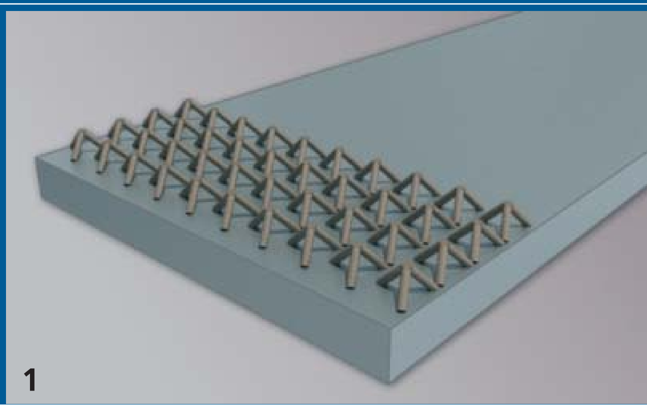
BUSINESS UNIT
ADDITIVE MANUFACTURING AND PRINTING



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MICRO-GENERATED CLAMPING STRUCTURES

THE TASK

Low weight and costs, as well as integrated functionalities, are major objectives for product optimization in many fields of research and development. Multi-material design is a global trend. Placing the right material in the right place means saving weight, e. g. by the use of lightweight plastics in component areas under less stress. Ceramic insulation layers in zones subject to high thermal load, where high strength is contributed by the metal components, permit an increase in the operational temperatures of turbo-jet engines.

Material combinations enable to integrate functions that would be impossible through metal design alone: daming of vibrations, thermal and electrical insulation, and protection against corrosion.

Changing over from a classical single-material to a multi-material design approach is challenging and requires, for instance, a joining process to join different materials permanently and robustly.

OUR SOLUTION

Both delicate and large components of several meters can be made on a multi-scale through additive manufacturing. For the change from plastics to metal or ceramics to metal, weld beads can be built up in several layers with a tailored profile to be interlocked with the plastic or ceramic. To reproducibly build delicate microstructures with varying cross sections in large quantities, all processes must be performed carefully with high accuracy using precise equipment.

Microstructures can be tailored for individual tasks, e. g. even with strong undercuts (Fig. 1). The latter yields a strong compound made of the metallic substrate and the join partner, which withstand heavy mechanical loads.

For profound adhesion of the melted plastic, as well as for fiber-reinforced plastic, the CAD / CAM tools were modified and used to optimize the manufacturing process.

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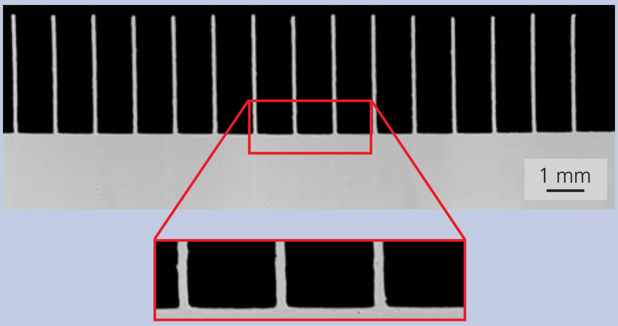
RESULTS

Precise structures can be laser powder cladded on rotationally symmetrical or planar substrates and free-formed surfaces as well in a reproducible, reliable, rapid and economical procedure, with a wide design variety.

In the transition area developed, the force is introduced into the volume of the plastic, which is better than an interface in conventional joining, such as adhesive bonding. Critical transition areas are sealed, or an intermediate layer is applied before joining by means of layer structures. These layers are important for medical and dental applications where they prevent bacterial impairment due to a defective joint.

It is also possible to combine different metals, adapted to the loads and stresses for each case. Even the material compositions can vary (for gradients and others) in size in a two-digit micrometer range. Functional elements can also be applied to the structures made by additive manufacturing.

Transverse microsection of a web-like interlocking structure without pores with strong metallurgical adhesion on the substrate



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As can be seen in Figure 4, metallurgical material compounds can be built layer by layer and without pores even in small sizes. The technology is successfully in use in the latest generation of turbo-jet engines for civil use thanks to consistent process and system refinement and quality assurance measures in parallel.

2-3 Structure to join metal and plastic

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