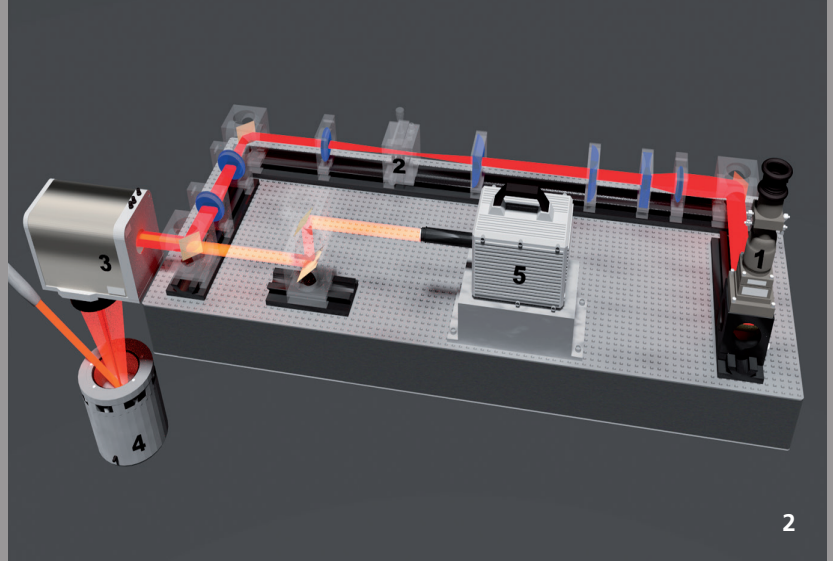
1



2

INCREASING THE AREA RATE OF LASER POLISHING BY USING SPATIALLY ADAPTED INTENSITY DISTRIBUTIONS

Task

Laser polishing is an innovative process for automated polishing of metal workpieces. In this process, a thin boundary layer is remelted, thereby smoothening the surface as a result of interfacial tension. The state-of-the-art in laser polishing with continuous laser radiation is the use of circular, Gaussian and top-hat intensity distributions. The process typically employs laser beam diameters of 150 to 600 µm and a track offset dy between 30 and 75 µm. Partial multiple crossings are necessary in order to achieve the required surface quality. This results in area rates in the range of 1 cm²/min. For many applications in mechanical and plant engineering, the area rate of laser polishing of 1 cm²/min is, however, still too low for economical use. By using an intensity distribution adapted to the material and its initial state, the area rate should be improved by increasing the track offset dy.

Method

Within the framework of the BMBF project »polieren10X«, an experimental setup was used to examine laser polishing with different intensity distributions. This setup has a flexibly adjustable aperture, in which an intermediate focus was positioned and which was uniformly illuminated with laser radiation, then mapped to the workpiece surface. The tests were carried out on the austenitic stainless steel 1.4435.

Result

On the material 1.4435, the area rate could be increased from FR = 1.2 cm²/min with a circular intensity distribution to FR = 7.2 cm²/min with a line-like intensity distribution at a constant surface quality of Ra = 0.6 µm. The process is not yet easily transferable to other materials, however. The intensity distribution of the increase in surface rate must be adapted to the material used.

Applications

Possible fields of application can be found in areas where metallic surfaces with an average quality (Ra = 0.1 to 0.8 µm) have to be polished. In particular, tool and mold manufacturing, but also in medical technology, the automotive industry and general mechanical engineering, laser polishing can be used with increased surface rates as an economical, automated polishing process.

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1 Light microscopy of a polished surface with line-shaped intensity distribution on the material 1.4435, FR = 7.2 cm²/min, Ra = 0.7 µm.

2 Flexible test set up (1: collimation, 2: flexible diaphragm, 3: scanner, 4: process chamber, 5: high-speed camera).

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