TAILOR-MADE JOINTS FOR PLASTIC-METAL HYBRID COMPONENTS

Task

Manufacturing multi-material components requires reliable bonding technologies since dissimilar materials need to be joined. Laser-based joining of plastics and metals is an innovative approach to do this quickly and permanently. To optimize the components in a load-adapted manner, however, designers and developers need sufficient knowledge of the joining properties when the component is designed and dimensioned: in other words, guidelines and tools for implementing hybrid joining technology.

Method

The laser-based process chain for joining consists of two process steps. In the first process step, microstructures are introduced into the metal surface, and in the subsequent joining process these structures are then filled with molten plastic. Depending on the strength and load requirements, the joining properties can be specifically influenced by load-adapted laser microstructuring. This opens up extended possibilities for optimizing components during design and component layout. So that characteristic values can be determined, laser-structured metal inserts are injected into a hybrid injection molding process to produce hybrid test specimens, which are then tested under various loads.

Results

The strength parameters for shear, tensile and peel loads from the component test serve as the basis for simulations of the joining zone at micro level and for component design at macro level. By adapting the structures depending on the load case, Fraunhofer ILT can optimize components and minimize process times. The institute aims to derive design methods for hybrid components and transfer them to demonstrators and real components.

Applications

Plastic-metal hybrid components are used in almost all areas of life. High demands are placed on the performance of structural components, particularly in the automotive and aerospace industries.

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3 Hybrid rib test specimen for characteristic value determination.

4 Simulation of the joining zone.