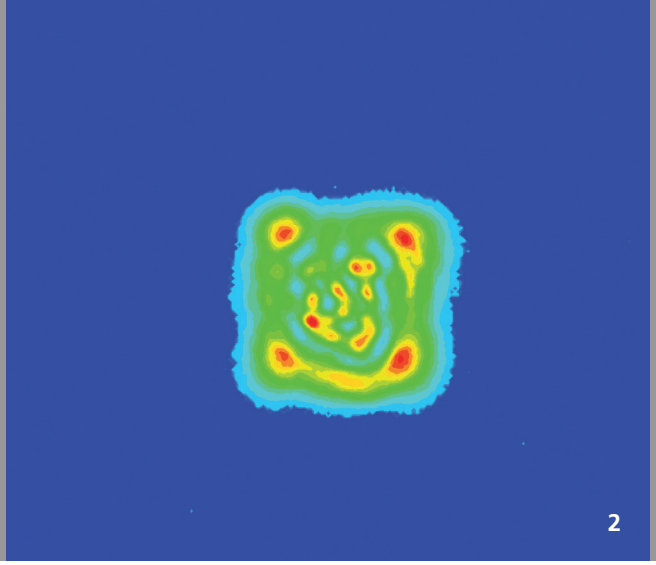
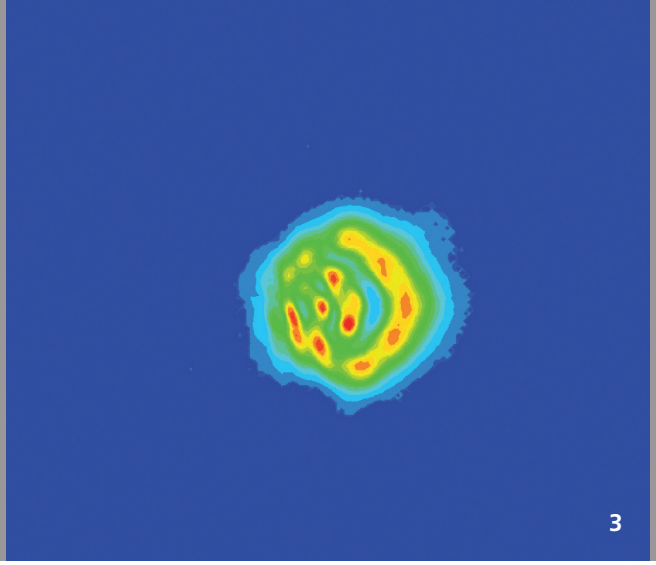


2



3

PROCESS-ADAPTED LASER BEAM SHAPING WITH MEMBRANE MIRRORS

Task

The development of active optical systems is opening up new possibilities in laser materials processing. Generating flexible focal spot geometries with membrane mirrors allows the intensity distribution to be adapted to the processing situation by an active variation of the optical system behavior. This leads to improved process efficiency and a higher processing quality. Moreover, the economic manufacture, even with small lot sizes, is made possible because the often necessary change of beam forming and guiding components is not needed.

Method

An active optical system has been developed using laser beam cladding as an example. When commercially available electrostatic membrane mirror was integrated into the system, flexible, homogeneous focal spot geometries could be generated from the raw beam profile of a fiber laser (P_{cw} = 100 W, λ = 1070 nm, TEM_{00}). To generate the target intensity distribution, the available degrees of freedom of the mirror can be adapted since the intensity profile is continuously measured, while heuristic control algorithms are utilized.

Result

By using a membrane mirror, homogeneous intensity profiles can be reproduced successfully. Depending of the targets conveyed by control algorithms, the focal spot's geometries are oriented, whose dimensions, in particular, can be varied during the processing duration.

Applications

The optical system presented here was developed for laser cladding. From a process and technical point-of-view, the advantages of dynamic laser beam forming, on the basis of membrane mirrors, can be transferred to other fields of laser materials processing, in particular to the scaling to higher output powers of laser beam sources.

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2 Adapted intensity distribution, quadratic.

3 Adapted intensity distribution, circular.