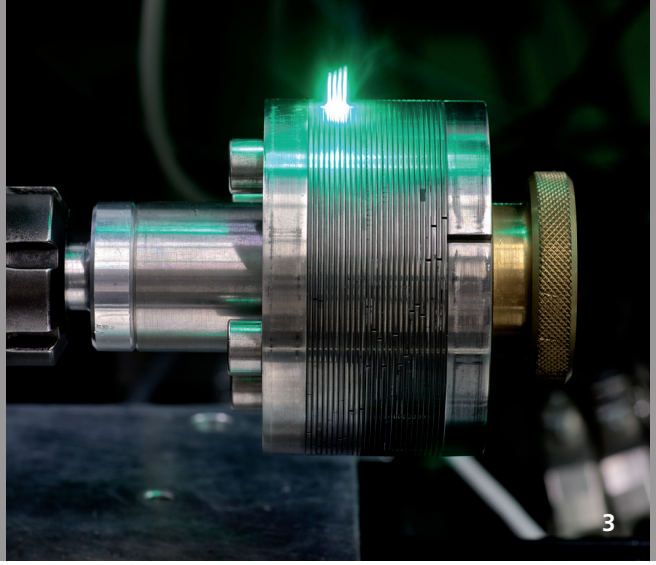
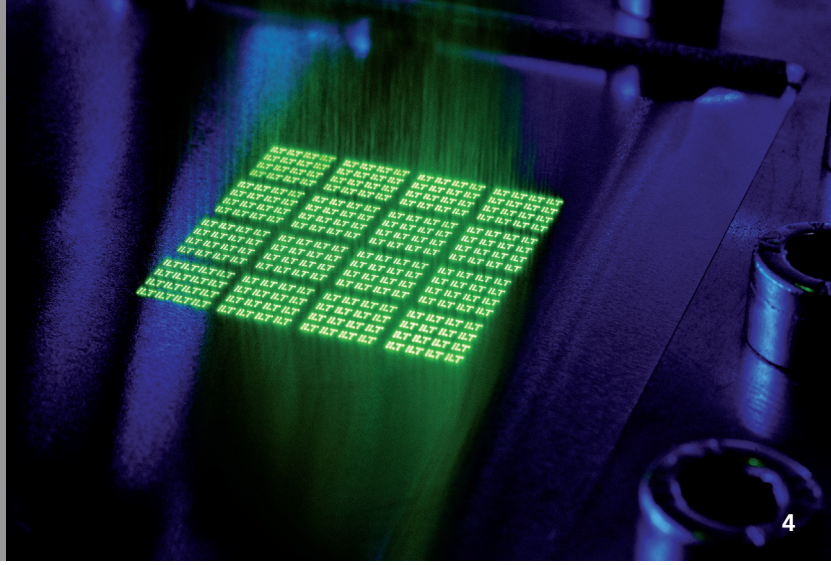


3



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PROCESS ACCELERATION IN ULTRASHORT PULSED MICROMACHINING USING MULTI-BEAM OPTICS

Task

As ultrashort pulsed laser sources continue to be developed, the available laser power for laser micromachining is increasing constantly. For industrial use ultrashort pulsed laser systems with output powers in the range of 50 - 100 W are already commercially available, while laser systems with average powers of 1000 W and more will conquer the market in the next few years.

Many applications using these laser systems demand small spot sizes to achieve high precision or small structure sizes. However, when the average power of the laser systems increases at the same spot size, thermal or material dependent factors limit the potential for enhancing the process velocity at constant machining quality considerably. In order to raise the process velocity, new technologies are needed that allow a fast distribution of the laser power on large areas.

Method

In addition to the possibility of a fast beam deflection with, for example, polygon scanners, the available laser power can also be split into a number of partial laser beams. To accomplish this, a multi-beam scanning system on the basis of diffractive optical elements and a galvanometric scanning head has been developed and built.

Result

The new system allows the available pulse energy to be split into up to 196 partial beams, in order to generate a pattern of laser spots with fixed spot period in the machining plane. Using this system, researchers at the Fraunhofer ILT have been able to boost the process velocity by a factor of 196 and more. Thanks to the availability of ultrashort pulsed laser systems with pulse energies in the range of 1 mJ, this technology will enable users to machine large work pieces with periodic structures precisely and allow high power USP lasers to be used efficiently.

Applications

This optical system can be used to solve current issues in the field of tool technology for the production of light guiding and scattering structures or other functional structures. This scan approach can also be used in other fields of laser material processing such as laser cutting, laser annealing or rapid laser manufacturing.

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3 Parallel machining of piston rings for wear reduction.

4 Multi-spot beam distribution generated with a diffractive optical element.