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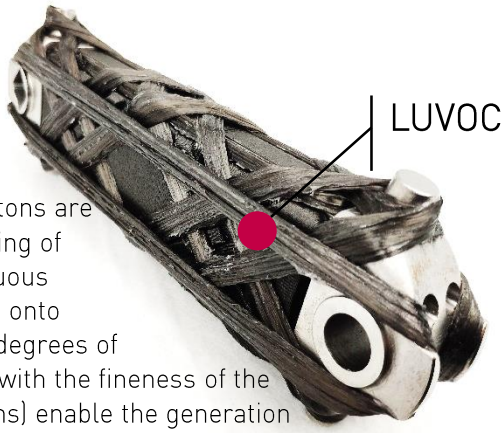
Additive manufacturing solutions

LUVOCOM® 3F for printed core structure

Research project: CFRP bicycle crank in 3DSW design



The 3D skeleton winding technology (3DSW) is a design and manufacturing approach to realizing topology-optimized, continuous fiber-reinforced lightweight structures. The so-called fiber skeletons are produced through robot-based 3D filament winding of thermoplastic or thermoset impregnated continuous reinforcement fibers (e.g. glass or carbon fibers) onto component-specific winding tools or cores. The degrees of freedom of the 6-axis industrial robot combined with the fineness of the semi-finished products (mostly commingled yarns) enable the generation of complex, three-dimensional composite structures as well as a load-path-optimized alignment of the continuous fibers. By integrating inserts (e.g. metallic load introduction or support elements) into the wound structure, a form-fit load transfer is enabled. This ensures maximum utilization of the reinforcement fibers' mechanical properties. The fiber skeletons produced using 3DSW can be used as extremely light skeletal components or for local reinforcement of molded parts (e.g. injection-molded components) or additively manufactured parts (e.g. FFF components).

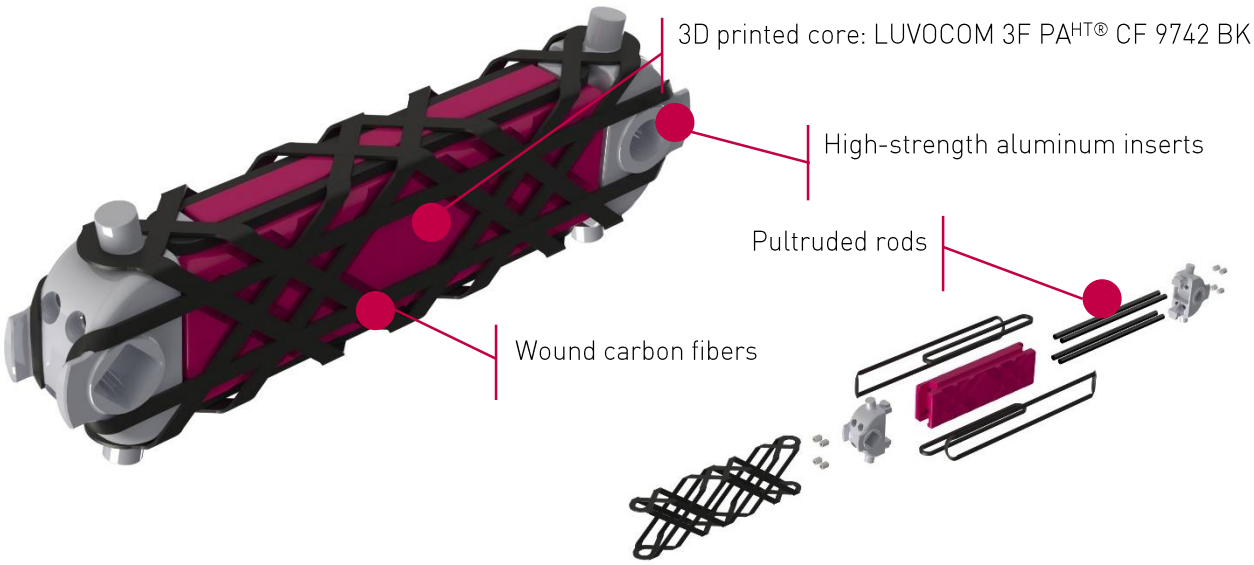
As part of the research project ELeGanz-3D (funded by the German Federal Ministry of Education and Research, grant no: 03VP06670), a pedal crank for bicycles was implemented as one of the demonstrator components using the 3DSW technology. The resulting pedal crank demonstrator illustrates the potential of 3DSW in the context of lightweight applications implying complex interactions of tensile, compressive and torsional loading.
To be able to withstand this superposition of different load types, the developed pedal crank consists of the following components:

- The 5-axis milled inserts made from high-strength aluminum enable form-fit load transfers and bearings.
- The additively manufactured core (FFF process) made from LUVOCOM 3F PA$^{HT®}$ CF 9742 BK absorbs compressive loads and contributes to the load-path-optimized positioning of the continuous fibers. It is also used as base part for the assembly of the overall system.
- The 3D filament wound loop structures made from continuous carbon fiber-reinforced thermoplastic tapes are used to transfer tensile and torsional loads.
- Pultruded CFRP rods are inserted for the absorption of further compressive loads.

The LEHVOSS Group supports and cooperates with Fraunhofer ICT in this project regarding material selection, design and processing for the 3D-printed core.

Fraunhofer ICT

LEHVOSS Group



About Fraunhofer ICT

The Fraunhofer Institute for Chemical Technology ICT, founded in 1959, is one of the largest and longest-established institutes of the Fraunhofer-Gesellschaft, which currently has around 30,000 employees and a total turnover of 2.9 billion €. At Fraunhofer ICT's site in Pfinztal over 550 employees carry out research and development work in the core competence areas of chemical and environmental engineering, polymer engineering, new drive systems, energy systems and explosives technology.
The Polymer Engineering department develops concepts, materials and processes for the manufacture of lightweight components (e.g. for automotive, aerospace, and construction industry). Within the Polymer Engineering department, the Injection and Compression Molding group is working on material and process development for the large-scale manufacturing of material systems with thermoplastic and thermosetting matrices and flowing characteristics. The 3D skeleton winding technology is one development area of this research group.

About LEHVOSS

The LEHVOSS Group under the management of Lehmann&Voss&Co. is a group of companies in the chemicals sector that develops, produces and markets chemical and mineral specialities for various industrial clients. Lehmann&Voss&Co., Hamburg, was founded in 1894 as a trading company. Since that time, the owner-run company has evolved into a powerful global organization – with long-standing connections to prominent, mainly foreign suppliers and with its own production sites in Europe, the USA and Asia. Home (lehvoss.de)
The Customized Polymer Materials (CPM) division has been a partner to industry since 1984 in terms of material development, production and support, from design to part production. LEHVOSS offers customized solutions for challenging applications that are unique and stand out in the market.

With the 3D printing product lines LUVOSINT® and LUVOCOM® 3F the LEHVOSS Group offers innovative and customized polymers for 3D printing. They are dedicated to the most common technologies as powder bed fusion, fused filament fabrication (FFF) and fused granulate fabrication (FGF). 3D Printing Materials (luvocom.de)

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