SMART FABRICS

Pants that serve as sports trainers and jackets that detect poisons: Future-oriented researchers at Creavis are developing the textiles of tomorrow

TEXT **EVA MORSBACH AND BJÖRN THEIS**

Clothing is one of mankind's earliest innovations. Some researchers believe that humans were making clothing as early as the Middle Paleolithic period—approximately 200,000 years ago. The main function of this clothing was to protect the wearer from cold, sunlight, moisture, and injuries. For at least the past 5,000 years, clothing has had an additional significant function—one that was demonstrated by the discovery of the Tarkhan Dress. This elaborately knife-pleated linen garment is the world's oldest surviving woven garment. It testified to the wealth of Egypt's First Dynasty and signified its wearer's high social status. Clothing had become fashion.

Thanks to nanotechnology and the miniaturization of computers, today we are on the brink of the next evolutionary leap in the historical development of textiles. In the years ahead, pants, jackets, and coats will be performing entirely new and complex functions. In the vision of researchers, clothing will no longer consist of passive textiles. Instead, it will be the active performer of various tasks.

One important basis for these innovations was created when synthetic textile fibers were developed in the first half of the twentieth century. Before that time, clothing consisted of natural fibers such as linen, wool, and silk. In 1935, the DuPont company started selling the first synthetic fiber, which was made of polyamide. Nylon stockings, which were launched on the market on May 15, 1940—"N-Day"—immediately became a bestseller. On that day alone, five million pairs were sold in the USA. During the war years, synthetic fibers were needed for military equipment such as parachutes, tents, and ropes. As a result, nylon manufacturers promptly restricted their production of nylon stockings. They were sorely missed—in fact, surveys of American women showed that nylons were missed even more than the men who had gone to war.

Synthetic fibers opened up opportunities to provide clothing with new functions. For example, nylon stockings can be made so thin and elastic that they cling to the legs without becoming uncomfortably hot. Today's bulletproof vests are quite comfortable to wear, because they are made of lightweight synthetic fibers that are woven together into stiff and firm textiles that bullets cannot penetrate.

In the near future, clothing may watch over the vital functions of newborns, and protective work suits could monitor the well-being of workers. Sensors in romper suits could protect babies from sudden crib death while they sleep. Workers doing hazardous jobs could be warned by their clothing if the concentrations of toxic gases in their surroundings exceed the limit values.

Other types of fibers could make it unnecessary to change clothes when the temperature changes, because they will be able to switch between warming and cooling their wearers. The volume of the fibers would change according to whether the wearer is sweating or shivering. Sportswear could take over a number of trainer functions by vibrating at the points where the wearer's posture is not correct. In order to do that, fibers with a sensor function would have to register the wearer's posture and compare it with a database in which the ideal postures were described.

In order to integrate all of these functions into clothing comfortably, it must be possible to process the functional material into fibers without it losing its ability to gather information and share data. This requirement presents a number of problems, because the material's functional properties must be retained even though the material is manufactured in the form of very long fibers with tiny diameters. At the same time, the material must be flexible enough to be woven into a textile and robust enough to survive the spin cycles of washing machines.

The challenges posed by these requirements have not been solved so far. Evonik is playing an active role in the development of smart fabrics. After all, the company has gained expertise through its development of various polymers, and Evonik Fibres GmbH has had years of experience spinning polymer fibers. Evonik's Corporate Foresight team, which is part of the Strategic Innovation unit at Creavis, is conducting research on the future applications of intelligent clothing. And who knows? One day shirts and blouses might be smart enough to iron themselves.

This interactive dress developed by the Canadian fashion designer Ying Gao interacts with its environment: It reacts to an observer by moving around and glowing in the dark