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COST-EFFECTIVE HIGH SPEED PRODUCTION OF MULTI-MATERIAL COMPONENTS BY SELECTIVE TAPE PLACEMENT

Christian Brecher, Tido Peters, Michael Emonts

Fraunhofer Institute for Production Technology IPT, Germany
C.Brecher@wzl.rwth-aachen.de, tido.peters@ipt.fraunhofer.de, michael.emonts@ipt.fraunhofer.de

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Summary: Cost efficient production technologies for lightweight composite components are the key-enabler for a broad application. The use of laser-assisted tape placement in selected locations in existing composite structures provides the production of thermoplastic multi-material composite parts with the optimum reinforcement, weight and cost profile. Enhanced by the new manufacturing process route the weight of components can be significantly reduced as the combination of different reinforcement fibers in one single structure allows the achievement of an optimized relation between performance and weight. This is being developed in the European funded FP7 Project Stellar.

Providing excellent weight and mechanical characteristics in combination with high corrosion resistance fiber-reinforced plastic (FRP) composite show remarkable potential for a substitution of conventional materials like metals for many applications. In particular endless unidirectional (UD) fiber-reinforced tape materials allow to design multi-layered laminates and 3D structures with optimized fiber direction tailored to the load. However, advanced automated manufacturing capabilities cannot supply the required production speeds and the prices for these semi-finished products are too high to be affordable for mass markets. The FP7 project "Selective Tape-Laying for Cost-Effective Manufacturing of Optimised Multi-Material Components (Stellar)" aims at the development of the first manufacturing process route for the production of hybrid fiber-reinforced thermoplastic structures in order to achieve the best composition of costs, performance and weight addressing transportation and aerospace markets.

Aiming at higher cycle times fully impregnated sheets with random orientated fibers embedded into a thermoplastic matrix sourced commercially can be reshaped using the fully exploited thermoforming process. The subsequent selective tape placement onto the formed parts at the load-bearing areas with the optimum orientation aims to increase the component stiffness. Thus the combination of tape placement, being one of the most flexible composite production processes, and thermoforming, being one of the most productive processes, can be realized. This production step requires a full consolidation over the entire applied tape length to eliminate subsequent trimming operation prior to finishing and surface treatment operations.

Furthermore "Stellar" aims at the combination of a high variety of different materials tailored to the engineering application and considers also the process routes of combining random fiber sheets and endless fiber-reinforced UD using laser-assisted tape placement as primarily process step and thermoforming as reshaping step. Thus a high performance component can be produced which provides the fiber orientations along the load paths, has a high stiffness the needed ductility and the optimum of weight.

A transfer of thermoplastic composites and multi-material systems into major markets also requires material innovations. Within Stellar new tapes and random fiber sheets have been developed that enable constancies in quality and matrix materials.