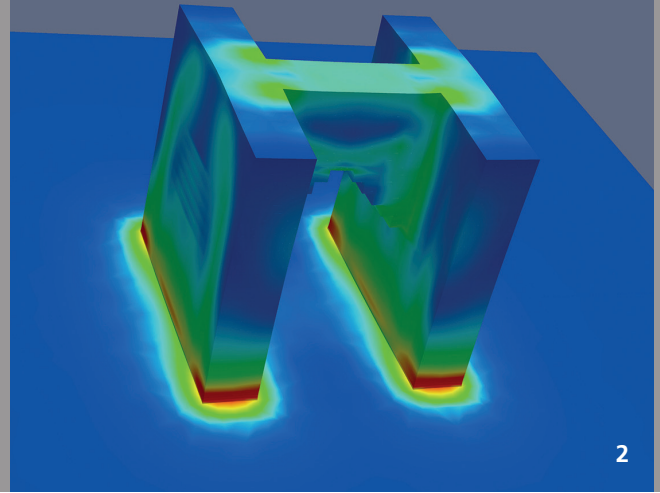# SIMULATION OF THE DISTORTION OF ADDITIVE AND ABLATIVE PROCESSES

Task

In additive manufacturing processes or in the structuring of thin films, thermally induced plastic strains lead to residual stress and distortion. A component shape modified by these plastic strains can require post-processing or simply become useless. To determine a component-specific and material-specific process control, a considerable experimental effort is needed, but can be simplified by numerical simulation of thermal distortion.

Method

In order to calculate the deformation of components as a function of process parameters, simulation tools are required with which temperatures, plastic strains and stresses on time-dependent component geometries can be calculated efficiently. For this purpose, a simulation tool (StrucSol) was developed that uses an iterative numerical method for the rapid solution of thermo-elastoplastic equations. This solver is massively parallelized and characterized by a low memory requirement and a high calculation speed in large systems of equations.

Results

StrucSol was used to calculate the temperature distribution and the distortion in the structuring of thin films (Fig. 1) with ultrafast laser pulses and Selective Laser Melting SLM (Fig. 2). In the structuring, the deposited laser power and the ablation geometries of the individual structures are calculated with a micro model and taken into account during the production of the metallic film in a macro model. In the SLM process, individual layers are grouped together into a compound and then activated and processed in a layer-by-layer manner as the component is built.

Applications

The developed simulation tool can be used to calculate the temperature distribution and distortion during structuring and during the SLM processes. In addition, the tool can be transferred to other machining processes such as Laser Metal Deposition, welding or drilling.

Contact

Dr. Markus Nießen
Telephone +49 241 8906-8059
markus.niessen@ilt.fraunhofer.de

Dr. Rolf Wester
Telephone +49 241 8906-401
rolf.wester@ilt.fraunhofer.de

1 Distortion of a thin film after structuring.

2 Von Mises' yield criterion for an SLM component.