# New Moisture-wicking Metafabric Passively Cools the Wearer

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Scientists have synthesized a moisture-wicking passive cooling hierarchical metafabric, as reported in ACS Nano.

People belonging to various professions, such as firefighters, military, medicine, and miners are often exposed to extreme heat conditions. Hence, a lack of thermal comfort could hamper their productivity as well as expose them to many ailments.

Two methods are generally used to maintain thermal comfort, namely, active cooling and passive cooling. Active cooling methods provide a good cooling effect but are associated with energy consumption.

On the other hand, passive cooling has been associated with personal cooling and does not require electrical energy. They utilize passive radiation cooling technology that emits infrared (IR) radiation and reflects solar light.

## Intelligent Fabric and Nanotechnology

Scientists have designed many intelligent fabrics using nanoporous and nanofiber membranes and microfiber.

These fabrics have been used to develop personal thermal management products that are guided by the elimination of solar irradiance and increase in the emission of thermal radiation.

Previously, scientists designed a functional textile using zinc oxide nanoparticles inserted in polyethylene.

One of the most important characteristic features of this material was that it could simulate skin to avoid overheating by 5−13 °C, compared with normal textiles.

Another multilayer metafabric has been developed, which is knitted with composite microfibers. This intelligent fabric has been woven with titanium oxide-polylactic acid and laminated using a layer of polytetrafluoroethylene that can cool the human body by around 4.8 °C.

Some of the disadvantages of these intelligent materials are associated with their unfavorable thickness, lack of moisture management ability causing discomfort in the skin, and ineffective cooling while sweating.

## Development of a Hierarchical Metafabric

The newly synthesized metafabric has been developed using a modified electrospinning and dip-coating processes. The nanofiber layers that are close to the skin comprise CA/Al2O3 with HPX.

The upper nanofiber layers (away from the skin) comprise PA6/SiO2 modified by HPX. HPX is a moisture control agent. IR radiation cooling performance analysis has provided a desirable result, where the selective absorption band overlapped with the atmospheric transparency window.

Researchers have revealed that the addition of inorganic particles, such as Al2O3 and SiO2, has enhanced the IR emissivity of the hierarchical metafabric.

## Characteristic Features of the Newly Developed Hierarchical Metafabric

The hierarchical metafabric has a significantly high sunlight reflectivity. This is due to its optimal fiber diameter and porous structure of the associated nanofiber membrane and inorganic particles.

In the current study, scientists optimized the fabric, such that the pore size of the upper PA6/ SiO2/HPX layer fiber was 300−500 nm and the fiber diameter was 100 nm.

The CA/Al2O3/HPX lower layer had 900−1500 nm fiber pore sizes. The addition of inorganic elements enhanced the reflectivity in the near-IR (NIR) region.

The indoor cooling of the hierarchical metafabric was determined using an IR camera.

Scientists revealed that hierarchical metafabric was more transparent than cotton fabric, and stated that the cooling effect of the metafabric was due to the high solar reflectance, and material transparency.

Apart from the cooling performance, maintaining the humidity near the skin is also an important factor.

The moisture-wicking function of the metafabric is based on optimally designed pore sizes, as well as its hydrophilic properties. In this context, the CA/Al2O3/HPX layer can rapidly eliminate sweat from the surface of the human skin, while PA6/SiO2/HPX layer absorbs and quickly diffuses the sweat from the CA/Al2O3/ HPX layer.

Researchers revealed that the hierarchical metafabric could absorb a considerable amount of sweat, rapidly, and therefore, it could keep the skin dry under humid and sweaty conditions.

Additionally, sweat evaporation would provide an additional cooling effect, due to the massive latent heat of the water.

The team highlighted that as water has a robust IR absorption at around 3 and 6 μm, the IR emissivity of the metafabric was higher under wet conditions.

## Application of the Metafabric

Scientists have pointed out a potential application of the hierarchical metafabric, which could rectify the thermal discomfort issues experienced by the medical personnel, especially, during treating COVID-19 patients, where they are required to wear additional protective gear for long periods.

The protective clothing reduces heat dissipation and moisture permeability and could become very uncomfortable if worn for a long duration.

The hierarchical metafabric possesses cooling and moisture-wicking properties along with filtration efficacy. These properties could be extremely beneficial for the production of medical-grade protective clothing.

Additionally, the outer hydrophobic layer has been associated with the antifouling property and is also resistant to penetration of blood, and airborne droplets.

The inner hydrophilic layer can absorb and diffuse human sweat and, thereby, lower the thermal effect.

Read the original article on AZoNano.