TECHNISCHE UNIVERSITÄT DRESDEN

ITM

Fakultät Maschinenwesen Institut für Textilmaschinen und Textile Hochleistungswerkstofftechnik

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PRESS RELEASE

Cutting-Edge Research Made in Saxony: Symbiosis of High-Technology Sectors „Lightweight Engineering With Carbon“ and „Energy Storage“

Based on global mega trends, such as the shortage in natural resources and the simultaneously increasing individualisation in lifestyles, the sectors of energy storage and lightweight engineering have become key technologies, for example in the field of innovative mobility concepts. The resource-efficient use of novel, application-specific materials with high functional density is of particular importance for the development of high-tech products in Saxony for which carbon fibres exhibit tremendous potential.

Scientists at the TU Dresden (TUD) have succeeded in creating an interdisciplinary junior research group named „*e*-Carbon“ (ESF-SAB 100310387), including chemists, textile experts and plastics engineers, which will spend the next three years – starting July 1st 2017 – generating customized and multifunctional carbon fibres for the storage of high energy densities. This promising project was chosen among over 40 applications by the TU Dresden and the Sächsische Aufbaubank SAB-ESF, as it provided the most future-oriented and forward-thinking concept.

This complex topic will be explored by young scientists at the TUD from the Institute of Textile Machinery and High Performance Material Technology (ITM), the Institute for Lightweight Engineering and Polymer Technology (ILK), and the Chair of Inorganic Chemistry I (AC1). Due to the interdisciplinary focus of the consortium, ideal preconditions have been established for intense scientific and industrial networking in innovative fields of research with high practical relevance on regional, national and international levels. Main efforts will be on qualifying and training future experts for the Saxon labour market, spin-offs of start-ups and assuming entrepreneurial responsibility in the high-tech sector.

Professor Chokri Cherif, coordinator of the junior research group and director of the ITM, “The work performed by this young research group will spark further fundamental and application-oriented research in the fields of carbon fibres. We will set new standards for the development of carbon fibres and trigger notable impulses with global impact.”

The required machinery, tools and equipment along the entire process chain are already available and ready for use at the three Institutes of the TU Dresden. In 2016, the Research Center Carbon Fibers Saxony (RCCF) has been founded by the ITM and the ILK in order to pool unique expertises regarding the development, research and production of carbon fibres in

Dresden as a major location for lightweight engineering. Thus, there is already a complete stabilisation and carbonisation plant available for “*e*-Carbon” to develop innovative functionalised carbon fibres.

Not only can stiffness and strength of this new type of carbon fibres be increased significantly, but their structure can also be adjusted specifically to complete further functions. Carbon fibres offer - due to their large internal surface that has not yet been made accessible - an enormous potential for energy storage systems, which will be targeted by the junior scientist group in future. Most significantly, this will be enabled by a trans-scale interconnected pore system, i.e. continuously cross-linked voids of defined sizes within the fibers. A great advantage in terms of energy storage is that the mechanical properties of conventional carbon fibres are not impaired, and active materials as well as carbon fibres act as current collectors.

„The customisation of carbon fibres and the hybridisation of materials on a micro scale will result in considerably higher battery capacities and completely new construction methods for electric mobility from micro to macro scale” says Professor Hubert Jäger from the Institute for Lightweight Engineering and Polymer Technology (ILK). “Customized carbon fibres offer precise material properties, and thus form the foundation for highly stressable and high-energy battery concepts with an enormous lightweight engineering potential. This will be our contribution to the development of innovative systems for electric mobility.”

Among various research foci, energy storage systems based on lithium sulfur batteries with a high energy density are to be investigated, and long-term concepts for the transmission of new discoveries into the fields of flexible dual-layer capacitors with rapid energy storage are to be designed. The results of this junior research group are supposed to ring in the industrial breakthrough in battery technology and electric mobility. Professor Stefan Kaskel points out, “The integration of electric storage elements into building components will open new markets for carbon materials. It is an important step towards the establishment of decentralized energy storage systems.”

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Institute of Textile Machinery and High Performance Material Technology (ITM)
Research activities at the Institute of Textile Machinery and High Performance Material Technology (ITM) of the TU Dresden, with its 240 employees lead by Prof. Dr.-Ing. habil. Dipl.-Wirt. Ing. Chokri Cherif, are focused on the development of machinery, technology and products (fibre-reinforced composite materials, construction textiles, biotextiles and medical textiles, textiles for sensor networks/functional textiles, assembled products/preforming). They include, for example, the processing of fibre-based high-tech materials such as carbon, glass, aramid, steel and ceramic fibres using various processing methods as well as the functionally integrated development of textile 3D semi-finished products and textile products. These research efforts are complemented by modelling and simulation of structures and processes along the entire textile process chain. Recently, the textile value chain has been expanded by a bicomponent melt spinning plant as part of the excellence initiative of the TU Dresden called “Support-the-Best”. Thus, this highly modular melt spinning plant enables the ITM to gain further competencies in the fields of fiber spinning for technical thermoplastics, such as Polyetheretherketone (PEEK), as well as bio-based materials, e.g. Lignine. In addition, the ITM already owns a highly flexible wet solvent spinning machine for the manufacture of, for example, PAN precursor fibres for carbon fibres. Moreover, the ITM is equipped with state-of-the-art infrastructure including modern machinery and technical devices along the entire textile process chain.

Institute of Lightweight Engineering and Polymer Technology (ILK)
The Institute of Lightweight Engineering and Polymer Technology (ILK) is a research facility of the Faculty of Mechanical Science and Engineering and the “Friedrich List” Faculty of Transport and Traffic Sciences at the Technical University Dresden. In the fields of resource-saving lightweight construction characterized by high material and energy efficiency, round about 240 employees are conducting comprehensive research and development activities.

Work at the ILK is shaped by the Dresden model of a „function-integrative system lightweight engineering in multi-material design", and is based on a cross-materials and cross-product approach. In the development of new concepts, processes and products, the scientists consider the entire development chain: material – construction – simulation – production – prototype testing – quality assurance – costs. The ILK is led by a four-person board: Prof. Dr.-Ing. habil. Maik Gude (Chair of Lightweight Design and Structural Assessment), Prof. Dr. rer. nat. Hubert Jäger (Chair of Lightweight Systems Engineering and Multi Material Design), Prof. Dr.-Ing Niels Modler (Chair of Function-Integrative Lightweight Engineering) sowie Prof. Dr.-Ing. habil. Prof. E.h. Dr. h.c. Werner Hufenbach (Distinguished Senior Professorship).

Chair of Inorganic Chemistry 1 (AC 1)

The Chair of Inorganic Chemistry 1 is led by Prof. Kaskel at the TU Dresden. For the past years, its over 40 employees have been focused on exploring and developing porous and nanostructured inorganic materials for energy storage. Nanoporous materials are applied for gas storage and used as electrode material. With a specific surface area of over 4000 m^2/g, high values can be achieved. Thus, AC1 is considered a technological frontrunner in this regard. These results refer to the class of "DUT-n" materials and are now to be transferred onto the carbon-based structures. Research regarding carbon-based electrode materials has been supported by the regional excellence initiative of the State of Saxony (ECEMP). Scalable methods were developed in cooperation with the Fraunhofer IWS for the production of carbon electrodes with surface areas of up to 3000 m^2/g for super capacitors and lithium sulfur batteries. For the first time, lithium sulfur batteries were achieved with sulfur carbon composite cathodes containing up to 1200 mAh/g with 4 µl/mg sulfur. Prof. Kaskel operated as coordinator of the DFG-program SPP 1362 (Porous ceramic materials).