

Bionics/Biomimetic in Textile Research

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The German Institutes for Textile and Fiber Research (DITF) Denkendorf are the largest textile research center in Europe, (Figure 1). Three research areas, Textile Chemistry and Chemical Fibers, Textile and Process Engineering and Management Research, cover the entire textile value chain from molecule to product. DITF conduct research on new high-performance fibers and materials, on new and adaptive processes in fiber and yarn production, and in textile finishing and textile functionalization. In all research areas, modern and cutting edge technologies are used; in addition, the potential of digital information and communications technologies are used for textile industry, Textile 4.0. A wide range of textile testing services, prototype construction and a pilot factory complete the offer. From the molecule to the finished product and its market launch, DITF conduct research and develop products along the entire textile value chain, always taking into consideration the corporate processes and business models. This makes Denkendorf a unique location worldwide for innovations in the textile industry.



Figure 1: DITF Buildings, Aerial View

Founded in 1921, today the research center employs about 300 scientists, technicians and laboratory assistants. On 25,000 m² research and production area the DITF conduct interdisciplinary research and development projects involving chemistry, material sciences, process technology, material technology, mechanical engineering and plant design and management. The scientists utilize the latest findings in fundamental and application-oriented research for the textile industry, and set new standards with their

own developments. This not only applies to products but also to production and analytical procedure methods. Due to three chairs and two professorships, the DITF are closely connected to the University of Stuttgart and Reutlingen University.

The DITF has been researching bionics topics for fiber-based materials for many years. The aim is to understand the relationships between structures, surfaces, sensors and data processing in living nature, to model them and to implement them in technology. In addition to self-cleaning surfaces, (Figure 2), developments such as the mist trap, (Figure 3), oil-absorbing materials and extremely light fiber composite materials have already found their way into industry. Building with textile materials is also being promoted by inspirations from living nature. One example is a solar thermal roof inspired by the fur of the polar bear. In a demonstration building, (Figure 4), the solar energy harvesting and the seasonal storage of the thermal energy from summer into winter time was realized. For the separation of dispersed oil in water from industrial and natural waters we are developing a high efficient filtration technology inspired by natural spider-silk as a biomimetic model and its functionality in water droplets coalescence in the air, (Figure 5). This is a joint-research project between DITF, Germany and the Jilin University, China. The target is to design and fabricate special fiber surfaces capable of transporting liquid droplets on a fiber surface with the aim of improving micro-sized oil droplets coalescence in aqueous environment (oil in-water), (Figure 6).



Figure 2: Self-Cleaning Surface like the Lotus-Effect

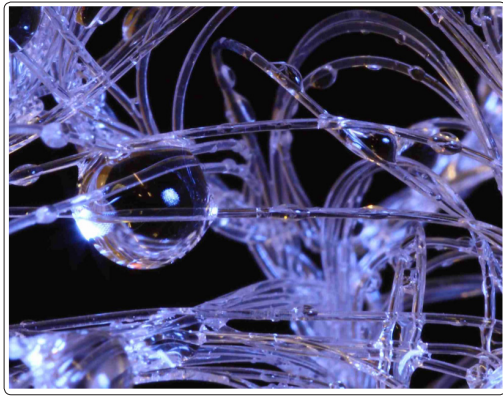


Figure 3: Fog Harvesting With a 3 Dimensional Net



Figure 4: Polar Bear Pavilion with Solar Thermal Roof and Integrated Thermal Energy Storage

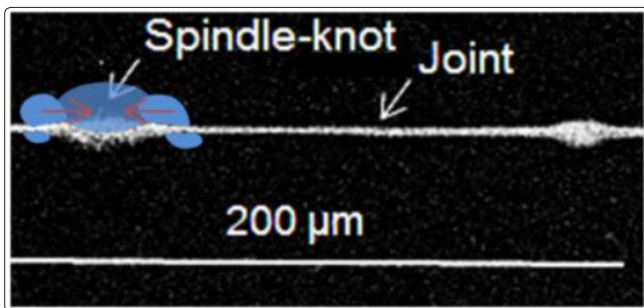


Figure 5: Natural Model with Spider Silk Fiber – Water Droplet in Air

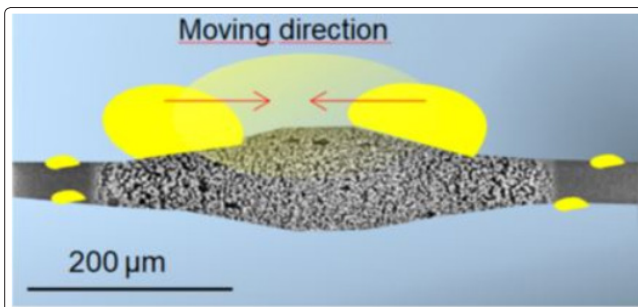


Figure 6: Technical Model with Synthetic Fiber-Oil Droplet in Water

Further research, e.g. Bionics to friction-reducing surfaces, puncture-resistant lightweight materials are in the works.

The DITF are involved in the International Society of Bionic Engineering (ISBE). The association has grown steadily since it

was founded in 2010. The more than 2,700 members currently come from over 60 nations (www.isbe-online.org). The society promotes and supports cooperation, knowledge exchange and training in the field of bionics.

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