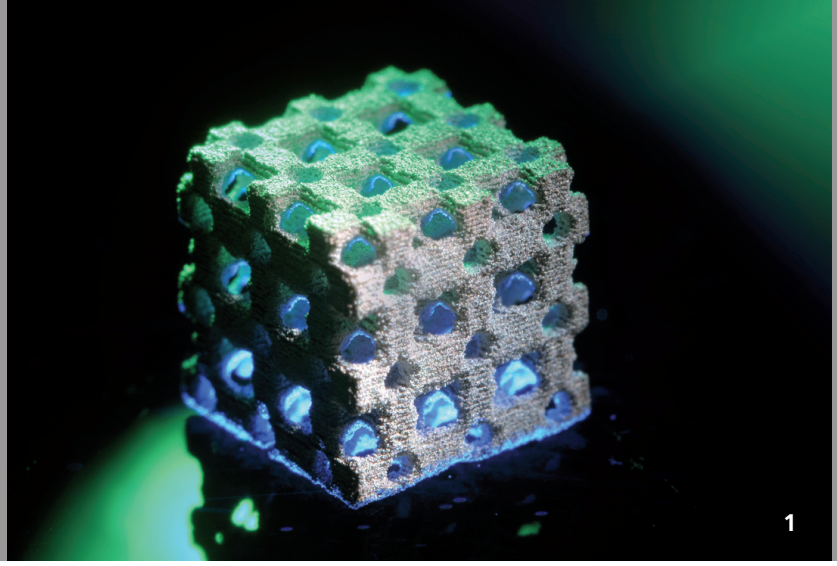

SELECTIVE LASER MELTING OF MAGNESIUM ALLOYS

Task

Magnesium and magnesium alloys are used primarily in lightweight construction due to their low density. At the same time, magnesium is biocompatible as an essential part of the human metabolism and offers huge potential for use as a bioresorbable material for degradable bone replacement implants even in load-bearing areas, thanks to its corrosion and mechanical properties. In combination with the geometrical freedom offered by additive manufacturing, components and implants with unique functional properties can be manufactured particularly in lightweight construction and medical technology applications. Selective laser melting (SLM) enables the manufacture of topology-optimized components that are tailored to the actual loading case as well as implants with defined, interconnected pore structures that can substantially improve bone ingrowth. These material and process advantages should be combined by developing SLM for processing magnesium alloys.

Method

The magnesium alloy AZ91 has been chosen for the initial studies to develop a suitable SLM process. The SLM system technology has been modified in accordance with the high oxygen affinity of magnesium and magnesium alloys, especially in the powder form used. The minimal difference between melt and vaporization temperatures poses another challenge when it comes to developing a suitable process window.

1 Test geometry manufactured using SLM (edge length 6 mm) with interconnected pore structure made out of AZ91.

Result

The modification of the system technology supports reliable processing of magnesium powders by reducing the oxygen content of the inert gas atmosphere used to 10 ppm. Under these process conditions, simple test specimens made from AZ91 can be manufactured with a density greater than 99 percent by modifying the process parameters. Initial complex geometries with interconnected pore structures have also been manufactured.

Applications

The additive manufacturing of light metals such as magnesium and magnesium alloys is ideal for lightweight applications as it enables extremely complex geometries to be manufactured. At the same time, the possibility of using magnesium alloys as bioresorbable materials paves the way for a new application field for SLM in the area of resorbable load-bearing bone-replacement implants.

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DQS certified by DIN EN ISO 9001, Reg.-No.: DE-69572-01