

Stretchable smart sensor a promising alternative to painful blood tests

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Credit: Polina Kovaleva from Pexels

Researchers have created a flexible, wireless sensor worn on the skin which monitors the pH of the wearer's sweat in real time. Developed in the course of the EU-funded project CONTEST, the device is a stepping

stone towards eliminating invasive blood tests when monitoring chemical levels in the body.

Monitoring chronic conditions such as diabetes and kidney disease currently involves drawing blood from the patient's body. However, the substances tested in the blood such as glucose and urea are also found in sweat. "Human sweat contains much of the same physiological information that blood does, and its use in diagnostic systems has the significant advantage of not needing to break the skin in order to administer tests," says Prof. Ravinder Dahiya, one of the project's coordinators, in a Glasgow University news item. With an effective sweat monitoring sensor, painful pin-prick blood tests could therefore potentially become a thing of the past. But only if the device measuring the levels of these substances in sweat has been designed also with the user's comfort in mind.

Offering a practical alternative to the rigid materials used in current non-invasive wearable systems, the CONTEST team's pH sensor can stretch and flex to fit the contours of users' bodies and is therefore more comfortable to wear. Its features are described in a paper published in the journal *Biosensors and Bioelectronics*.

The sensor is a 1 cm² stretchable, wireless system whose pH sensing electrode is made from a novel graphite-polyurethane composite. Thanks to a pair of serpentine-shaped interconnecting pieces, the sensor can stretch up to 53 % in length and still perform well. Tests have also shown that it can withstand being stretched by 30 % up to 500 times.

The device has a quick and stable response time for sweat pH levels ranging between 5 and 9, providing results within 8 s. Moreover, substances such as sodium, potassium and glucose that are present in [sweat](#) have almost no impact on the pH sensor's performance.

The engineers' wireless sensor also has an additional advantage. While traditional wireless systems that transmit data via Bluetooth are often bulky and need to be charged often, the new sensor can transmit its data without using external power. The pH data is sent to an accompanying smartphone through a stretchable radio-frequency identification antenna, which performs well as long as the sensor is under 20 % strain. The data is transmitted continuously to a smartphone app called SenseAble, which lets users track their pH levels in [real time](#).

Having demonstrated the sensor's ability to measure pH levels, the team has now begun research to expand its diagnostic capabilities. "We're planning to add [sensors](#) capable of measuring glucose, ammonia and urea, for example, and ultimately we'd like to see a system ready for market in the next few years," says Prof. Dahiya.

CONTEST (Collaborative Network for Training in Electronic Skin Technology) trained young researchers in the design, fabrication, characterisation and use of e-skins. The project investigated ways of integrating sensors onto flexible substrates using organic and inorganic semiconducting materials. Research was also conducted on the application of e-skin in robotic and human-environment interfaces. One innovative outcome was the new use found for e-skin as a pain sensor.

More information: CONTEST project website: www.contest-itn.eu/

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