

Line integration of additive manufacturing processes

LPBF on the threshold of series production

Fraunhofer ILT has been researching the additive manufacturing process laser powder bed fusion (LPBF) since the mid-1990s. Although it was initially used as a process for prototype production, industrial users are now establishing this manufacturing process in series production. Major hurdles include high unit component costs, a low level of automation, and a lack of integration into industrial process chains – both at the digital and physical level. Fraunhofer ILT has addressed these challenges together with partners from industry and research in the projects IDAM (FKZ 13N15080) and IDEA (FKZ 13N15001) as part of the BMBF funding measure "Line integration of additive manufacturing processes".

Industrialization and digitization of additive manufacturing using LPBF

In the IDAM project focusing on automotive series production, Fraunhofer ILT investigated not only how an adaptive, geometry- and application-adapted LPBF process control could be developed, but also how support structures could be automatically removed and how recycling the metal powder used in LPBF influences the overall process. In the IDEA project, which focused on turbomachinery and aerospace, Fraunhofer ILT

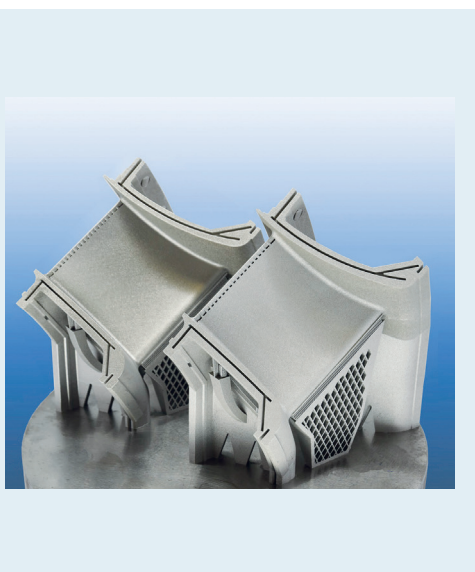
developed pulsed-modulated exposure of the component contour and integrated a high-resolution stereo camera into the system for detecting process instabilities.

Decisive developments for the use of LPBF in series production

Adaptive LPBF process control has made it possible to increase productivity in processing the aluminum alloy AlSi10Mg by up to 50 percent while maintaining high component quality. Using the digital tools developed, Fraunhofer ILT was able to demonstrate that the LPBF process parameters could be dynamically selected according to the component load. The developed process for wet-chemical component support removal enables fully automatic and tool-free support removal during LPBF.

With the aid of pulsed-modulated LPBF process control, the institute was able to increase detail resolution and contour accuracy for Inconel® 718. This innovation means that smaller part features can be manufactured, such as complex cooling systems, and reduces the amount of post-processing required. AI-based evaluation of the monitoring data can reliably detect process instabilities in LPBF such as powder bed defects and component distortion.

Authors: Dr. Tobias Pichler, Thomas Laag M. Sc., tobias.pichler@ilt.fraunhofer.de., thomas.laag@ilt.fraunhofer.de



*1 Pilot line for additive series production at the BMW Group, © BMW Group.
2 Turbine guide vane with continuous (left) and pulsed-modulated (right) LPBF process control.*