

USING SLM WITH NICKEL-BASED SUPER ALLOYS FOR TURBOMACHINERY APPLICATIONS

Task

While resources are becoming more and more scarce, energy and mobility needs are growing – this places great economic and ecological challenges upon manufacturers of turbines for the energy and aerospace sector. The possibility of producing complex, functionally optimized component parts out of heat-resistant nickel-based super alloys such as MAR M-247 by means of Selective Laser Melting (SLM) offers great potential for meeting these challenges. The task here consists in developing the SLM process for processing such working materials free of cracks.

Method

The working material MAR M-247 is considered to be difficult to weld and, according to the current state-of-the-art, cannot be processed by SLM. Within the scope of the market-oriented preliminary research project »NanoGen«, concepts were developed for processing this working material free of cracks using SLM. A promising approach emerged from these ideas – using high-temperature preheating to reduce thermal gradients and stress during SLM.

1 Micro gas turbine out of IN-718.

2 Process image of high temperature SLM.



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Result

To implement high-temperature preheating, an equipment design was developed using an inductively heated construction platform. This approach enables preheating temperatures of > 1200 °C in an inert gas atmosphere of < 10 ppm oxygen content. By using this equipment design, Fraunhofer ILT succeeded in processing MAR M-247 without cracks. In addition, the altered cooling conditions allow material isotropy to be enlarged by a reduction of the directed grain growth. Further work should evaluate the mechanical specific values of the samples produced this way as well as the possibility to generate complex structures with a surface quality of Ra < 20 µm.

Applications

Complex nickel-based super alloys such as MAR M-247 are used, above all, in the field of steel turbines and of turbomachine construction for the energy and aerospace sector. Furthermore, these materials can also be used for complex, lightweight motor components in automobile construction.

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