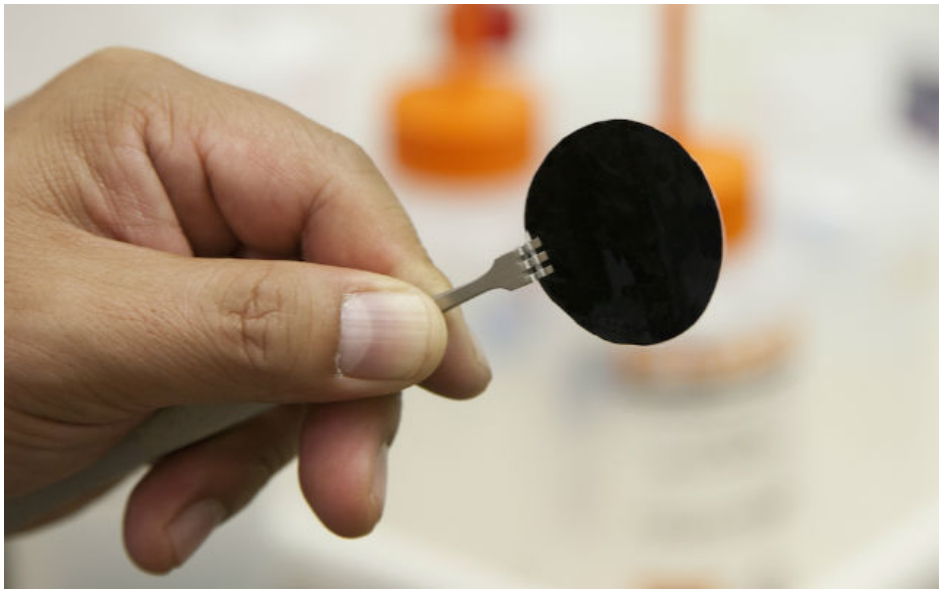
‘Smart’ Uniforms to Sense Chemical Weapons



Researchers are looking to make a fabric for military uniforms that has pores to keep soldiers cool — but can quickly shut its pores in the face of danger. The result would be soldiers of the future wearing “smart” uniforms that sense chemical weapons and snap into a protective mode.

“Without the need of an external control system, the fabric will be able to switch reversibly from a highly breathable state to a protective one in response to the presence of the environmental threat,” said Francesco Fornasiero, a chemical engineer at the Lawrence Livermore National Laboratory who will lead research into making the new fabric. “In the protective state, the uniform will block the chemical threat while maintaining a good breathability level.”

It will be a while yet before the uniforms are ready for combat. So far, researchers have made small pieces of one layer of the proposed fabric. The futuristic material could be ready in less than 10 years, according to a statement from the lab, one of several U.S. institutions involved in making the new uniforms.

Sweating the Details

When done, the uniforms will be a boon to soldiers working in contaminated environments. Current protective uniforms aren’t very breathable, so soldiers wearing them sometimes suffer from heat stress or heat exhaustion, researchers said.

The prototype layer that researchers have already made is a black material that has pores lined with carbon nanotubes, which are tiny tubes of carbon whose walls are just one atom thick. The pores themselves are only a few nanometers wide, or

about 100 times smaller than a speck of dust.

In spite of their small size, the pores should help sweat evaporate away from the body, keeping wearers cool. The nanotube-lined pores are able to shuttle gas in and out at a rate 100 times faster than expected, based on their size, researchers found. “We have demonstrated that our small-size prototype carbon nanotube membranes can provide outstanding breathability in spite of the very small pore sizes,” said Sangil Kim, a biotechnology researcher working on the fabric at Livermore.

The pores are also too small for bacteria and viruses, which are about 10 nanometers in size. Thus, even in its breathable state, the futuristic fabric should be able to protect wearers from biological weapons.

Next Steps

Next, researchers plan to coat their porous fabric with chemicals that sense when there’s a chemical weapon in the air. The molecules of chemical weapons are much smaller than bacteria and viruses and could pass through nanometer-size pores.

The researchers want to make two types of chemical-sensing coating. In one, the coating will shut the fabric’s pores when there’s a threat. In the second, the coating will peel off when it’s attacked, shedding contaminated layers.

The U.S. Defense Threat Reduction Agency has given Livermore and other institutions $13 million to develop the futuristic fabric over the next five years.

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