

New Research Ups the Performance Possibilities in Cotton Fabrics. By Kathlyn Swantko

Groundbreaking Graphene-based Inks



Cotton is about to ramp up the performance challenge to the next level. Through the use of graphene-based inks and research being conducted at the University of Cambridge, cotton is on the verge of new possibilities in creating inexpensive, scalable applications for flexible and wearable electronics in smart fabrics.

Wearable electronic devices are now progressing into textiles for everyday apparel. Graphene is a single atom-thick membrane of carbon that is highly conductive, environmentally-friendly, and an ideal metal for broader applications.

"In response to this need, our team of over 20 PhDs and MEng students began investigating the production of graphene in liquid by direct exfoliation of graphite into the solution through the application of ultrasounds," explains Dr. Felice Torrissi, University Lecturer in Graphene Technology and Project Leader for the Cambridge Graphene Centre (CGC) at the University of Cambridge, UK.

Over the last five years, the research has evolved into the formulation of graphene-based conductive inks for printed and flexible electronics.

The CGC researchers, working in collaboration with scientists at Jiangnan University, China, developed a method for infusing the graphene-based inks onto cotton to produce a conductive textile. The inks, made of chemically modified graphene flakes, were found to adhere easier to cotton than unmodified graphene.

"Our printing technology has enabled the integration of graphene printed motion sensors directly onto cotton fabric by using an environmentally-friendly process that is compatible with the natural fiber, leaving the comfort of the cotton substrate unaltered,"

cites Torrissi. "The cotton fibers act as an effective host matrix for the conductive graphene flakes. After depositing the ink onto the fabric, a heat treatment improves the conductivity of the modified graphene, creating a conductive network of many graphene sheets."

This printing process creates a thin and uniform conducting network of nanometer flakes, and is the secret to the high sensitivity to strain induced by motion. A simple graphene-coated conductive cotton textile, used as a wearable strain-sensor, has shown it can detect up to 500 motion cycles, even after more than 12 washing cycles in a typical washing machine.

Advantages and Future Advances

The adhesion of modified graphene to the cotton fiber is similar to the way cotton holds colored dyes, and allows the fabric to remain conductive after washing. Both modified and pure graphene inks printed on the cotton fabric enable direct circuit patterning, which makes the process eco-friendly, scalable and easy to integrate into traditional cotton fabric dyes and printers.

Turning cotton fibers into functional electronic components can open up an entirely new set of applications from healthcare and wellbeing to the "Internet of Things." Commercial opportunities for graphene-cotton fabrics range from personal health technology, high performance sportswear and wearable technology/computing, fashion-tech, military garments, and into automotive end-uses such as a motion/pressure sensors and heaters in car seats.

Graphene and Related Materials (GRMs) are changing the science and technology landscape with the ability to create attractive physical properties for electronics, photonics, sensing, catalysis and energy storage that extend beyond cotton and natural fibers.

Torrissi explains, "Our short-term goal is to expand the range of GRM-enabled electronic devices on cotton, and establishing this technology as a powerful tool for successful wearable electronic textiles. Our long-term goal is to bring a more intimate presence of nanomaterials into cotton, wool and silk fibers that will enable yarns with electrical and optical properties, which could be woven into commercial fabrics to create fully fiber-based electronics." ●

For More Information

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Scanned electron microscopy image of the graphene-cotton fabric.

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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