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LASER POLISHING SLM MANUFACTURED 3D COMPONENTS

Task

Due to its virtually unlimited design freedom, the additive manufacturing process Selective Laser Melting (SLM) can be used to produce complex and individual components of series-identical materials. However, since SLM generates components layer by layer in a powder bed, its components have, in comparison to those made with classic machining processes, high surface roughness (S_a about 10 - 30 μm). According to the current state of the art, therefore, it is often necessary, and expensive, to post-process the functional surfaces in order to improve the surface quality of the components.

Method

Within the scope of the European research project »AMAZE« (FP7-FoF.NMP.2012-4), Fraunhofer ILT has developed the laser polishing process for the finishing of components made of nickel-based alloy Inconel® 718 and manufactured with SLM. The roughness S_a of the surface after the SLM process was determined with »InfiniteFocus«, a device from the company Alicona and based on focus variation. The parameters needed for laser polishing were determined on cubic test specimens. To transfer the laser polishing results of the planar sides of the

cubes to a 3D demonstrator, the institute developed strategies for working with non-perpendicular angles of incidence and for shaping edges. The roughness of the laser-polished surface was determined by the profile method.

Result

Initial laser polishing results on a component of an aircraft engine mount out of IN718 show that the surface roughness of the SLM surface can be reduced from $S_a = 10 - 15 \mu\text{m}$ down to $S_a = 0.25 \mu\text{m}$. The area rate during laser polishing of the selected component geometry is 3.8 cm^2/min . In the next step, the institute will conduct further research to reduce the surface roughness and increase the area rate as well as to adapt the strategy and parameters for small wall thicknesses.

Applications

In particular, the aerospace and turbomachinery sectors can profit from using SLM to produce components made out of IN718.

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- 1 Pylon brackets out of IN718
manufactured by means of SLM.
2 Laser-polished sub-segments
of a pylon bracket out of IN718.