

New Possibilities

The future of wearable e-textiles will be determined by the ability of manufacturers to deliver comfortable garments with reliable electronics that are lightweight, flexible and durable.

The University of Delaware is currently working on developing the next-generation of smart textile sensing technology by creating flexible, carbon nanotube (CNT) composite coatings usable on a wide range of fibers, including cotton, nylon, polyester, aramid, glass, spandex and wool. The fabric-coated sensing technology is flexible, thin and breathable, and is chemically bonded to the surface of the fibers. It can detect a wide range of pressures, from the light touch of a fingertip up to tons of compression. Due to the CNT's unique microstructure and ultra-high sensitivity, stretchable knit fabric sensors have been developed, which have not been achieved in other types of sensors.

For nearly a decade, the research laboratory, affiliated with the University of Delaware's Center for Composite Materials, has been hybridizing carbon nanotubes for advanced fibers like carbon and glass. These materials have been used in fiber-reinforced composites for aerospace applications. Recently, the team has narrowed its focus on creating functional CNT coatings for natural and synthetic fabrics for smart textiles.

Erik Thostenson, associate professor in the Department of Mechanical Engineering and Materials Science/Engineering, and director of the research states, "Our recent collaborations include researchers in biomechanics, physical therapy, as well as fashion and apparel studies. There has also been interest from prosthetic/orthotic manufacturing companies, as well as from the automotive and aviation industries."

The process for developing this sensing technology from the carbon nanotubes (CNTs) utilizes a polymer/chemical called

polyethyleneimine (PEI), which is dispersed in water.

Thostenson explains, "When the pH of the dispersion is acidic and the PEI has a positive charge, the CNT's with the attached PEI repel each other, and the positive charges form a uniform dispersion in the water. When an electric field is applied, the CNTs, with the positively charged PEI attached, move towards the negative electrode and are deposited on the fabric. The result is a very thin uniform CNT coating of PEI, bonded to the surface of the fibers. This thin coating does not change the feel or the fabric, but imparts the unique sensing capability."

Thostenson says the team's short-term goal is to conduct human subject tests of the sensors and validate the sensing response using current state-of-the-art technology. The team is also working on optimizing the sensitivity of the sensor and collaborating with researchers in the University's fashion and apparel studies department on integrating the sensors into garments in a non-invasive way.

Since these flexible and comfortable-to-wear sensors can be easily integrated into everyday clothing, there are numerous potential applications. The uses can range from e-skins, e-textiles, smart garments with feedback, gesture recognition, tele-operation and biomedical devices.

The long-term goal is to develop sensors that create a holistic system, which includes the sensors, a wireless data acquisition system and data analyzing software. This will provide the end-user with simple and easy-to-understand information." ●



The team demonstrates a thin and flexible pressure sensor that can be integrated within the sole of a shoe to detect for detecting forces while walking.

For more information on the **University of Delaware's** research on "Creating the Next Generation Smart Textiles Using CNT Coatings as Sensors," contact Erik Thostenson, associate professor in the Department of Mechanical Engineering and Materials Science/Engineering, at: thosten@udel.edu, 302-831-8789.

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.

The FabricLink Network

How will they find you, if you're not there?

THE Networking / Education Search Engine for ALL Things Textile Related!

Why clients are excited about the benefits of The FabricLink Network

"We have been using the FabricLink Network for over 10 years and it has consistently been one the top digital drivers to our site, and a great source of information for trade and consumers alike."



Lisa Hardy

North America Marketing Manager
Teflon™ textile finishes, Teflon™ fabric protector,
The Chemours Company

Partnership Opportunities:

Kristi Rummel
kristi@rummelmedia.com
608.435.6220

Editorial Opportunities:

Kathy Swantko
kgswantko@fabriclink.com
818.345.7501



FabricLink.com



TheTechnicalCenter.com