

- 1 Product sample for a composite part made of CFRP and aluminum.
- 2 CFRP-aluminum hybrid connection made by cast infiltration of glass-fibre laminates with molten aluminum.

## »CARBONAL«

# CFRP-ALUMINUM COMPOSITES FOR LIGHTWEIGHT STRUCTURAL PARTS BY CASTING

Fraunhofer IFAM has developed a new technology for the direct joining of CFRP and aluminum in the casting process. The focus of this technology is directed at achieving series manufacturing while simultaneously avoiding electrochemical corrosion between the two materials.

### Motivation

Lightweight construction is a key technology. Whenever low weight is asked for and mass needs to be moved, fiber-reinforced composites are the materials of choice. However, not always can be dispensed with metals. A good method to combine the best properties of different materials is using hybrid construction, and with weight reduction in mind, CFRP and aluminum make a very useful material combination.

### State of the art

Usually, metal and CFRP components are joined either mechanically or with adhesives. With a view on weight-optimized, integral structures with improved mechanical properties, developing new construction or joining techniques are of interest, especially since all conventional joining techniques like bonding or riveting possess major disadvantages, e.g. extensive pre-treatment, time-consuming process steps, thickening of material in the joining area, destroyed fibers due to riveting or difficulties with the testing of the adhesive joints.

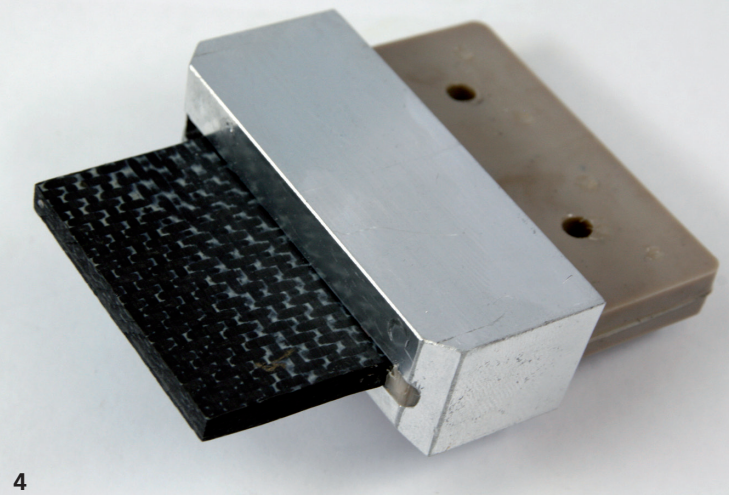
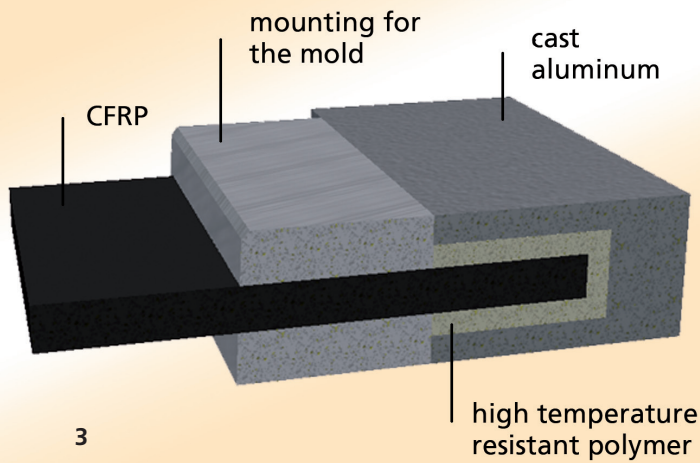
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### Technology

The Fraunhofer Institute for Manufacturing Technology and Advanced Materials is developing new approaches for different joining technologies in high pressure die casting. A transition structure between the materials aluminum and CFRP that are to be joined generates the connection between metal and CFRP with regard to fiber-suited design and - compared to conventional joining techniques - reduced weight and volume.

The inserted joining element leads to galvanic isolation between both materials and thus reduces the corrosion behavior of the Al-CFRP composite. The unique advantage of these transition structures consisting of heat-resistant glass or ceramic fibers or protective polymer layers is the easy direct integration in aluminum parts by means of aluminum casting technology.

This new hybrid casting-joining technology called *CARBONAL* is being explored and developed in the »Casting Technology and Component Development« at Fraunhofer IFAM, with additional support from the »Plasma technology and Surfaces« department. Here, suitable surface modifications are being developed that improve mechanical properties and corrosion behavior of the composites.

### Potential applications

Potential applications for this technology can not only be found in the automotive industry, but also for consumer goods or robotics. With the new *CARBONAL* process, metallic joining areas can be cast on conventional CFRP elements.

These connecting elements in turn allow an easy joining with other metallic components. The problematic adhesive or mechanical joining process between metal and CFRP therefore becomes obsolete.

If the CFRP element is damaged, the metallic component can be easily disconnected and the CFRP component can be replaced with the help of the metallic connecting elements.

### Our offer

- Consulting and brainstorming for CFRP-aluminum hybrid composites
- Process development for manufacturing the hybrid composites
- Design and production of polymer insulation layers
- Experimental and small series of aluminum castings
- Interface characterization in the hybrid composite (metallography, mechanical testing)
- Concept development for the positioning of CFRP elements in the mold
- Casting simulation
- X-ray and computer tomography

3 *Sectional view of the joining technique between aluminum and CFRP by means of a PEEK transition structure.*

4 *Joint component for recasting in aluminum for the creation of an aluminum-CFRP composite by means of a PEEK transition structure.*