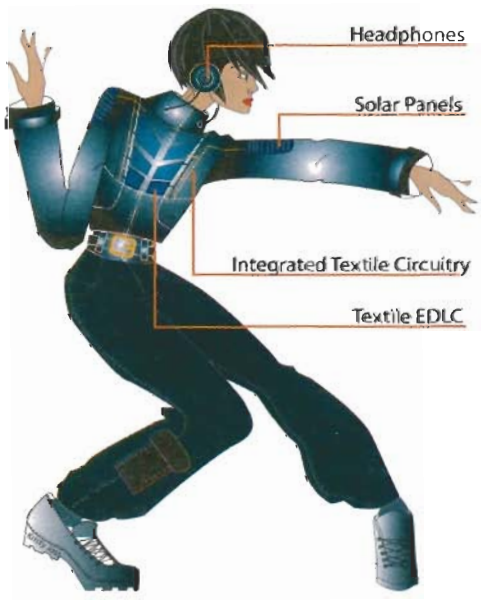
**Drexel University Research Integrates Fashion Design and Science for Wearable Smart Garments.** By Kathlyn Swantko

# Comfort Comes To E-Textiles

While there has been much interest and research concerning the development of so-called "smart textiles" or "e-textiles," the real challenge is to integrate electronic textile technology into finished garments. A major roadblock is that conventional batteries and circuitry are too heavy and bulky for wearable "smart garments."

Kristy Jost, a Ph.D. student in the College of Materials Science and Engineering at Drexel University, intends to solve this problem. She states, "I believe that the bio-medical field and military would benefit greatly from having integrated energy storage paired with bio-sensors, energy harvesting materials, and other communication devices that could relay real-time vitals without the hassle of wires and other bulky devices."




**Smart Garment:** Design concept including solar panels that charge the textile supercapacitors on the chest of the jacket in order to power an integrated audio system.

As a sophomore fashion design student at Drexel in 2007, Jost was inspired by international fashion designer Hussein Chalayan's Spring 2007 collection of technical wizardry and robo type fashions, which transformed ball gowns into mini-skirts and illuminated clothes that changed color. Jost states, "At this point, I realized that clothes can be so much more than something to wear, they can be electronic, transformative, functional, and all the while being beautiful!"

During her junior year, Jost designed a collection of audio- and video-enhanced smart garments. She then proposed research on wearable technology to Dr. Gogotsi, head of the A. J. Drexel Nanotechnology Institute. In the spring of 2010, Jost received a Research Co-op for the fashion design department and Drexel's nanomaterials lab to work together, focusing on her textile energy storage research.

"My first few weeks in a lab setting, having come from design, was quite a change," notes Jost, "and there was much to learn." By the end of her co-op, she had re-designed the traditional process for making supercapacitors, and had developed a screenprinting ink and process for making textile electrodes.

In her Ph.D. research, Jost continues to focus on creating energy textiles that can bridge the gap between lab scale science and the apparel industry. The four keys of her focus include:

1. Integrate electronic devices into the structure of textiles so the fabric remains comfortably wearable.
2. Use textile structures as a foundation for device design and ensure the electronics are truly integrated.
3. Utilize existing manufacturing techniques that are common in the apparel industry and advanced materials to fabricate textile electronics.
4. Use collaboration between fashion design, materials science and electrical engineering as the core to ensure successful energy storage research.

In her research, Jost uses textile supercapacitors as her energy storing device. Supercapacitors are currently being used for devices that need quick bursts of energy, like a camera flash or brakes/acceleration in automobiles. She explains, "Supercapacitors, unlike batteries, can charge and discharge in a matter of seconds; they can be made entirely of non-toxic materials, making them safe for wearable systems; and they are high power without the same high energy density of batteries."

Currently, Jost's team has found that cotton and polyester wovens yield excellent electrochemical behavior, and allow the screenprinting of carbon onto the highly porous fabric face. "Carbon materials have the surface area of a football field per teaspoon, which provides more surface area for the absorbing ions," explains Jost.

Jost's research also focuses on the use carbon fiber yarns to knit conductive materials directly into a full piece of fabric using a Shima Seiki 3D knitting machine. Jost's long term goal is to devise a manufacturing and design system that allows the dissemination of this technology to engineers, doctors and soldiers, as well as to the consumer. ●

*For more information on Drexel University's research on energy-stored printed fabrics, contact Kristy Jost, 215-895-2323 or kristy.a.jost@drexel.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 about everything fabric.*