on-demand, wireless, and real-time health monitoring, *Nano Energy* (2022). DOI: 10.1016/j.nanoen.2022.107511

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