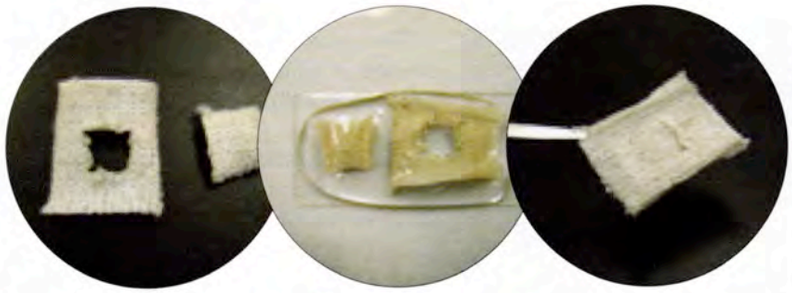
Research on Self-Healing Textile Shows Promise. By Kathlyn Swantko

Repair Solutions

Penn State University, Drexel University and the U.S. Naval Research Laboratory have been working together to create self-healing textiles that not only repair themselves, but also neutralize chemicals. Penn State's Demirel Group's research, headed by Dr. Melik Demirel, professor of engineering and Director of the Center for Research on Advanced Fiber Technologies (CRAFT) at Penn State University, shows that self-healing structural proteins not only provide high strength polymeric materials but also assist in the discovery of novel properties for medical and protective applications.

"Self-healing fibers that can detoxify agents have various applications in protective and transportation products as well as building materials," explains Demirel. "Our technology can be implemented on roofing materials, air ducts and window screens, interior of transportation vehicles, protective suits or appliances, and medical applications."

Initial research began two years ago by three PhD students (David Gaddes, Huihun Jung and Abdon Pena-Francesch), along with Professor Demirel, who had been working on structural proteins for the last four years. The researchers joined forces and became known as the Demirel Group.



Images show the Demirel Group's novel protein based biocompatible coating for Self-Healing textiles and its ability to enzymatically detoxify chemical agents.

In a 2015 paper published in *Scientific Reports*, the research team reported that underwater self-healing materials could be found in nature, and by using DNA technology a protein can be experimentally put into a cell that does not normally make that protein. By adding a coating to textiles, this has the potential to create strong, repairable engineering materials. The team focused its research on mimicking the interfacial chemistry of aquatic life. The self-healing proteins of barnacles were known to self-assemble through supramolecular organization, but understanding the role of supramolecular self-assembly in the self-healing process remained limited.

Recently, additional evidence of supramolecular self-assembly was found in the protein complex of squid ring teeth (SRT). SRT-based materials were shown to have several interesting properties as multifunctional engineering materials, including a high elastic modulus; capability of forming a strong adhesive bond underwater; and a reversible glass-to-rubber transition.

Demirel explains, "Based on this preliminary work, our research proposes that nature uses this supramolecular self-assembly to achieve stiff self-healing structural proteins with soft/hard domain separation, so textile coatings were a logical extension for our SRT material."

The Demirel Group conducted tests on a variety of textile fabrics.

Goals for Self-Healing Textiles

The Demirel Group's goal through its research is to create enzyme encapsulated self-healing materials in which a crack can self-heal to repair either microscopic to macroscopic defects. Demirel states, "These self-healing materials are of interest for dual use such as biomedical implants or bulletproof vests. Self-healing structural proteins provide not only high strength polymeric materials, but can also discover novel properties for protective applications."

Demirel cites the importance of using enzymes in the layers, such as those capable of degrading chemical or biological agents, in facilitating the fabrication of textiles for protection against toxic exposure. He says, "This means the rapid repair for doctors, in the event of a fabric tear in the clinic, or in the field for soldiers or farm workers."

While there won't be self-repairing clothing in department stores next week, this material is very interesting. "We are still in the early stages of exploring and understanding its unique properties, and the amount of material available is still limited," says Demirel. "Cost is an issue, but one we feel will diminish, if and when the process is scaled-up to meet anticipated commercial needs. Also, it's important to consider that the required coating is very small, so the cost of the textile will not increase drastically." ●

For more information on the Self-Healing Textile research project, contact Professor Melik Demirel: MDemirel@engr.psu.edu

Kathlyn Swantko, president of the FabricLink Network, created TheTechnicalCenter.com for Industry networking and marketing of specialty textiles, and FabricLink.com for consumer education involving everything fabric.

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