

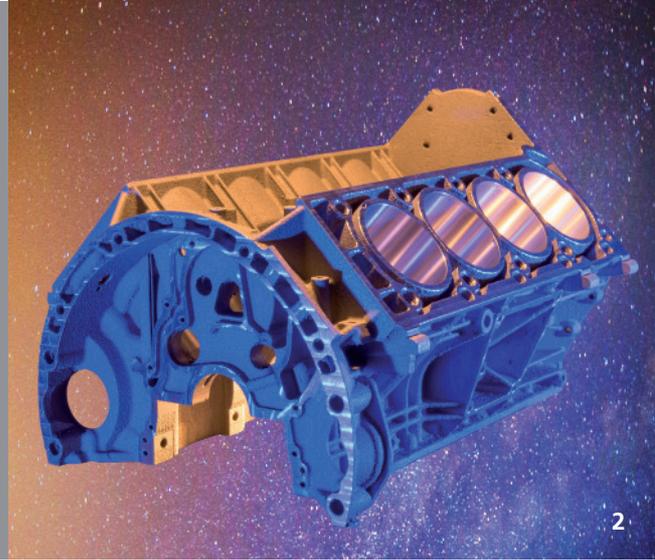
OPTICAL SYSTEMS FOR HIGH POWER SLM

Task

The pronounced trend toward the increased usage of Selective Laser Melting (SLM) for series production requires, among other things, higher productivity, reproducibility, and reliability of SLM systems. The increase in productivity through the use of laser sources in the kW region (High Power SLM) and the associated higher build-up rate achieved has already been demonstrated in the laboratory. The industrial usage of kW beam sources and material-dependent exposure strategies in commercial SLM systems call for new, robust optics concepts for beam guidance and shaping.

Method

New process control strategies are being developed to translate laser output power into build-up rate. Studies have demonstrated the feasibility of different exposure strategies with tailored beam diameters, dependent on factors including the thermo-physical properties of the materials. Tailor-made optical systems are being designed for the control of specific processes in order to implement these exposure strategies. Selected systems are being implemented in commercial SLM systems in collaboration with manufacturers, taking into account specific framework conditions such as required scan field size and



focus diameter. When selecting the optical components their suitability in terms of destruction thresholds and thermal load for the power class of 1 kW and the associated intensities, especially with the use of single-mode beam sources, are prime considerations.

Result

In collaboration with various equipment manufacturers, two different optical systems have been implemented in commercial systems which for the first time supports SLM systems with a laser output power of 1 kW. One version involves the use of variable focusing optics for the continuously variable adjustment of the beam diameter when using a 1 kW single-mode beam source. The other employs a dual-beam concept that facilitates switching between two sources: one that provides a small beam diameter with a gaussian-shaped intensity distribution and one that provides a large beam diameter with a top-hat-shaped intensity distribution. These optical systems enable components to be manufactured with a higher build-up rate while maintaining detailed resolution and surface quality.

Applications

The 1 kW SLM systems are being used for additive manufacturing of components in various industries such as automotive, turbomachinery, or toolmaking.

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1 Beam path of an optical system for HP SLM.

2 SLM V8 engine block (model 1:3, concept laser system).