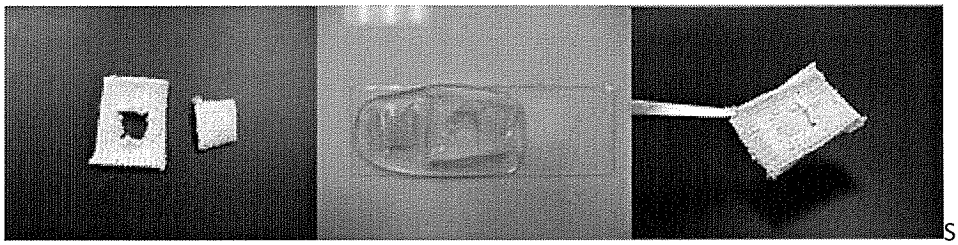
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Self-healing textiles not only repair themselves, but can neutralize chemicals

(*Nanowerk News*) Someday, chemically protective suits made of fabric coated in self-healing, thin films may prevent farmers from exposure to organophosphate pesticides, soldiers from chemical or biological attacks in the field and factory workers from accidental releases of toxic materials, according to a team of researchers. "Fashion designers use natural fibers made of proteins like wool or silk that are expensive and they are not self-healing," said Melik C. Demirel, professor of engineering science and mechanics. "We were looking for a way to make fabrics self-healing using conventional textiles. So we came up with this coating technology."



SRT coated fabric self-heals. From left, fabric with hole, wet fabric and patch in a drop of water, self-healed fabric. (Image: Demirel Lab / Penn State) (click on image to enlarge) The procedure is simple. The material to be coated is dipped in a series of liquids to create layers of material to form a self-healing, polyelectrolyte layer-by-layer coating. This coating is deposited "under ambient conditions in safe solvents, such as water, at low cost using simple equipment amenable to scale-up," the researchers report today (July 25) online in *ACS Applied Materials & Interfaces* ("SELF-HEALING TEXTILE: ENZYME ENCAPSULATED LAYER-BY-LAYER STRUCTURAL PROTEINS"). Polyelectrolyte coatings are made up of positively and negatively charged polymers, in this case polymers like those in squid ring teeth proteins. "We currently dip the whole garment to create the advanced material," said Demirel, who is also a member of the Huck Institutes of the Life Sciences. "But we could do the threads first, before manufacturing if we wanted to." During the layering, enzymes can be incorporated into the coating. The researchers used urease -- the enzyme that breaks urea into ammonia and carbon dioxide -- but in commercial use, the coating would be tailored with enzymes matched to the chemical being targeted. "If you need to use enzymes for biological or chemical effects, you can have an encapsulated enzyme with self-healing properties degrade the toxin before it reaches the skin," said Demirel.

SRT-coated fabrics will self-heal in water. Many toxic substances can be absorbed through the skin. Organophosphates, for example, which are used as herbicides and insecticides are absorbed through the skin and can be lethal. Some of these chemicals have also been used as nerve agents. A garment coated with a self-healing film containing an organophosphate hydrolase, an enzyme that breaks down the toxic material, could limit exposure. The squid ring teeth polymer is self-healing in the presence of water, so laundering would repair micro and macro defects in the coating, making the garments rewearable and reusable. "The coatings are thin, less than a micron, so they wouldn't be noticed in everyday wear," said Demirel. "Even thin, they increase the overall strength of the material." For manufacturing environments where hazardous chemicals are necessary, clothing coated with the proper enzyme combination could protect against accidental chemical releases. Future use of these coatings in medical meshes could also help patients minimize infections for quick recovery. "For the first time we are making self-healing textiles," said Demirel.

Read more: Self-healing textiles not only repair themselves, but can neutralize chemicals