PolyU THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學
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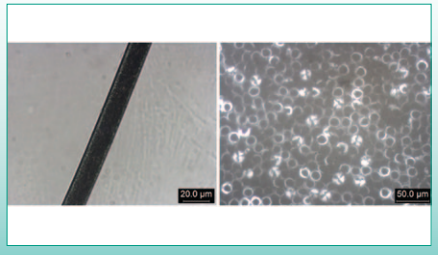
News Bite on PolyU's Innovation

Fabric with solar energy reflecting fibres

Cools wearers by up to 4°C under the sun

Global temperature increases steadily every year with heat waves occurring more often. Heat-related illnesses are serious and could be fatal. For those who need to work under the sun for extended hours, researchers from the Institute of Textiles and Clothing (ITC) have developed a UV-protective cooling fibre boasting micro-ceramic crystals that reflect solar heat away, yet without stopping the body from releasing heat. It proves to reduce the fabric temperature as much as 4°C under intense sunlight and its cooling effect lasts beyond 50 washes.

Dr Bin Fei



The core-sheath structure of fibres (left – side view; right – cross section)

In recent years, most climate scientists agree that global warming has increased the odds or severity of extreme heat waves. According to NASA's Goddard Institute for Space Studies, global temperature has been steadily rising since 1950, and 2016 ranks as the warmest year on record. Heat-related illnesses are serious and can even be deadly. Many healthcare professionals now argue that air conditioning is not a luxury, but a necessity to combat heat stroke and dehydration. But what about those who work extended hours under the sun? What can they do except putting on a wide-brimmed hat, applying sunscreen, drinking lots of water and taking regular breaks in the shade? Inspired by the ice plant studded with salt water vesicles that look like ice crystals, Dr Bin Fei, Associate Professor, Institute of Textiles and Clothing (ITC) and his research team developed a revolutionary fibre incorporating micro-ceramic crystals that reflect solar heat away, yet without stopping the body from releasing heat. In the experiments, the temperature on the back side of the fabric made with this cooling fibre is up to 4°C lower than the front under intense sunlight.

Not all cooling fabrics are created equal

Cooling sportswear has been in the market for a while and most works by

Salty ice plant

The cooling fibre with selective near-infrared and visible light reflection won a silver medal and a special merit award in the 45th International Exhibition of Inventions of Geneva.

wicking sweat through the fabric so that perspiration evaporates quickly and draws heat from the body. Some include mesh panels for ventilation. However, in case of heat stroke, the most serious heat-related illness, the body stops sweating and such clothing may not be efficient in cooling the body. "For sweat-wicking and mesh sportswear, the cooling agent is the sweat and it needs movement of air to evaporate. Thus, they work less effectively when the wearer doesn't sweat or when there is no wind. On the other hand, our new fibre targets more specifically people who are exposed to intense sunlight. It reflects solar heat away while allowing the body to release heat without being dependent on sweating or ventilation," said Dr Fei.

Wearable glacier lettuce

The cooling fibre was inspired by glacier lettuce whose ice-like bladders hold salt water to reflect sunlight and cool itself. Dr Fei then investigated the possibility of applying tiny ceramic crystals in the fabric just like those glistening vesicles. When the size of the ceramic crystals is comparable to the wavelength of the radiation, most of the energy is scattered and bounced away. Under sunlight, most solar heat is picked up by our body as radiation in the visible and near-infrared spectrum with shorter wavelengths. On the contrary, human body radiates heat in longer wavelengths. "By carefully selecting crystal sizes in the fabric, solar heat can be reflected away without stopping the body from releasing heat," said Dr Fei. For the best result, he found a mix of ceramic crystals ranging from 0.2 to 0.8 microns in diameter that reflect most of the ultraviolet rays.

Durable fabric that cools the body

But the cooling effect won't last if the ceramic crystals are just sprayed on the surface. Thus, Dr Fei tried to find ways to encase the ceramic crystals securely inside every fibre. "We can mix a polymer with ceramic crystals and make yarn with it. Yet, with the exposed crystals, the fibre will be too weak and the cooling effect will be lost after a few washes. Thus, we use two components to spin the yarn – a core with ceramic crystals, and an outer shell with only polymer. The strength of the fibre is not undermined and we found the cooling effect is retained beyond 50 washes this way."

In March 2017, the cooling fibre with selective near-infrared and visible light reflection won a silver medal and a special merit award in the 45th International Exhibition of Inventions of Geneva, Switzerland.