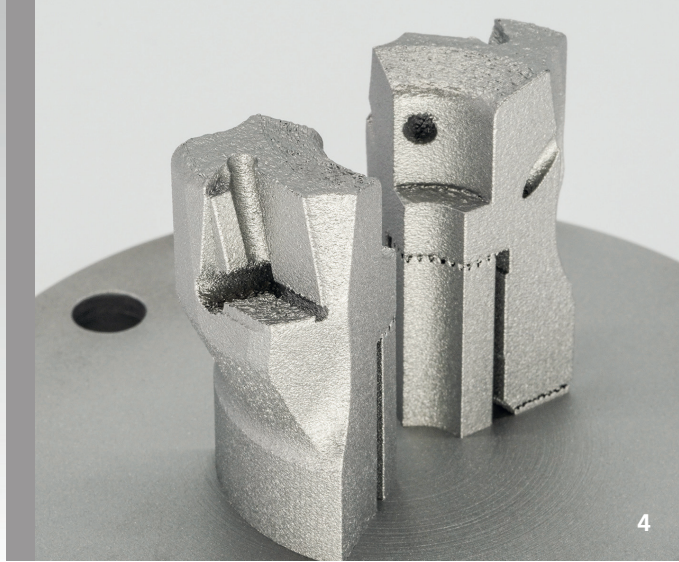


3



4

ADDITIVE MANUFACTURING OF MILLING CUTTER HEADS MADE OF BAINITIC STEEL

Task

Additive manufacturing with laser powder bed fusion (LPBF) unlocks great potential in tools for machining because it can be used not only to customize cooling channel guides and nozzle arrangement, but also to improve their fluid-mechanics. Since the process offers such a high geometric freedom, there is almost unlimited flexibility in developing and manufacturing components. However, the material requirements for milling cutter heads cannot be fulfilled as few steel materials have been qualified.

Method

In collaboration with the Fraunhofer Institute for Laser Technology ILT, the Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University has been designing milling cutter heads with an improved cooling lubricant supply (fluid mechanics). Fraunhofer ILT additively manufactured them from bainitic steel, qualified them for LPBF and tested them. First, a process window was determined by systematically varying the process parameters so that components could be manufactured without defects (e.g. preventing pores and cracks) and with a high component density (> 99.5 percent). In addition, the process parameters were transferred to complex structures; moreover, the partners also investigated suitable post-processing methods for internal cooling channels and outlet nozzles. This enables adapted milling cutter heads

to be manufactured in a high number of variants. The partners are focusing on deriving design guidelines to improve the design of additively manufactured milling tools from the collected findings.

Results

Promising results have already been achieved for bainitic steel: Components were manufactured crack-free with a density > 99.9 percent at a hardness of 400 HV.

Applications

The LPBF process enables tool weight to be reduced by adapting the geometry (e.g. integration of lattice structures) and integrating additional functions (e.g. complex cooling channels). The material under investigation could also be applied in the automotive industry as well as in mechanical and plant engineering.

The research project – as part of the program to promote joint industrial research (IGF No. 21049 N) – has been funded by the German Federal Ministry for Economic Affairs and Energy (BMWi) via the German Federation of Industrial Research Associations (AiF) e. V.

Contact

Jasmin Saewe M. Sc., Ext.: -135
jasmin.saewe@ilt.fraunhofer.de

Christian Tenbrock M. Sc., Ext.: -8350
christian.tenbrock@ilt.fraunhofer.de

3 CAD of a milling cutter head
(design: © Sumitomo).

4 Additively manufactured milling cutter
head elements made of bainitic steel.