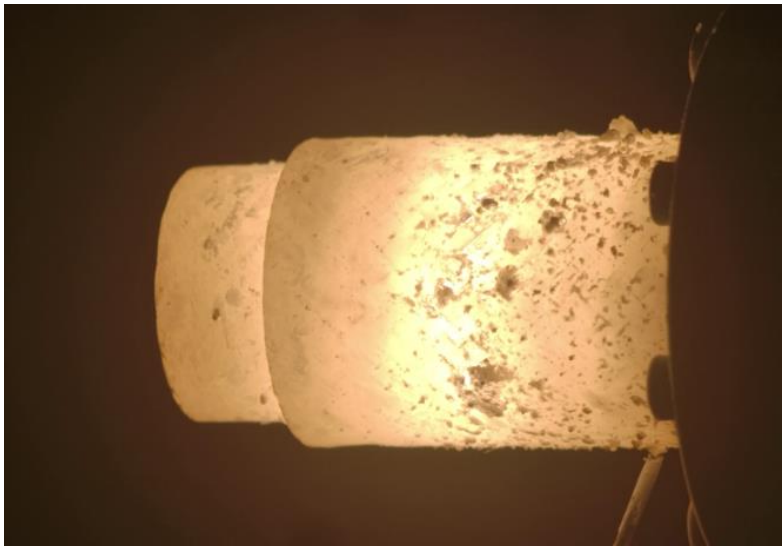
C/C-SiC THRUST CHAMBERS



RESEARCH LOCATION

DLR Institute of Structures and Design, Stuttgart

PROJECT

NeoFuels

PROJECT TERM

2022-2024

MATERIAL

Ceramic Matrix Composite (CMC, C/C-SiC)

OBJECTIVES

- Light-weight and high-temperature stable C/C-SiC thrust chambers for 20 N space propulsion systems
- Effective design concepts based on liquid silicon infiltration (LSI) and in-situ joining technologies

In the frame of the DLR project NeoFuels the DLR Institutes of Space Propulsion and Structures and Design are developing different green propellant systems for the use in rocket engines for space propulsion. Besides the propellants, thruster structures made of light-weight and high temperature stable CMC are in the focus.

C/C-SiC materials are characterised by carbon fibres, embedded in a carbon and silicon carbide matrix, and are manufactured via the Liquid Silicon Infiltration (LSI) process. Due to the use of low-cost raw materials and short process times, the LSI process is already used for commercial applications like jet vanes and brake discs. For the manufacture of the thrusters, a differential design based on three components, a tubular combustion chamber, a tubular flange and a nozzle insert was selected. Therefore, CFRP preform tubes were made via the prepreg wrapping method, whereas the nozzle was warm pressed using cut carbon fibres and powdery phenolic resin. After the pyrolysis of the CFRP tubes and nozzle, the C/C preforms were machined, joined and siliconised. Firing tests of the thrusters in a vacuum chamber showed a high temperature resistance and a low abrasion of the nozzle throat diameter, determined by computertomography before and after the tests.

An important step in the development was the collaboration with IWC Schaffhausen, in which we developed a manufacturing process for a CMC watch case and perfected the feasibility of small components.

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More information
NeoFuels project