Chair of Carbon Composites
TUM School of Engineering and Design
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Hybrids & Integration of Functions

Modern Lightweight Design requires Intelligent Mixture of Materials

Hybrid Composites

Hybrid materials are the combination of different polymers (matrices), different reinforcing fibers and/or additional materials, such as metallic components. Design and process layout must be considered for hybrid structures in order to manufacture parts with sufficient quality, mechanical properties and reasonable cost. The application of hybrid materials and structures enables the development of the most suitable material to meet a specific set of requirements.

Novel applications and processes for hybrid-materials are developed and investigated across a range of research areas. The manufactured materials are characterized with respect to their mechanical, physical and chemical properties.

Integration of Functions

The combination of different materials and manufacturing processes enables integration of a wide variety of functions. A distinction is made between functions in the end application and during the manufacturing process. At component level, for example, surface coatings or locally different mechanical properties can contribute to added value, while more economical solutions are sought at process level.

The Topic Field

The research field at the LCC bundles and pilots research of the material mix and functionalization of composite components. Know-how generates reliable and rapid statements on the suitability of processes, materials and functions for future applications.

Applications at the LCC

Multi-Material Processing

Current production processes such as resin transfer molding (RTM) or Large Scale Additive Manufacturing (LSAM) are being adapted to co-process different material combinations. Examples include different matrix materials for locally tailored stiffness, as shown in Figure 1.

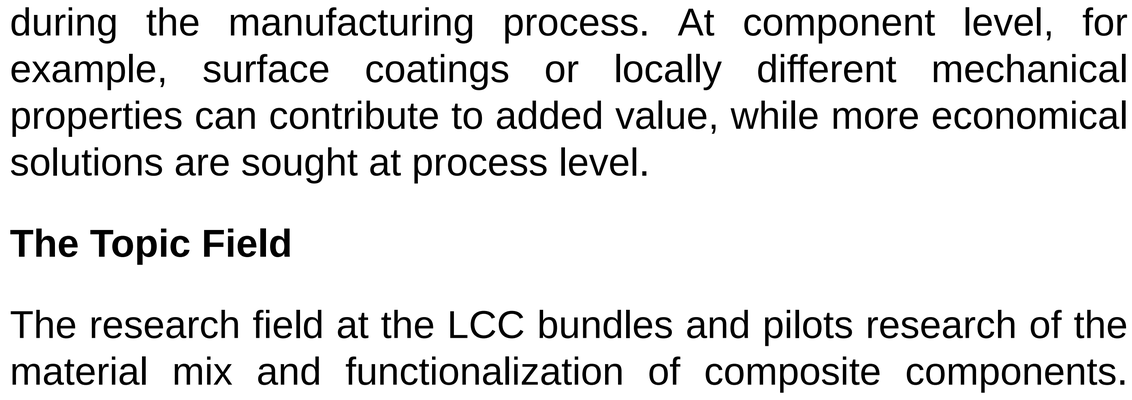

Fig. 1: Thermoset and elastomer matrix material for modifying local part properties

Better processability can be achieved by altering the viscosity of the resin used for infusion. With this technology, one can control the flow during the process, obtaining more control over the composite manufacturing process. (Figure 2)

The addition of continuous fibers into a short fiber reinforced, 3D printed thermoplastic part offers the advantage of low-cost feedstock with the benefits of continuous fibers. Stiffness and

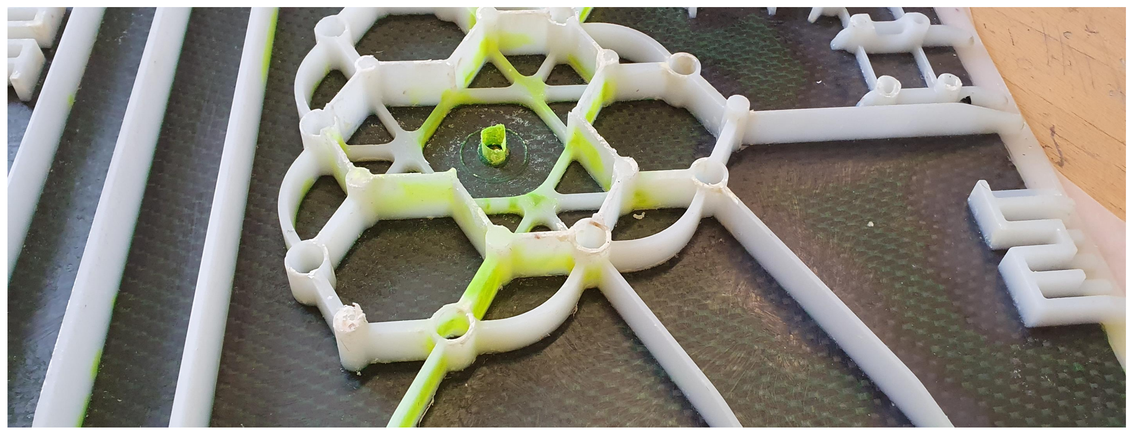

Fig. 2: Viscosity tuning of matrix material for more control during resin infusion

thermal expansion can be tailored by the amount, location and direction of the fibers which are placed inside the short fiber reinforced part. Figure 3 shows 2D-woven carbon fiber fabric on top and inside a 3D printed plate.

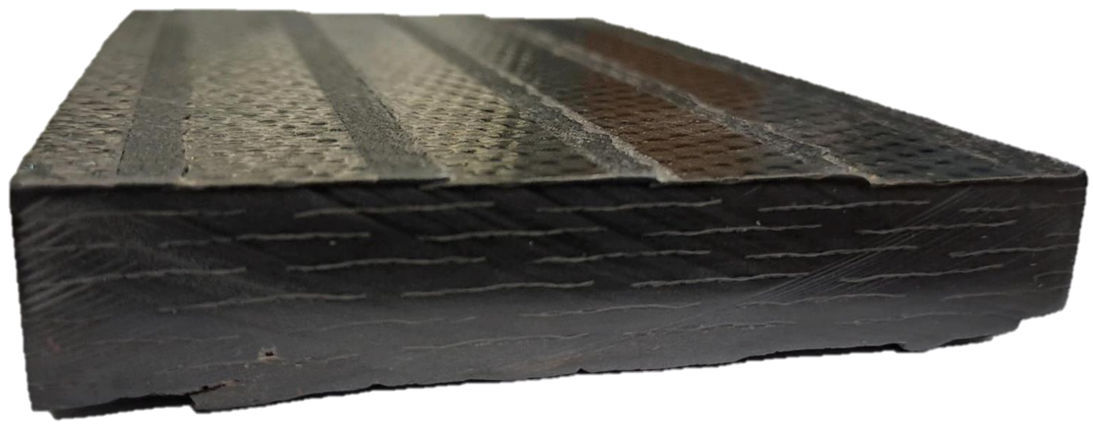

Fig. 3: Thermoplastic short – and continuous fiber reinforced plate manufactured by the ATLAM process

Load-Introduction Structures

In industrial applications, the joining of thermoset with thermoplastic components in load-introduction areas present new challenges. The design and the development of manufacturing processes for novel force-introduction concepts such as thermoplastic struts in wet-wound hydrogen pressure vessels (Figure 4) are current research topics.

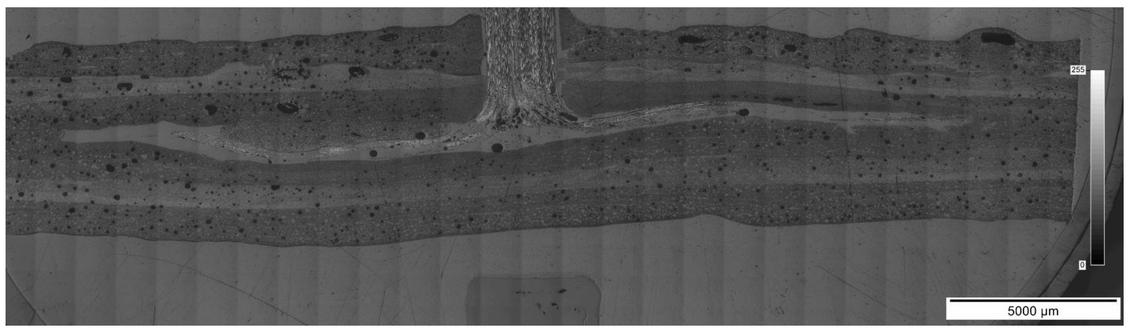

Fig. 4: Micrograph of the crosssection of a TP strut joint into the shell of a hydrogen pressure vessel

More information and contacts: