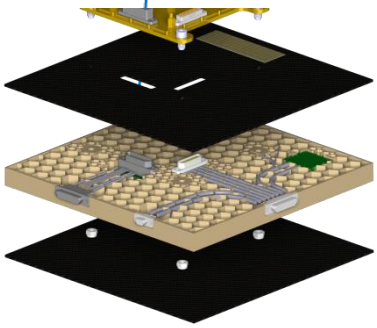
Additive Manufacturing

At the Institute of Structures and Design in Stuttgart, additive manufacturing processes and materials are investigated for their suitability for aerospace and energy applications. The IRAS (Integrated Research Platform for Affordable Satellites) project aims to produce flexible and cost-effective satellite structures. Concurrently, MuSiK (Multimaterialdruck von C/Si/SiC-Keramiken) investigates the multi-material printing of C/Si/SiC ceramics.



IRAS: Multifunctional sandwich panel

Polymer Structures

High-temperature thermoplastics such as PEEK and PEI have been proven to fulfil the strict requirements for aerospace structures. Due to the large design freedom of 3D-printing, such structures can be implemented as lightweight, multifunctional components with a high cost-efficiency. Current research projects aim to design, produce, and qualify multifunctional satellite structures by integrating electronics and sensors into primary sandwich panels. Through this approach, both integration and launch costs of future satellites can be reduced.

IRAS: Laval nozzle throat
Left: 3D-printed green body
Right: Converted to silicon carbide ceramic

Ceramic Materials

Silicon carbides can be used to produce various high-temperature components in satellites, such as a Laval nozzle throat in an apogee engine, where high temperatures, corrosion, pressure, and wear are all critical factors. Additive manufacturing of complex SiC-ceramic parts begins with a cost-effective, highly filled thermoplastic raw material. The 3D printed green body is then pyrolysed, resulting in a porous carbon preform. During the liquid silicon infiltration the carbon of the preform reacts with molten silicon and forms silicon carbide. The result is a near net-shaped SiC-ceramic component.

MuSiK: Silicon carbide ceramic gyroide structure
(Design by Airbus)

Gyroide Structures

Gyroide structures are popular in extrusion-based 3D printing technologies due to their exceptional strength and lightweight structure. They do not require a support structure while printing and are commonly used as an infill pattern. Due to the separated channels and silicon carbide properties (e.g. high thermal conductivity and thermal shock resistance), structures of this nature may be used in a wide variety of demanding applications, particularly in the energy sector.

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