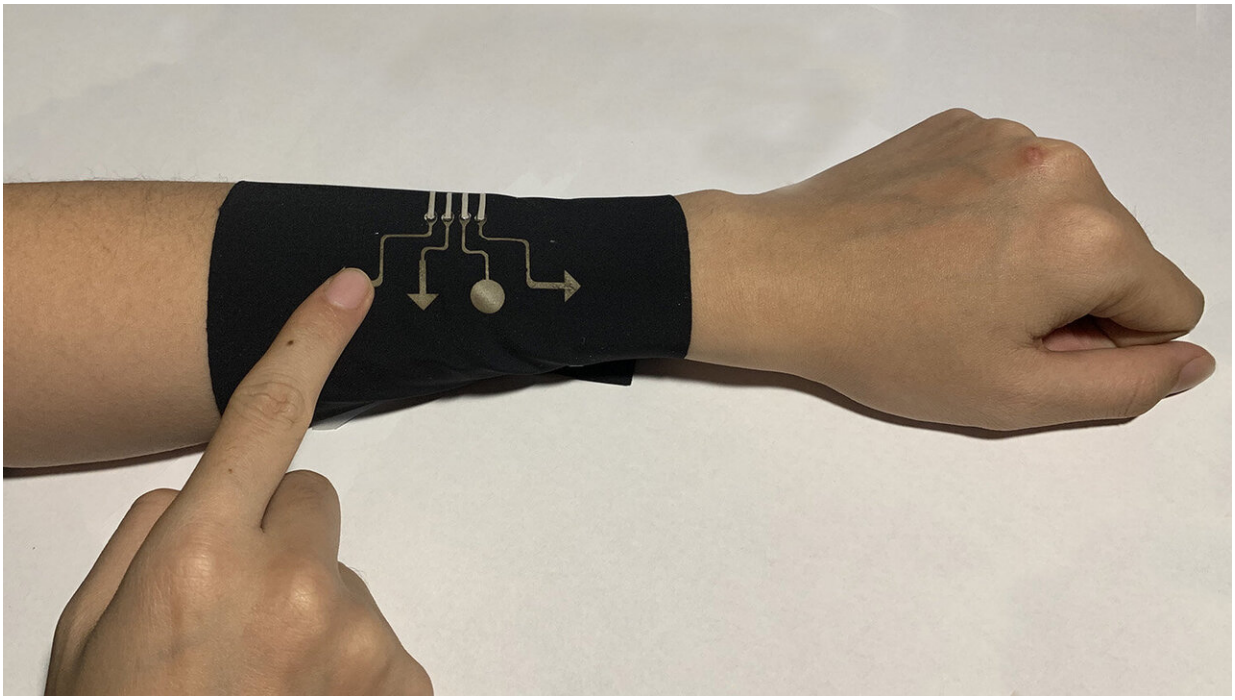
'Breathable' electronics pave the way for more functional wearable tech

April 30 2020, by Matt Shipman



This sleeve incorporates the new electronic material, allowing it to function as a video game controller. Credit: North Carolina State University

Engineering researchers have created ultrathin, stretchable electronic material that is gas permeable, allowing the material to "breathe." The material was designed specifically for use in biomedical or wearable technologies, since the gas permeability allows sweat and volatile organic compounds to evaporate away from the skin, making it more

comfortable for users—especially for long-term wear.

"The gas permeability is the big advance over earlier stretchable electronics," says Yong Zhu, co-corresponding author of a paper on the work and a professor of mechanical and aerospace engineering at North Carolina State University. "But the method we used for creating the material is also important because it's a simple process that would be easy to scale up."

Specifically, the researchers used a technique called the breath figure method to create a stretchable polymer film featuring an even distribution of holes. The film is coated by dipping it in a solution that contains silver nanowires. The researchers then heat-press the material to seal the nanowires in place.

"The resulting film shows an excellent combination of electric conductivity, optical transmittance and water-vapor permeability," Zhu says. "And because the silver nanowires are embedded just below the surface of the polymer, the material also exhibits excellent stability in the presence of sweat and after long-term wear."

"The end result is extremely thin—only a few micrometers thick," says Shanshan Yao, co-author of the paper and a former postdoctoral researcher at NC State who is now on faculty at Stony Brook University. "This allows for better contact with the skin, giving the electronics a better signal-to-noise ratio.

"And gas permeability of wearable electronics is important for more than just comfort," Yao says. "If a wearable device is not gas permeable, it can also cause skin irritation."

To demonstrate the material's potential for use in wearable electronics, the researchers developed and tested prototypes for two representative

applications.

The first prototype consisted of skin-mountable, dry electrodes for use as electrophysiologic sensors. These have multiple potential applications, such as measuring electrocardiography (ECG) and electromyography (EMG) signals.

"These sensors were able to record signals with excellent quality, on par with commercially available electrodes," Zhu says.

The second prototype demonstrated textile-integrated touch sensing for human-machine interfaces. The authors used a wearable textile sleeve integrated with the porous electrodes to play computer games such as Tetris.

"If we want to develop wearable sensors or user interfaces that can be worn for a significant period of time, we need gas-permeable electronic materials," Zhu says. "So this is a significant step forward."

The paper, "Gas-Permeable, Ultrathin, Stretchable Epidermal Electronics with Porous Electrodes," is published in the journal *ACS Nano*.

More information: Weixin Zhou et al. Gas-Permeable, Ultrathin, Stretchable Epidermal Electronics with Porous Electrodes, *ACS Nano* (2020). DOI: 10.1021/acsnano.0c00906

Provided by North Carolina State University

https://phys.org/news/2020-04-breathable-electronics-pave-functional-wearable.html