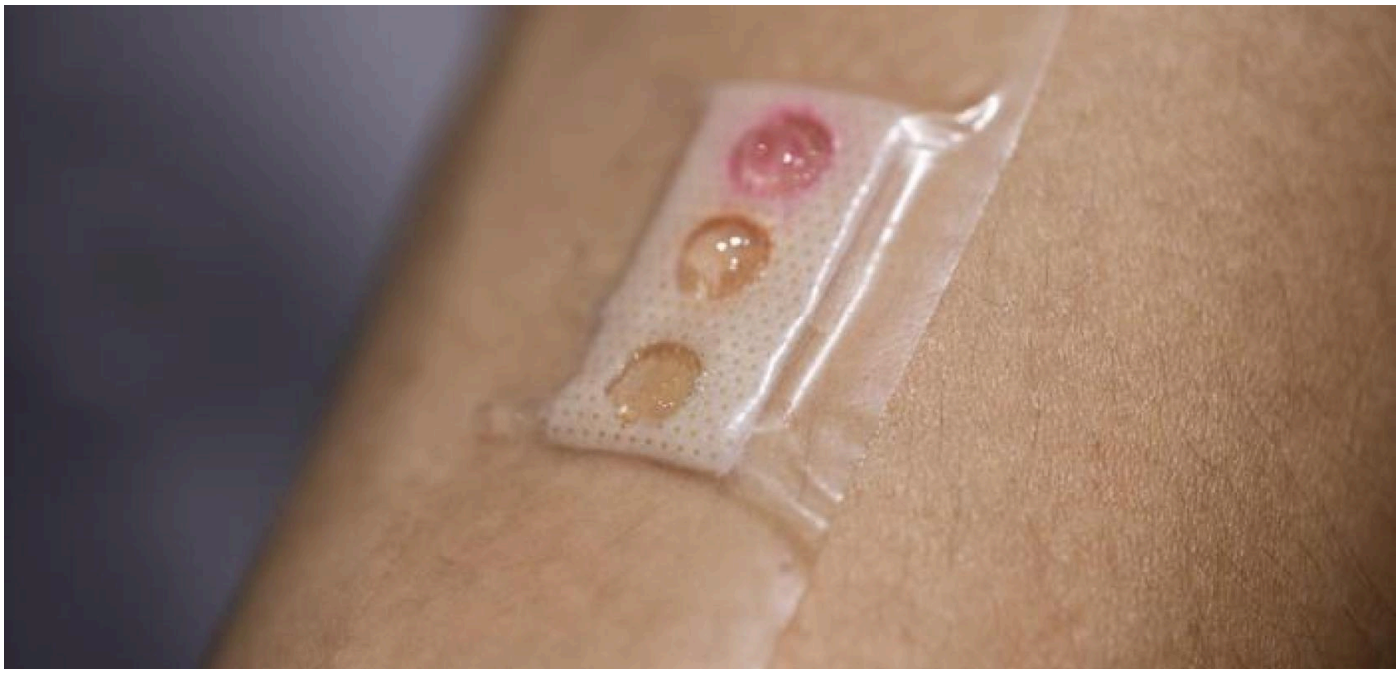
Electro Optics

Wearable microlasers read glucose levels from sweat

By James Wormald



NTU's 'smart-plaster' includes microlaser sensors embedded in liquid crystal droplets, and is customised to read three types of biomarkers, lactate, glucose and urea. Image: NTU

Users are able to self-monitor their glucose, lactate and urea levels with a painless, non-invasive wearable 'plaster' that analyses their sweat.

With constant proximity to our bodies, wearables have the ability to perform background health monitoring and biomarker detection simultaneous to other applications, and with recent developments in flexible photonics technology, such wearable devices are becoming increasingly versatile.

Mapping the body's health with sweat

Measuring the body's biomarkers – key indicators of health – through the real-time analysis of sweat, scientists from Nanyang Technological University (NTU) in Singapore have developed a wearable product similar to a plaster – or 'band-aid' – that could become a new non-invasive way to monitor one's personal health.

Human sweat contains multiple key biomarkers such as glucose, lactate and urea, that give an insight into a body's health, indicating various medical conditions. Excreted naturally from the body, sweat can also be painlessly and non-invasively monitored, collected and even analysed.

Existing biomarker collection methods

Diabetic patients, for example, are typically required to perform invasive finger prick tests to self-monitor their blood-glucose levels, inserting a strip with a small drop of blood into a portable glucose metre to obtain a reading. The alternative to this process, meanwhile, involves wearing expensive and rigid sensor-based monitoring devices attached to the skin.

In response to this difficult, expensive or cumbersome process, the team at NTU created a compact light-based sensing device that encapsulates a microlaser in liquid crystal droplets, and embedding the liquid in a soft hydrogel film. The device sits like a plaster on the skin, but provides the wearer with highly accurate biomarker readings in minutes.

"Our innovation represents a non-invasive, quick and effective way for diabetic patients to monitor their health," said Chen Yu-Cheng, assistant professor at the NTU's School of Electrical and Electronic Engineering (EEE). "By combining a microlaser with a soft hydrogel film, we have demonstrated the feasibility of a wearable laser to provide a more pleasant health monitoring experience for patients."

How sweat-reacting biomarking plasters work

The plasters are able to pick up three distinct biomarkers – lactate, glucose and urea, with liquid crystal dots of varying colour distinguishing between them. When the plaster interacts with the body's natural sweat, the concentration of each biomarkers will alter the amount of light emitted by the microlaser. By shining a light source onto the plaster, users can read their own biomarker levels when the light emitted from microlaser sensors is analysed, once it's translated via a mobile app.

Even tiny fluctuations down to 0.001mm of glucose, lactate and urea were detected by the plaster during experimentation – 100 times more sensitive than existing technologies. The NTU team believes this to be the first device of its kind, to successfully measure multiple biomarkers in sweat using a wearable sensing device. In the next stage of development, the

research team plans to fine-tune the microlaser sensors to detect a wider variety of substances in sweat.