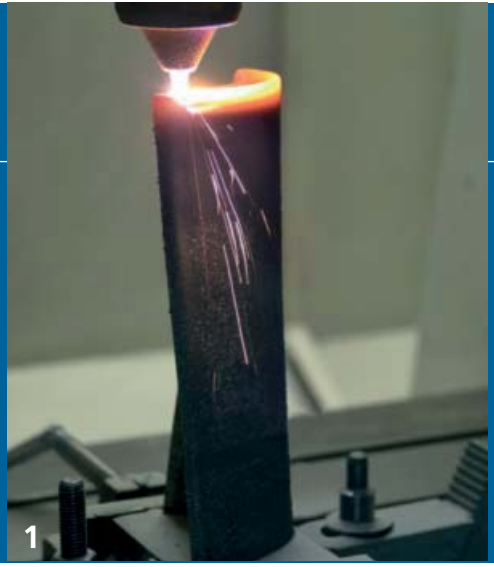

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ADDITIVE MANUFACTURING OF LARGE-SIZED SOLID BODIES

THE TASK

Today we have flexible and efficient additive manufacturing technologies that use modern metallic and nonmetallic construction materials to build functional components and structures. The unique selling point is a fabrication approach that spans broad ranges of scale and materials. Thus customers from a diverse portfolio of industry branches can benefit from tailored solutions.

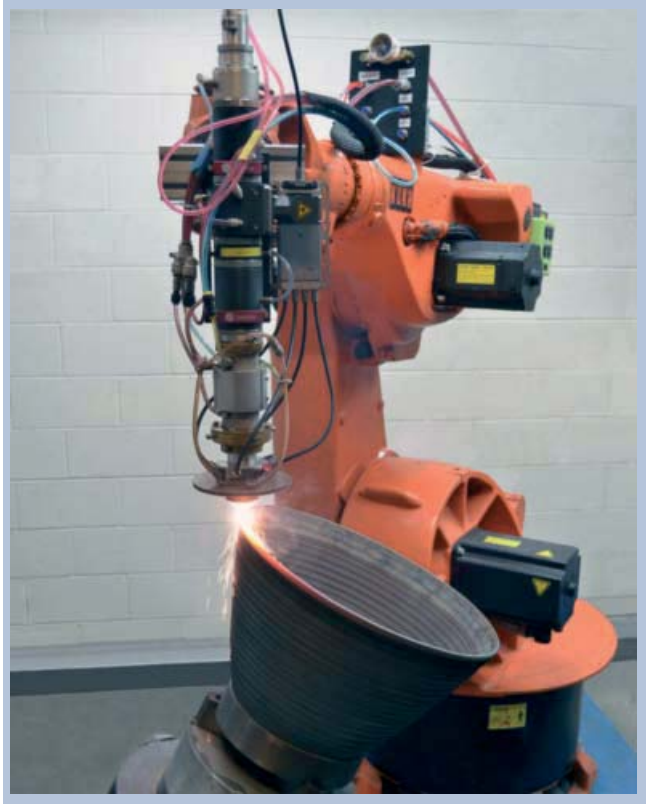
In principle one distinguishes between processes that have a continuous material delivery and those that use a powder bed. Powder bed processes can fabricate parts of virtually any three-dimensional shape. Even parts with undercuts are possible, which cannot be produced using conventional machining and casting manufacturing methods. Thus, the process offers much freedom of part design, the possibility for functional optimization and integration. However, the process limitations of powder bed processes include limited part dimensions and comparatively low processing speeds.

The Fraunhofer USA Center for Laser Applications (CLA) developed an additive manufacturing technology, which is capable to build much larger parts at significantly increased processing speeds.

OUR SOLUTION

CLA's approach relies on the laser powder buildup welding process with continuous powder delivery. Robots and CNC machines are used in combination with various lasers as well as the powder delivery nozzles that were developed at the Fraunhofer IWS Dresden. Robots and CNC machines allow for the fabrication of parts as large as 2 m x 4 m x 2 m.

Laser based additive manufacturing of a demonstration part for the aerospace industry



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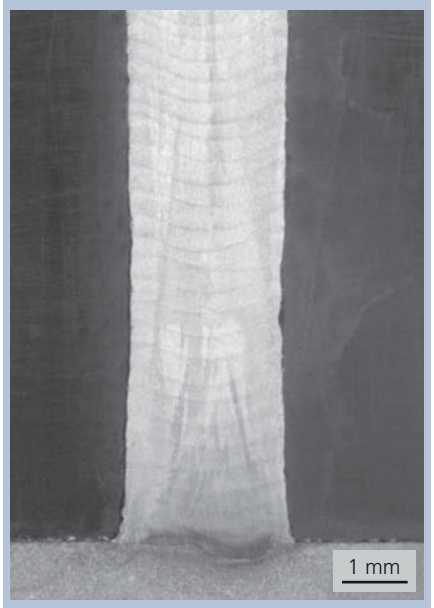
RESULTS

Large-sized aerospace application demonstrators were produced using laser systems and the IWS powder nozzles COAX8 and COAX9 (Fig. 1 and Fig. 3). It is also possible to build turbine blades with hollow structure and components of rocket engines.

The rocket nozzle demonstrator in Figure 3 was made from Inconel 625 powder using a 6 kW laser and a robot system. The tool paths were programmed offline using a CAD-CAM software. A typical cross section of a laser generated demonstrator is shown in Figure 5.

Cross section of a laser generated rocket nozzle made from Inconel 625



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CAD-CAM software was used to develop and evaluate various buildup strategies for test parts using powder coating technology. This way deposition rates were achieved of up to 2 kg per hour.

A 6 axes robot system with tilt and turn table and the IWS powder nozzle COAX8 were used to produce an extrusion cylinder made from stainless steel 316L. To do this, a screw thread was deposited onto a standard steel tube (Fig. 2). The part is longer than 1120 mm and has a diameter of 255 mm. The production time was 18 hours.

Fraunhofer CLA is also testing the new Fraunhofer IWS wire head COAXwire for multidirectional buildup of wire material (Fig. 4). The focus of this work is the manufacturing of high-quality titanium components for the aerospace industry.

1 Laser based additive manufacturing of gas turbine blade
2 Laser based additive manufacturing of an extruder screw from stainless steel
4 Additive manufacturing with the IWS wire head COAXwire

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