Magic fibers: A researcher's work to create 'smart fabrics' that can change color

October 21 2020, by Emi Endo

Credit: Pixabay/CC0 Public Domain

Imagine using a cleaning wipe that could detect the presence of a bacteria or pathogen and change to a different color, or an N95 respirator mask that could detect the presence of the novel coronavirus and respond in a way that alerts the wearer, so they would know when they had to change it.

Christina Tang, Ph.D., an assistant professor in the Department of Chemical and Life Science Engineering at Virginia Commonwealth University, is testing new ways to bring these scenarios to life by spinning liquid crystals into fibers that change color at different temperatures.

Tang and students on her Vertically Integrated Projects team have been working on a project with the U.S. Army to make fibers with these seemingly magical—or thermochromic—properties. Instead of a spinning wheel, Tang's lab uses an electrospinning instrument in a process that she compared to making cotton candy. A nozzle generates the material, which is then pulled into a fiber and rolled into sheets.

Tang's group is determining how the fiber and liquid crystals can be processed so that a rise or drop in temperature will result in a change "so we can still get color, but then also fundamentally understand how that processing affects the phase change."

These "smart fabrics" are made of soft, lightweight and elastic materials and could be used in clothing such as camouflage or for other applications such as detecting the presence of a pathogen like a virus. They have also been used to create wearable sensors and devices.

Tang works at the nanoscale, where one nanofiber is 1,000 times smaller than the width of a human hair. Her research areas include functional polymer nanomaterials and nanoparticles.

Polymer nanomaterials are made of plastics such as nylon or polyethylene—the same kind of material used to make plastic soda bottles. Tang's lab makes nonwoven nanofibers, similar to a reusable shopping bag, which can be easily mass produced.

"We like to think about how we can add function to these materials," she said.

In the case of the N95 mask, she said, a wearer would know "when you had to change it, instead of just guessing." With the cleaning wipes, "you could keep wiping until it didn't change color anymore."

In her investigation into understanding the fundamental properties of these materials, Tang is testing how to make thermochromic fibers by incorporating liquid crystal formulations into electrospun nanofibers.

Aaron Wimberly, a junior majoring in chemical and life science engineering, began working on the project the summer before his sophomore year.

"When I first came into the lab and Dr. Tang was showing me some of the samples of electrospun woven mats and polymer solutions, it was really, really cool," he said. He has since helped make samples that can change color.

Tang said some researchers in the field focus on liquids while others on polymers. Her approach, at the intersection of the two, applies methods typically used for liquids to these materials.

The liquid crystals, which are in between liquid and solid phases, have the optical property of reflected color—"the same principle that gives butterfly wings their color instead of dyes that absorb color," Tang said.

Provided by Virginia Commonwealth University