Source: *The Straits Times,* pB8
Date: 4 January 2021

Moisture-absorbing film can get sweat off your skin faster

NUS team's creation can be used in products like armpit pads and even help power wearable devices

Cheryl Tan

Underarm pads, insoles and shoe linings that can enable faster evaporation of sweat than conventional ones could soon become a reality in Singapore.

A team of five researchers from the National University of Singapore (NUS) recently developed a new moisture-absorbing film that is able to absorb the moisture from sweat six times faster and hold 15 times more moisture than conventional materials.

The scientists also found that the film, when moist, can be tapped to generate electricity to power wearable electronic devices such as watches and fitness trackers.

The film is made mainly from two water-absorbing chemicals – cobalt chloride and ethanolamine, which are known for their high moisture absorbency rate.

As the material has a strong tendency to attract moisture, it is able to force the sweat from one's skin surface to vaporise, thus quickening the pace of natural sweat evaporation, said Assistant Professor Tan Swee Ching from NUS' Department of Material Science and Engineering, who is leader of the research team. "As the sweat evaporates from our skin a lot quicker, it absorbs heat from our skin surface, making us feel cooler especially on hot and humid days."

>100

Number of times the film can be "regenerated" and reused.

The film is also able to release water when exposed to sunlight, hence it can be "regenerated" and reused more than 100 times.

In contrast, conventional sweat pads are made mainly from materials such as zeolites and silica gels which have low water uptake, making them less efficient in moisture absorption.

In incorporating the film in shoe insoles and underarm pads, it is placed between two sheets of polytetrafluorethylene, or Teflon, commonly used in clothing for its breathability and waterproof nature.

As proof of concept, a shoe insole prototype with the film embedded was created using 3D printing.

"The material (of the shoe insole) is a mixture of soft polymer and hard polymer, thus providing sufficient support and shock absorption," said Professor Ding Jun, also from the NUS department and a member of the research team.

But the researchers' work did not end there. Discovering that electrical currents can pass through the film when it is moist, the team decided to make use of this property to generate power.

The film was first combined with a zinc foil and a copper foil, which served as the negative and positive electrodes, respectively. When the film absorbed moisture, electrons moved easily from the zinc foil to the copper foil, thereby creating an electrical current.

This film-and-foil combination thus functioned as an electrochemical cell, with each cell able to generate some 0.57 volt of electricity.

Several of these electrochemical cells can be connected together to form a power source for wearable electronic devices such watches.

To demonstrate this, eight cells were assembled together in a gadget to power an LED light. Both the gadget and LED light were attached to a T-shirt, which was then worn by a person who went for a 10-minute run. The moisture from his sweat – absorbed by the films – enabled electricity to be generated in the gadget, turning the LED light on.

Meanwhile, excessive underarm sweating can contribute to bacteria growth and cause unpleasant body odour. Accumulation of perspiration in the shoes can also lead to blisters, calluses and fungal infections, noted Prof Tan. "Using the moisture-absorbing film, the moisture from sweat is rapidly taken in, providing a dry and cool microclimate for personal comfort."

The team hopes to work with companies to incorporate the film into consumer products.

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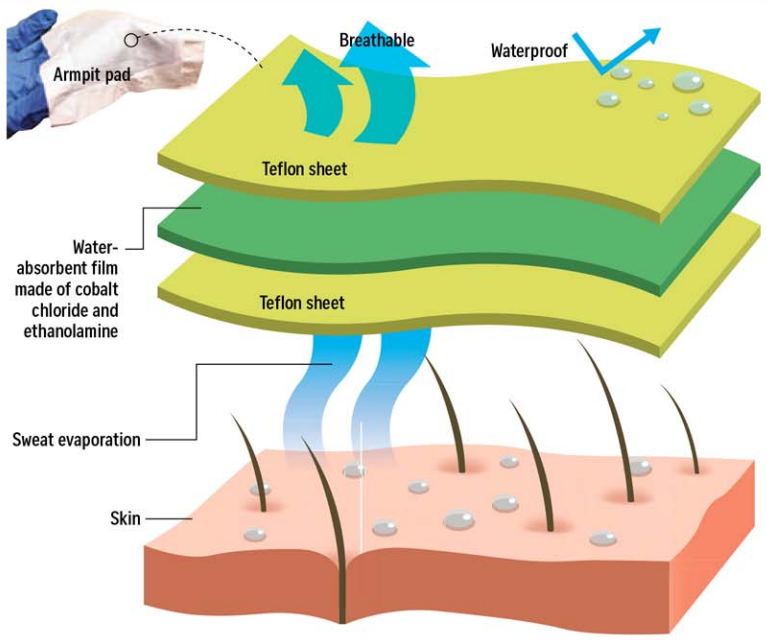
Practical applications of the film

The new film developed by researchers from the National University of Singapore is able to absorb the moisture from sweat six times faster and hold 15 times more moisture than conventional materials. Here are some of its potential uses.

IN ARMPIT PADS



With armpit pad
An armpit pad with the film is attached to the left side of a T-shirt. After 10 minutes of exercise, no sweat stain can be seen.

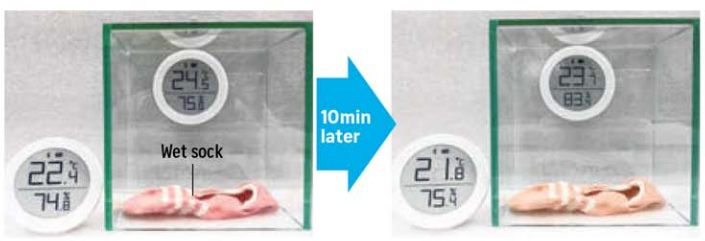
Without armpit pad
On the right side of the T-shirt where no armpit pad is attached, there is a visible sweat stain after 10 minutes of exercise.

IN SHOE INSOLES AND LININGS

For a test of effectiveness, the micro-environment of a shoe is simulated using a glass box.

Experiment with insole and armpit pads

- Armpit pads serve as shoe linings, and a 3D-printed shoe insole is placed under a wet sock, which simulates a perspiring foot.
- As the moisture from the wet sock is rapidly absorbed by the armpit pads and insole, there is no increase in relative humidity inside the glass box.



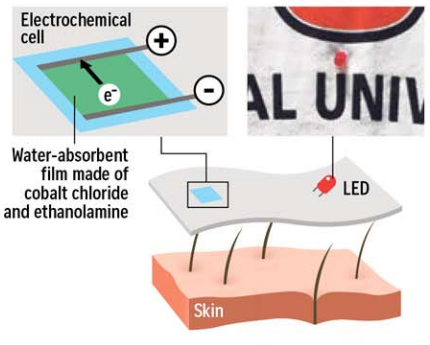
Experiment without insole and armpit pads

- The wet sock is placed alone inside the glass box.
- Moisture from the sock evaporates and increases the humidity of the glass box rapidly, leading to moisture build-up and bacteria breeding.

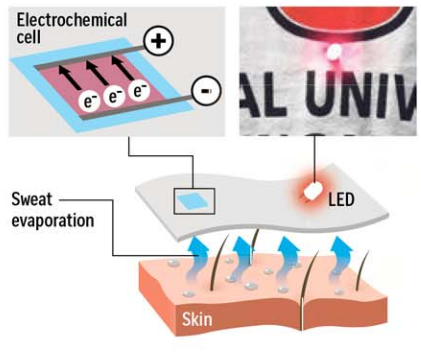
HELPING TO POWER A WEARABLE DEVICE

- The film is combined with a zinc coil and copper coil to form an electrochemical cell. When the film absorbs moisture from sweat, electrons pass from the copper coil to the zinc coil, creating an electrical current.
- In a demonstration, a gadget containing eight such cells is attached to a T-shirt, along with an LED light. The T-shirt is worn by a person who goes for a 10-minute run.

BEFORE THE RUN
The LED light is off.



DURING THE RUN
Sweat is absorbed in the film and an electrical current is generated in the electrochemical cells. This powers up the LED light.



Source: National University of Singapore PHOTOS: National University of Singapore STRAITS TIMES GRAPHICS