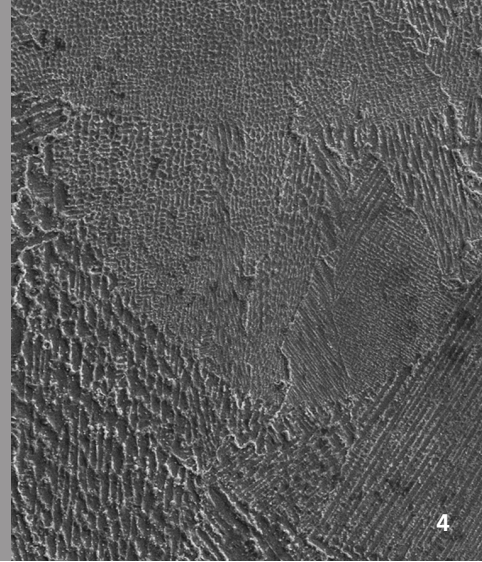


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## PROCESSING IN738LC USING SLM

### Task

Nickel-based superalloys such as Inconel 738LC have been developed for components exposed to high temperatures and represent the state of the art in turbine manufacture. Conventional manufacturing of components using precision casting is time-consuming, costly and limited in terms of geometrical freedom. Designed as cast alloys, the complex materials are difficult if not impossible to weld owing to the formation of hot cracks. Up to now it has not been possible to process IN738LC using SLM without crack formation.

### Method

The processibility of IN738LC using SLM is being investigated at Fraunhofer ILT in association with partners from research institutions and turbine manufacturers as part of the EU's »MERLIN« project. Process control for manufacturing defect-free test specimens at preheating temperatures up to approx. 900 °C has been developed using a specially modified laboratory test system. On this basis the thermomechanical properties are determined once a suitable heat treatment process has been established. Finally, functional prototypes are manufactured using SLM and tested under real conditions.

### Result

An SLM laboratory test system developed at Fraunhofer ILT allows test specimens with a density of almost 100 percent to be manufactured without crack formation at preheating temperatures between 800 and 900 °C. The smaller temperature difference between the weld pool and solid microstructure reduces process-induced stresses, resulting in a defect-free microstructure. Further research will investigate whether the preheating temperature can be reduced by suitably modifying the other process parameters.

### Applications

IN738LC is primarily used in turbine manufacture, e.g. for turbine blades; this means the aerospace and energy industries represent the main applications. The rapid manufacture of complex functional prototypes, in particular, paves the way for much shorter and hence more cost-effective development processes. Basically, the results can also be applied to other alloys susceptible to cracking and make processing using SLM possible.

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3 SLM process at a preheating temperature of 900 °C.

4 Microstructure of test specimens made from Inconel 738LC without post heat treatment.