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Innovative textiles made possible by biotechnology

Biotechnology plays a part in many high-tech fabrics that have become an integral part of our everyday life. Whether it is products for the treatment of wounds, fabrics for marquees or for clothing, many materials have been developed or are produced using biotechnological techniques and processes. Many products marketed as "micro" or "nano" are inspired by nature. The current topic of the month addresses different aspects of innovative textiles in which the biotechnology sector plays a role.

Modern biotechnology integrates the most diverse disciplines such as nutrition sciences, environmental technology and the textile industry. The close cooperation of the textile industry with biotechnology has, in recent years, led to many innovative projects. The textile industry is one of the oldest industrial sectors worldwide. Textile manufacture and textile research also have a long tradition in the southwest of Germany. 200 years ago, the first mechanical spinning factory was established in Baden. Today, with 30,000 people working in this field, the textile industry has become an important economic factor in Baden-Württemberg.

Up until the 20th century, textiles were produced exclusively with natural materials such as cotton, hemp and flax. The invention of synthetic fibres in the 20th century hugely broadened the application range of textile materials. Major improvements have been made in technical textiles since the 1980s and now account for approximately 40 percent of the entire textile production. Their huge innovative potential makes them the driving force in the growing textile industry.

The textile industry explores new fields

Scientists from different disciplines work closely together to develop high-tech textiles.
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Specific interdisciplinary partnerships between the most diverse scientific fields enable the industry to combine several functionalities in one material. The new fabrics may be breathable, temperature-regulating, lightweight, shock-proof, water and dirt repellent and a lot more. It is, in particular, this multifunctionality which broadens the application of these modern fabrics, which, apart from being used as clothing, can be used in car manufacture, space technology, agriculture or biomedical technology.

Geoscientists from the "Functional Morphology and Biomimetics" group at the University of Tübingen are working with scientists from the universities of Freiburg and Stuttgart, the ITV Denkendorf, the Karlsruhe Institute of Technology and the Stuttgart State Museum of Natural History on the development of innovative textiles and all are members of the Biomimetics competence network. Alongside textile researchers from the ITV Denkendorf, the geoscientists from Tübingen are working on the development of textiles for use in what is known as fog harvesting, i.e. the collection of fog droplets. Based on the model of nature, these textiles have the potential to be used for collecting and boosting the quantity of drinking water in many regions of the world where water is scarce. In addition to collecting fog droplets, textiles of this kind could also be used for filtering and separating aerosols.

Textiles in medicine

Innovative textiles also play a major role in the development of medical products.
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Innovative materials are also used in the field of medicine and many applications are possible, ranging from tissue engineering to wound dressings and implants. In the field of biomedical technology, biologists and engineers work in close cooperation in the development of biomaterials and implants as well as methods for tissue regeneration such as absorbable, three-dimensional, shapeable fleeces in which autologous cartilage cells can be grown. Such implants can be used to counteract the wear and tear of bones and cartilage (arthritis) or to promote the growth of the kind of bone required

for dental implants.

New opportunities for modern textiles have also opened up in the treatment of wounds. In view of the growing number of elderly people and diabetics in modern society, the treatment of problematic wounds is a major application area of such textiles. In Germany alone, there are approximately two million patients every year suffering from severe and chronic wounds. Innovative medical textiles into which therapeutic substances can be integrated will certainly play an important role in the treatment of wounds and skin (see article entitled "Wound dressings with drug depots").

Antibacterial and antiviral textiles and personal everyday articles also play an increasing role in the field of hygiene. Amongst other things, the effectiveness of antiviral and antibacterial textiles and everyday articles (see article entitled "First system for assessing the antiviral efficacy of textiles and articles in everyday use") helps to break the chain of infection. Antiviral towel rolls in toilets and other products are already being used in hospitals.

Intelligent technical textiles

What is known as intelligent technical textiles is another interdisciplinary example of innovative textiles used in the field of health and safety. These are textiles with integrated microsystems used in clinical applications for measuring and monitoring of vital parameters such as blood pressure, pulse or breathing.

Better textiles with nature's help

Through the course of evolution, nature has come up with surfaces to which dirt is unable to attach thanks to complex micro- and nanostructures. The self-cleaning effect of such extraordinary hydrophobic micro- and nanostructured plant surfaces was discovered and clarified by W. Barthlott at the University of Heidelberg in 1975. Now, engineers and technicians at the ITV Denkendorf are transferring what is known as the lotus effect of plants to textile surfaces. The interest in the self-cleaning effect is huge, not only for outdoor clothing and marquees, but also in medicine.

Another innovative material is polylactide (PLA), which can be found in biodegradable catering dishes or packaging and which has become a popular material among clothing manufacturers. PLA is used for the production of a new class of synthetic fibres made from plant carbons. In contrast to nylon and polyester fibres made from non-renewable petrol, PLA uses carbon that is absorbed by maize plants during photosynthesis from the air.

Minimising the risk

Textiles with lotus effect developed at the ITV Denkendorf

Nowadays, many of these high-tech products are produced from nano-materials. It goes without saying that the nano-materials used need to be safe for both manufacturers and consumers, and crucially, they need to be safe throughout their entire life cycle. As part of the project TechnoTox, researchers are studying whether nano-functionalised textiles are safe for humans and the environment (see article "Risk assessment of nano-materials") by examining the properties and effects of the particles in detail. Since an increasing use of nano-functionalised textiles is expected in the future, the knowledge gained and test methods developed from the TechnoTox project will contribute to ensuring that new materials that are launched on the market are not toxic.

Dossier

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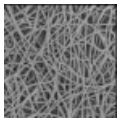

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