



LASER MATERIAL DEPOSITION WITH COAXIAL WIRE FEEDING

Task

Fraunhofer ILT has developed a light-weight and compact processing head for laser material deposition (LMD). Weighing five kilograms, the head enables 3D machining independent of direction with coaxial wire feed. This processing head is being used in various projects for the deposition of iron-, aluminum-, nickel- and titanium-based alloys. Within the scope of the International Center for Turbomachinery Manufacturing (ICTM) Aachen, process development has been carried out for the nickel- and titanium-based alloys, IN718 and TiAl6V4, which are relevant in turbomachinery applications. The overall objective is to determine the geometric, mechanical and microstructural as well as macrostructural properties of volume structures produced by wire LMD. In a first step, the required system technology (wire feed systems and coaxial wire head) has been qualified for turbomachinery applications.

Method

First of all, various wire feeding systems have been tested since wire diameters of less than 0.5 mm, required to produce smaller structures, place special demands on the wire feed (conveying speeds below 10 mm/s and conveying and straightening thin wires). For process development, suitable process parameters have been identified, application strategies

developed and samples produced and analyzed. By using a high-speed camera (Figure 2), Fraunhofer ILT has monitored the laser material deposition welding process to gather insight into process and wire feeding behavior. Based on these observations, process parameters and wire feeding were improved.

Results

The coaxial wire processing head was used to additively produce various metallographic test specimens (Figure 1). Suitable process parameters could be determined for the materials IN718 and TiAl6V4; the maximum laser power used is 1 kW. A coaxial shielding gas system has made it possible to produce virtually oxide-free volume structures. The metallographic analysis shows extremely low porosity and good metallurgical bonding of the layers.

Applications

The developed processing head can be used for LMD with wire-shaped filler materials for coating, repair applications and additive manufacturing. The system weight and size allow it to be used on systems with low load capacity and/or high dynamics.

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1 Cube form (20 x 20 x 5 mm³)

made of TiAl6V4 with wire LMD.

2 High speed image of the wire LMD

process with IN718.