



## LASER MATERIAL DEPOSITION WITH COAXIAL WIRE FEED

### Task

Fraunhofer ILT has developed a 5 kg compact processing head for laser material deposition (LMD), which makes direction-independent 3D processing possible thanks to a coaxial wire feed. This processing head has been qualified in various projects for the application of iron, aluminum, nickel and titanium based alloys. The nickel-based alloy IN 718, which is relevant for turbomachinery, has been developed for this process as part of the work in the »International Center for Turbomachinery Manufacturing (ICTM Aachen)« community. The overriding objective here is to determine the geometric, mechanical and microstructure/macrostructure properties of 3D structures produced by wire LMD. In a first step, material test samples made of IN 718 were produced and analyzed.

### Method

First, the institute identified suitable process parameters, developed build-up strategies and then produced 3D structures from which tensile specimens were manufactured. These samples were subjected to heat treatment and subsequently analyzed. In particular, the mechanical properties of the generated structures were examined. The process parameters were then transferred to a 3D geometry.

### Results

Suitable process parameters and build-up strategies could be determined for IN 718 in order to produce 3D solid bodies with a dimensional accuracy of  $< 0.2$  mm (Fig. 3). The maximum laser power used was 1 kW. Thanks to coaxial protective gas guidance, virtually oxide-free 3D structures could be produced. The metallographic analysis shows an extremely low porosity,  $\leq 0.1$  percent, and good metallurgical bonding of the layers. In the tensile tests, the structures achieved the required values according to DIN EN 10302. The process parameters were transferred to a 3D geometrical form, as demonstrated by the production of a component (Fig. 4).

### Applications

This processing head can be used for LMD with wire-shaped filler materials for coating, repairing and additive production. The system weight and the size allow its use in systems with low load capacity and/or high dynamics.

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- 3 3D structure (144 x 14 x 60 mm<sup>3</sup>, horizontal and vertical) out of IN 718 manufactured with Wire LMD.
- 4 Boroscope flange out of IN 718 manufactured with Wire LMD.