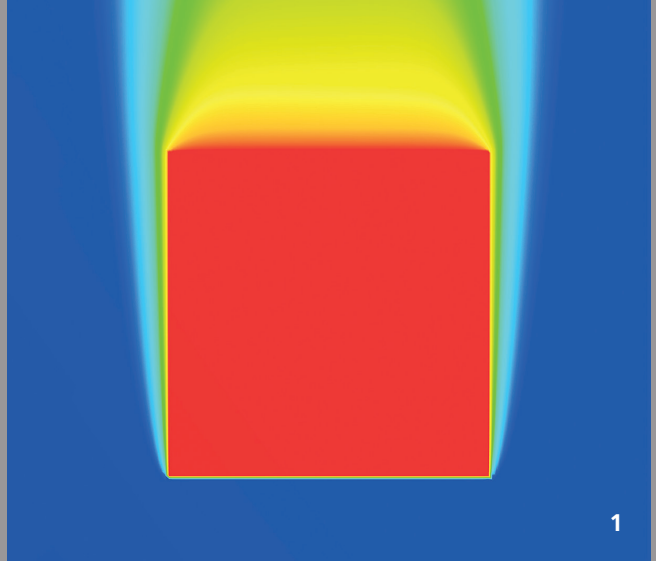

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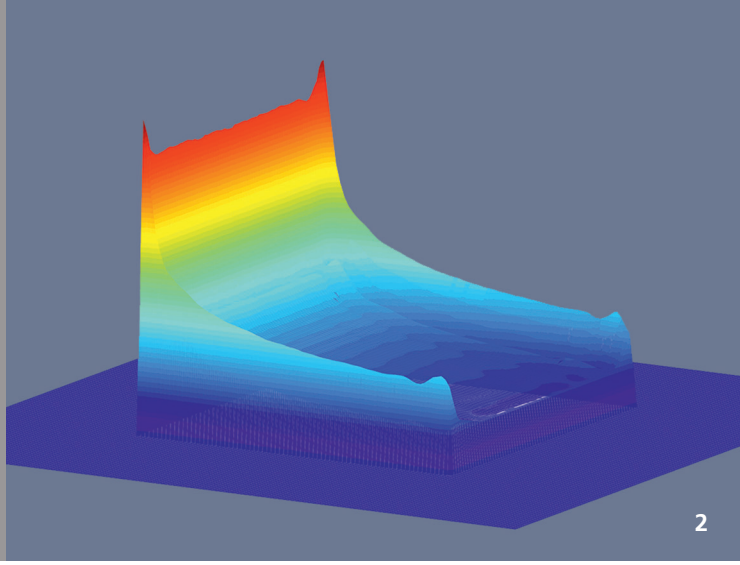

2

APPLICATION-SPECIFIC INTENSITY DISTRIBUTIONS FOR LASER HEAT TREATMENT

Task

Often, conventional intensity distributions cannot fulfil the ever-increasing requirements for laser heat-treatment processes in terms of workpiece geometry, material composition, processing quality and efficiency. When, however, intensity distributions are specifically adapted to the workpiece geometry and the material properties, these deficits can be counteracted. Here, beam shaping methods such as free-form optics or so-called »Vertical Cavity Surface Emitting Laser« beam sources (VCSEL) make it possible to adjust the temperature profile induced in the workpiece by shaping the intensity distributions.

Method

Firstly, for different laser heat treatment processes using conventional intensity distributions, Fraunhofer ILT has experimentally determined temperature-time curves that lead to an optimal processing result. When an algorithm is used to solve an inverse heat conduction problem, the optimal intensity distribution can then be deduced from the required temporal and spatial temperature profile. This is subsequently carried out – depending on the application – either by free-form optics or by VCSEL arrays.

1 Optimum temperature profile for many laser heat treatment processes.

2 Intensity distribution to produce a homogeneous temperature profile.

Results

For laser softening as well as hardening, optimal temperature profiles have already been calculated. By implementing an efficient solution algorithm of the inverse heat conduction problem, the institute could determine the corresponding intensity distributions and then design suitable free-form optics to generate them.

Applications

The methods developed here can be applied in a wide range of laser heat treatment processes in various industries. These include, among others, laser hardening, laser softening and the functionalization of thin layers.

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Contact

Annika Völl M.Sc.
Telephone +49 241 8906-8369
annika.voell@ilt.fraunhofer.de

Dr. Jochen Stollenwerk
Telephone +49 241 8906-411
jochen.stollenwerk@ilt.fraunhofer.de