Upcycling of Discarded Polyester Fabric Creates Fabric Coatings. **By Kathlyn Swantko**

Reaching into the Chemistry Toolbox

To address today's wide range of worrisome landfill and contaminated water issues, researchers are upscaling polyester textiles in a variety of ways. Cornell University has developed a unique upscaling method, allowing scientists to chemically break down discarded polyester clothing, and reuse its compounds to clean-up textile waste.

Juan Hinestroza, professor of fiber science/apparel design and director of Cornell's textile nanotechnology laboratory, along with a team of Cornell chemists and engineers, are creating new finishing coatings for fabrics. Through the textile decomposition of old clothing, the team reuses the polyester to create fire-resistant, antibacterial, or wrinkle-free coatings that can halt the proliferation of polyester textile waste in landfills.

"Although the majority of consumers think that recycled/reprocessed polyester clothes is the solution to the problem, the reality is that many of these products are actually sent to other places as solid waste," said Hinestroza. "Our main goal is to offer a pathway to reuse these materials."

Prior to Cornell's method, some researchers believed the dyes and impurities within the polyester would interfere with the upscaling process. Cornell's "proof-of-principle" method, known as "Controlled Crystallization," has proven that polyester-derived linkers seek out

Metal-organic frameworks (MOFs) in Hinestroza's lab at Cornell University.

and attach to metal compounds in the solution, in spite of other materials present.

The circular approach, aligns with the United Nations Environment Program, has spawned a worldwide effort to end the overconsumption of clothing. "Since we will eventually run out of landfill space and countries where we can send our textile garbage, our upscaling solution is possible, and it's within our reach," explains Hinestroza.

The research uses sample strips of polyester fabric placed into a flask, with enough sodium hydroxide solution added to cover the textiles. Through agitation and the application of heat, ethanol, and cool water, the tiny pieces of polyester cloth become a PET polymer resin, which is like the liquid made from plastic soda bottles.

"At this point, scientists can extract old polyester monomers from the liquid creating linkers that connect a functional (bio)molecule with a molecular tag to form a compound that joins two or more chemical compounds into metal-organic frameworks (MOFs)," says Yelin Ko, Cornell fiber science doctoral student. "These MOFs are used to create coatings for clothing that can protect people from germs/noxious gasses, or create other uses not yet imagined. Since we're using ethanol and water as solvents, instead of toxic solvents, we're able to depolymerize and reclaim the polyester monomers without environmental destruction. And, we can link the monomers safely to the MOFs within 30 minutes."

Phill Milner, assistant chemistry professor in Cornell's College of Arts and Sciences, team member states, "By changing the chemical structure of the polyester, an array of MOFs can generate a myriad of colors."

Copper salts added to the mixture can create a precursor solution to depolymerized polyester. "With the right metal salts like copper, we can chemically grab the organic molecule from the monomers recovered from these digested textiles," Milner adds.

The Cornell team believes that its new techniques can disrupt the "business-as-usual textile processes,"and see MOFs as a way to enable sustainable recycling of polyester materials. ■

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