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## VARIABLE MULTI-BEAM OPTICS FOR PROCESSING WITH HIGH-POWER USP LASERS

### Task

Ultrashort pulse (USP) laser processing is currently uneconomical for many industrial applications since the extremely high pulse energy can lead to plasma formation or thermal accumulation on the workpiece. Thanks to a powerful »dot-matrix printer«, the laser power can be divided into 64 partial beams, which can be switched on or off individually.

### Method

A two-dimensional diffractive optical element (DOE) is used to split the raw beam of a 1 kW USP laser beam source into 64 partial beams. The individual beams are switched on and off by means of acousto-optical modulators (AOM), which deflects the unneeded beams into a beam dump. All other beams are coupled into a galvanometer scanner and focused on the workpiece. The diameter of the laser beams has to be varied several times due to the components involved; two telescopes are designed for this purpose. In addition, the spot distances on the workpiece and the distances of the individual AOM are specified. Prisms and mirrors are used to adjust the position of the individual beams. Since the optics will be integrated into an industrial demonstrator, its dimensions impose further restrictions.

### Results

The optical design is divided into two areas. Since the AOM modules can each switch eight beams simultaneously, the entire optics is divided into eight parallel, independent optical systems. For this purpose, Fraunhofer ILT has developed an optics design which fulfills the boundary conditions for the beam path and the spot properties for each sub-optical system.

### Applications

The most important fields of application can be found in the surface structuring of functional structures as well as in the manufacture of forming, embossing and printing tools.

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