Wearable gas sensors for health and environmental monitoring

A highly sensitive wearable gas sensor for environmental and human health monitoring may soon be commercially available， according to researchers at Penn State University and Northeastern University.

The sensor device is an improvement on existing wearable sensors because it uses a self-heating mechanism that enhances sensitivity. It allows for quick recovery and reuse of the device. Other devices of this type require an external heater. In addition， other wearable sensors require an expensive and time-consuming lithography process in cleanroom conditions.

"People like to use nanomaterials for sensing because their large surface-to-volume ratio makes them highly sensitive，" said Huanyu Cheng， an assistant professor of engineering science and mechanics and materials science and engineering at Penn State." The problem is that nanomaterials are not something we can easily connect with wires to receive signals， so something called interchangeable electrodes are necessary， which are like the numbers in your hand."

Wearable gas sensors

Cheng and his team used lasers to pattern highly porous， single-wire nanomaterials similar to graphene for sensors that detect gases， biomolecules， and， in the future， chemicals. In the non-sensing portion of the device platform， the team created a series of serpentine wires and coated them with silver. When they applied a current to the silver， the gas-sensing region would heat up locally due to the significantly higher resistance， eliminating the need for a separate heater. The serpentine wire allows the device to stretch like a spring to accommodate the body curvature of the wearable sensor.

The U.S. Defense Threat Reduction Agency is interested in such wearable sensors to detect chemical and biological agents that could damage nerves or the lungs， the researchers said. A medical device company is also working with the team to scale up production for patient health monitoring， including detection of gaseous biomarkers from the human body and environmental detection of contaminants that could affect the lungs.

Ning Yi， a doctoral student in Chen's lab and co-first author of the paper published online in the Journal of Materials Chemistry A， said， "In this paper， we show that we can detect nitrogen dioxide， which is produced by vehicle emissions. We can also detect sulfur dioxide， which， along with nitrogen dioxide， causes acid rain. All of these gases could be a problem in terms of industrial safety."

The researchers say their next step is to create high-density arrays and try some ideas to improve the signal and make the sensors more selective. This could involve using machine learning to identify the unique signals of individual molecules on the platform.