CURRENT TRENDS IN CMC RESEARCH & DEVELOPMENT ACROSS DLR'S TECHNOLOGY PROGRAMS

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Ceramic Matrix Composites are key engineering materials for many aerospace and energy applications where properties such as high thermal-chemical stability, low weight, high strength and toughness are crucial. CMC come into play where other materials reach their stability limits: they can replace polymer-based materials, light-metal as well as refractory alloys. Depending on their constituents and architecture, CMC can serve as functional and structural components. At the German Aerospace Center (DLR), the Department of Structural and Functional Ceramics at the Institute of Materials Research (Cologne) and the Department of Ceramic Composites and Structures at the Institute of Structures and Design (Stuttgart) jointly develop CMC materials and components for a large variety of applications in line with the strategic goals of DLR's technology programs. All-oxide and non-oxide, continuous and short-fiber reinforced CMC are being developed for example as thermal protection systems, hot-gas leading components or other lightweight structures for technical systems. With widely varying requirements and target operating environments ranging from kryogenic up to 1800°C+ in oxidizing and non-oxidizing atmospheres, material selection is vital with regards to performance and economic factors. Furthermore, consideration of the availability, applicability and limitations of manufacturing processes and material specific component design are equally important for the successful application of CMC. Beyond the profound understanding of CMC materials properties, their behavior and application limits, a key issue for a successful transfer of CMC R&D to industrial application is concurrent work on component design and process digitalization towards the goal of a fully integrated process chain. Various examples of recent work in the field of non-oxide and oxide CMC and the integrated R&D approach of both DLR ceramics departments are presented.