DLR Institute of Structure and Design

Das DLR-BT forscht in verschiedenen Bereichen an non-oxide CMC und CFK Werkstoffen. // DLR-BT conducts research in various areas on non-oxide CMC and CFRP materials.

The Institute of Structures and Design (BT) of the German Aerospace Center (DLR e.V.) has decades of expertise in the development of materials for efficient high-temperature lightweight design. Together with its 150 employees and the colleagues of the Institute of Materials Research (WF), new processes and design methods are continuously being developed for innovative high-performance structures in the fields of aerospace, vehicle construction and energy technology. The basis of these developments is the interaction of high-performance, temperature-resistant materials and innovative digital methods. The result: new technological developments for a sustainable future.

Together with the department of Structural and Functional Ceramics (WF-SFK), the Ceramic Composites and Structures department (BT-KVS) designs and creates both oxide and non-oxide materials, as well as processes for manufacturing light weight ceramic matrix composites subject to high thermal and mechanical loads. The secret of success lies above all in the multidisciplinary cooperation between different development areas. Thus, component and material development are not only considered independently, but their structural integrity is also integrated into the engineering chain by means of process-optimized modeling tools.

By digitally and analogously mapping the process chain from material development to prototype production and linking material characterization and non-destructive analysis, new developments can be produced quickly, cost-effectively and without rejects, even for complex component geometries.

For the fabrication of non-oxide fiber reinforced ceramics, mainly, within DLR, the Reactive Melt Infiltration (RMI) and Liquid Siliconization Infiltration (LSI)




processes are used to produce CMCs with tailored material properties. These components can be used at temperatures ranging from room temperature to over 2000 °C. In cooperation with other DLR institutes, developed structures are not only tested under relevant conditions, but also applied in real life. Be it as thermal protection systems on sounding rockets, as engine components in the aerospace industry or as ceramic brake discs for cars, airplanes and propellers. The use of different matrices, fiber materials and shaping methods such as hot pressing, autoclaving, RTM and winding processes is constantly expanding the range of applications with regard to the lifecycle and atmospheric conditions of the high-performance structures, so that new areas of application can be continuously opened up.

Here, the available infrastructure also makes the difference. Adapted CAD and FEM systems for the calculation of structures in the real application, as well as furnace systems for pyrolysis and silicification in different sizes and temperature ranges enable process-optimized component development. Modern testing facilities for quality assurance such as CT and air ultrasound systems, as well as scanning electron microscopy with connected energy dispersive X-ray spectroscopy guarantee development projects with the highest technology standards.