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KARL SCHULTE-TECHNISCHE UNIVERSITÄT HAMBURG

COMPOSITE MATERIALS

WHERE WE ARE AND WHERE TO GO (MECHANICAL AND ELECTRICAL PROPERTIES OF POLYMER COMPOSITES)

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ABSTRACT

Composite materials have developed in the last 60 years from a just new material into a class of established engineering material with surprisingly outstanding properties. Best demonstrated as being the material of choice in the aerospace industry.

The idea of fibre reinforced composites was to develop a new class of structural material with the advantage of light weight combined with high strength, but accepting the “disadvantage” of being highly anisotropic. Consequently, the early research presented in the first ICCM, ACCM and ECCM conferences focused on the design and mechanics of composite materials. New production technologies had to be developed, which remain to be a subject of high importance. A new understanding on damage and failure was developed together with novel non-destructive evaluation techniques. Materials science is and has been necessary to overcome the misfit between the different classes of material (metal/ceramic; polymer/ceramic; bio based matrix/natural fibres etc.). Science on composite materials has matured into a real interdisciplinary research.

Advancements in materials science allow to control and tailor mechanical (structural) and physical (functional) properties of lightweight materials. On the example of reinforced polymer composites we discuss how carbon based fillers, as fibers and carbon allotropes, improve the mechanical and electrical properties of composite materials. This enables the design of lightweight composite structures with embedded functions, as heating or sensing capabilities to monitor deformation, load, damage or even identify gas. In this presentation we will discuss the improvements achieved based on technological advancements and its potential for future applications.

With the understanding of the complex interaction of the constituents new applications of composites will be possible which, on the other hand, deserves further and intensive research.

In the presentation we will discuss what we have reached already in composites science and technology, where we still lack understanding and where and how our research can lead to new applications.



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B I O

Prof. Dr.-Ing. Karl Schulte has been head of the Institute of Polymer and Composites of the Technische Universität Hamburg (TUHH), Hamburg, Germany, until September 2013. After working as an apprentice in electrician he graduated in Mechanical Engineering at the Ruhr-Universität in Bochum (Germany). Here he also earned his Ph.D.-Degree in 1979 in "Materials Science". He worked until 1991 with DLR (German Aerospace Research Center, Institute of Materials Science) in Cologne, Germany. Within the field of lightweight materials he changed the focus of his research from metals to fibre reinforced composites. In 1992 he became Professor at TUHH with a chair on Polymers and Polymer Matrix Composite Materials. He had sabbatical leaves at Virginia Polytechnic Institute and State University (Virginia Tech) in Blacksburg, Virginia, U.S.A. and the University of Cambridge, Department of Materials Science and Metallurgy, Cambridge, U.K. His research focused on degradation of fibre reinforced composite materials, nanocomposites and the synthesis of carbon nanotubes (CNTs) and Aerographite, a three dimensional graphitic aerogel.

Prof. Schulte is member of the Editorial Boards of several national and international journals in the area of composite materials. Together with his collaborators he has published more than 300 peer-reviewed publications in journals, books and conference proceedings. ISI HighlyCited.com listed Prof. Schulte as "Highly Cited Researcher in Material Science". Based on Scopus, the number of his citations amount to 20204 (up to December 9, 2021), and his present H-index is 66. He is an elected By-Fellow of the Churchill College, Cambridge, UK. In 2013 the "International Committee for Composite Materials" (ICCM) named him "Composites World Fellow" and in September 2014 he received the "Medal of Excellence in Composite Materials" from the University of Delaware, DA, USA. In 2013 he was also nominated in Germany for the prestigious "Diesel Medal". He worked as a consulting professor for the King Abdulaziz University (KAU in Saudi Arabia between 2013 and 2014.

After his retirement Prof. Schulte continues to work scientifically in the composites field as a consultant and assessor and as Editor-in-Chief of the international journal "Composites Science and Technology".