Woven electronics

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The fabric strip contains conductors and electronic parts such as temperature sensors woven into it. (Photo: Peter Rüegg / ETH Zurich)

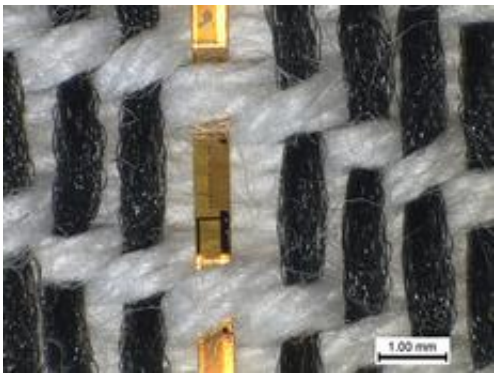
Electrical engineers from ETH Zurich have devised intelligent textiles that already have electronic components such as sensors and conductive filaments woven into them. The advantage: the fabric can be mass-produced on conventional ribbon looms - and washed.

Researchers have been experimenting with “intelligent” textiles for quite some time by integrating standard electronic components. However, for the most part the electronic parts have only been attached to or sewn into plain old clothes like coats or T-shirts - an endeavor ultimately doomed to fail because of one practical drawback: they’re difficult to wash. Moreover, it takes a lot of handiwork to produce them, which bumps up the price of the clothes.

Scientists from Professor Gerhard Tröster's Wearable Computing Lab, however, have now gone one step further: they've developed a new technology to attach thin-film electronics and miniaturized, commercially available chips to plastic fibers. The researchers eventually succeeded in integrating a large number of microchips and other microelectronic elements directly into the architecture of the material. In order to weave the E-fibers into conventional threads, the ETH-Zurich scientists used customary textile machines.

Despite the woven-in electronic components, the fabric is elegant and foldable. Moreover, it feels like normal material, which means clothes made out of it could be worn in daily life. And the beauty of the microchips, which sit on plastic strips, is that they are encapsulated, which means the fabric can be washed several times in a washing machine using a mild detergent, without damaging the e-fibers.

The Tröster group's electronic fabric is still ribbon-like. Nevertheless, the researchers aim to produce their intelligent textiles in any size so they can also be cut as required to satisfy the requirements of the clothing industry, for instance. After all, by exploiting the grid structure of woven textiles, the scientists can easily broaden the architecture of the intelligent textiles to support large-scale sensor devices or bus structures.



Smart textiles under the microscope: the woven plastic fibers with integrated

temperature sensors are clearly recognizable (Photo: K. Cherenack / ETH Zurich)

To start with, the researchers have produced two demonstration objects: a table cloth with temperature and humidity sensors and woven-in LEDs; and an undershirt that measures body temperature. They sewed a functional panel of fabric onto both items and connected it up to measuring instruments to demonstrate that their concept works. “One of the major issues is still the electricity supply, however”, says project leader Kunigunde Cherenack, a senior assistant at the Wearable Computing Lab. After all, to perform all of the measurements the fabric needs power.

The ETH-Zurich researchers realize that smart textiles are nothing new; however, the way they have embedded electronic components in the fabric is a completely novel approach, especially as the functional panels of material are to be mass-produced to make the method attractive industrially.

Kunigunde Cherenack also sees numerous applications for hybrid fabrics in monitoring the heart rate, helping athletes train or recover from injuries, or supervising aid workers or fire fighters; even keyboards or monitors in everyday clothing might by areas where functional hybrid textiles could be deployed.

The development of the novel electronic sensor fibers is part of the “TexInTex” project under the Swiss “nano-tera.ch” initiative.

More information: Cherenack KH, Kinkeldei T, Zysset C, & Tröster G: Woven thin-film metal interconnects. Accepted for publication by the IEEE Electron Device Letters.

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