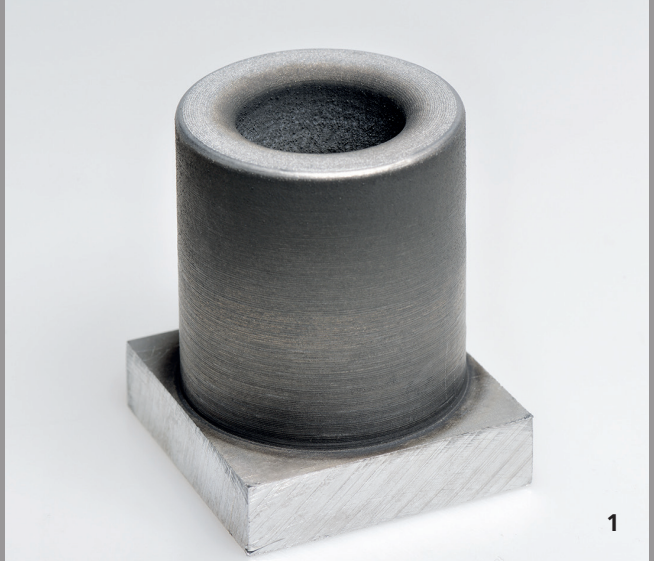

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LASER MATERIAL DEPOSITION OF ALUMINUM ALLOYS FOR LIGHTWEIGHT CONSTRUCTION

Task

Additive manufacturing (AM) is considered a key technology for the production of lightweight components and structures. Among AM processes, laser material deposition (LMD) stands out as it can be used to manufacture a wide variety of free-form surfaces. For this reason, LMD can be flexibly applied to repair and coat as well as to selectively individualize and functionalize prefabricated basic components (hybrid additive manufacturing). However, the processing of aluminum alloys with laser-based methods is challenging, especially because these alloys have a low degree of absorption and high thermal conductivity. This means that adapting the LMD process control to the specific material plays a decisive role in opening up lightweight construction applications with aluminum materials.

Method

Powder-based LMD was used to process aluminum alloys with silicon, magnesium and zinc – as the main alloying elements – in order to produce structural elements such as tracks, layers and solid bodies. Fraunhofer ILT is investigating process regimes that span orders of magnitude in terms of key process parameters, such as feed rate and deposition rate. For this purpose, the process control was adapted according to the desired requirements in terms of productivity, shape accuracy and material properties.

Results

Demonstration models with adapted coating thickness and dilution can be manufactured with a density of over 99.8 percent through targeted design of the process control and powder pretreatment. The processes developed here allow solid bodies to be produced at high precision, with structure resolutions of less than 100 µm and at build-up rates greater than 0.5 kg/h. Laser beam sources with a maximum output power of 4 kW were used.

Applications

Since the process control has been fundamentally advanced, new types of lightweight construction applications with aluminum can be put into practice, e.g. in the aerospace, automotive and mechanical engineering sectors. Current investigations into the processing of metal-ceramic composites will further expand the available range of materials.

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1 Solid body produced by EHLA (component height approx. 45 mm, build-up rate approx. 0.3 kg/h).

2 Solid body built with conventionally laser material deposition (component height approx. 90 mm, build-up rate approx. 12 g/h).

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