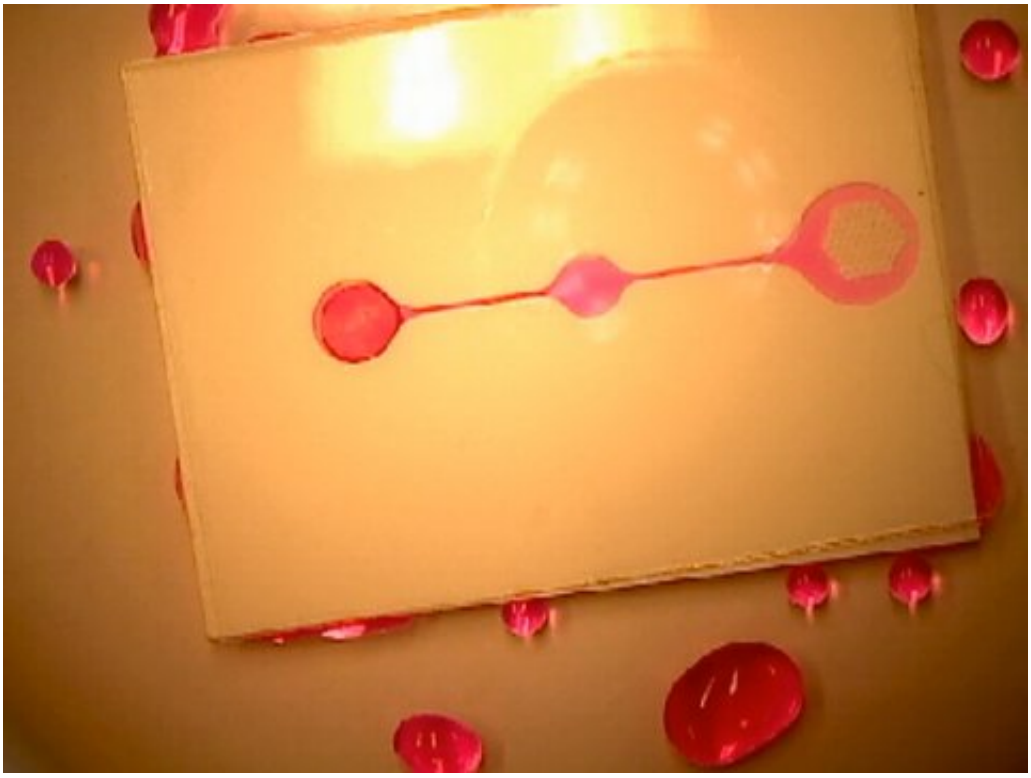
Wearable sweat sensor thanks to battery-free 'water pump' inspired by plants

April 8 2016



The device which takes in water and 'pumps' it to the other side. At the left is the intake, on the right is the porous structure through which water evaporates, which continuously drives the water flow without external power.

Plants and trees soak up water in the soil by letting it vaporize through pores in the leaves. Scientists at TU/e have now taken this principle to develop a sweat sensor through which the sweat itself flows at a steady

rate and is analyzed. Using laser micro-manufacturing, they made minuscule structures in flexible plastic and integrated a small analytic chip. Their work overcomes an important hurdle towards the development of flexible sweat sensors that can be stuck on the skin.

The substances in our sweat say much about our health, so sportsmen and women stand to gain quite a lot as do medical applications. For instance, the saline concentration in sweat can tells us about cystic fibrosis while the acidity level is a decisive factor in certain skin diseases. To be able to monitor the development of this over time, 'fresh' sweat must be constantly conducted through a sweat sensor, preferably one that has no moving or vulnerable parts and uses no power.

Doctoral student Chuan Nie and supervising professor Jaap den Toonder used nature as their source of inspiration for a sweat sensor to comply with these requirements. In the TU/e Microfab lab they made a device in flexible plastic foil with an inlet, a micro-channel and at the other end a porous structure. Using special paper at the inlet, the device soaks up the sweat. The moisture is transported by the capillary action of the channel and the vaporization via the porous structure at the other end causes a constant flow to be created, just as in trees and plants. The device works like a kind of water pump that operates without external power.

Ultimately, the researchers also integrated a microchip in the device. The electrodes of the chip are inserted onto the channel and can therefore constantly analyze the sweat that passes through the channel. Chuan Nie built a prototype that measures the acidity level and proved that it worked effectively. In the same way chips that measure other substances in the sweat can now be integrated.

The research was carried out in collaboration with Holst Centre in Eindhoven. Holst and TU/e will continue to develop the flexible sweat sensor; for example as a sports application and for the medical analysis

of sweat. The use of plastic foils will keep the final production costs low. One of the next steps will be the wireless transmission of the sensor's data.

Provided by Eindhoven University of Technology