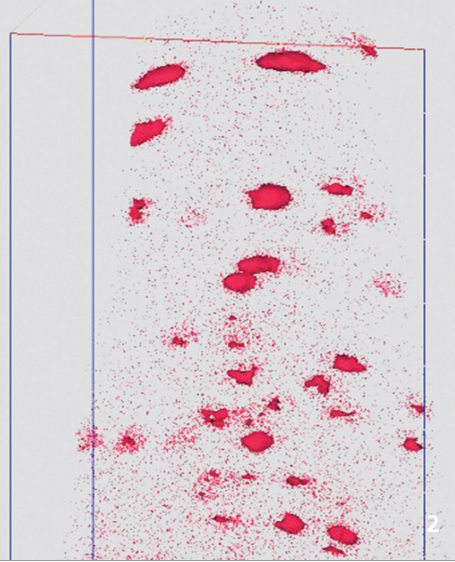


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INTRINSIC HEAT TREATMENT IN ADDITIVE PRODUCTION

Task

Selective Laser Melting (SLM) and Laser Metal Deposition (LMD) are important additive manufacturing processes. Additive manufactured components made of conventional alloys, however, frequently require subsequent heat treatment. As a rule, this is usually done by aging the alloy, which generates precipitates that increase the strength of the components. This additional process step is often, however, associated with a further distortion of the components. An alternative to this is using intrinsic heat treatment, which must be adapted to short temperature-time cycles of a few seconds occurring in SLM/LMD. Process technology and the alloy system must, however, be adjusted to this. Treatable aluminum-based alloys (aluminum-scandium), among others, have been investigated in cooperation with the Max-Planck-Institut für Eisenforschung (MPIE).

Method

When the process conditions, e.g. by preheating or a layered laser heat treatment, are varied, precipitates shall be generated from the supersaturated matrix after it rapidly solidifies. In parallel, the precipitation kinetics is adjusted to the short-term heat treatment by targeted modification of the alloying compositions.

1 LMD of Scalmalloy®.

2 Nanoscale precipitates of Al_3Sc

(Source: MPIE).

Result

In the first step, process parameters were developed for the production of dense and nearly defect-free solids bodies. For the Al-Sc alloy Scalmalloy®, the formation of nanoscaled precipitates of the Al_3Sc has already been demonstrated in the process. The distribution and size of the precipitates, however, are still inhomogeneous.

Applications

This heat treatment can be applied, in particular, where the highest demands are placed on additive manufactured components, e.g. in turbomachinery, tool engineering, and in the medical and aerospace industries.

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