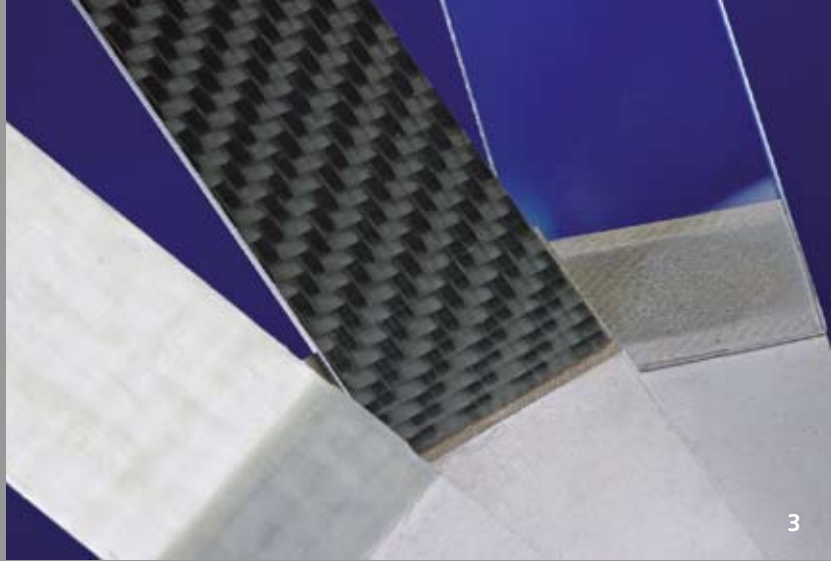

JOINING PLASTIC-METAL HYBRID COMPOUNDS

Task

Particularly in automobile construction, bonding heterogeneous working materials is an important requirement. The use of different working materials, such as plastics and metals, adapted to local loads should open up new paths for further weight optimization. While plastics are characterized by low weight, favorable price and a nearly infinite number of forming possibilities, metals can withstand, thanks to their mechanical properties, significantly higher mechanical loads. A direct and firm bond between plastics and metals, however, fails due to the chemical differences between them. A connection through a positive-locking fit or the use of additives is, thus, necessary.

Method

At Fraunhofer ILT, a process chain has been developed which uses laser radiation to generate microstructures in metallic joining parts. In a subsequent laser joining process, the plastic is bound due to an interlocking in the microstructure in a positive locking manner. For the bond to fix well, the plasticized material has to flow into the generated structures, which have an undercut geometry, and to harden there.

Result

The bond's mechanical strength depends decisively upon the structural density and the temperature during the joining process, in addition to the mechanical properties of the plastic. During laser penetration joining, a targeted joining temperature is used to plasticize the polymers through the temperature-based control of the laser power. This way, strength levels above that of an adhesive joint can be obtained without any specific disadvantages. With this innovative joining process, different plastics and metals can be joined (Figure 3), and an appropriate constructive dimensioning of the joint enables high powers (> 16,000 N, Figure 2) thanks to a double strap bond.

Applications

As components become more and more hybridized, the working piece-specific advantages of different materials can be combined, allowing light and stiff components to be manufactured. For this reason the two-step process presented here is especially suitable for the aerospace industry and automobile construction.

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2 Metal-plastic double-strap bond (maximum load capacity > 1.6 t).
3 Combination of steel (1.4301) with different plastics (GFK, CFK, PC).