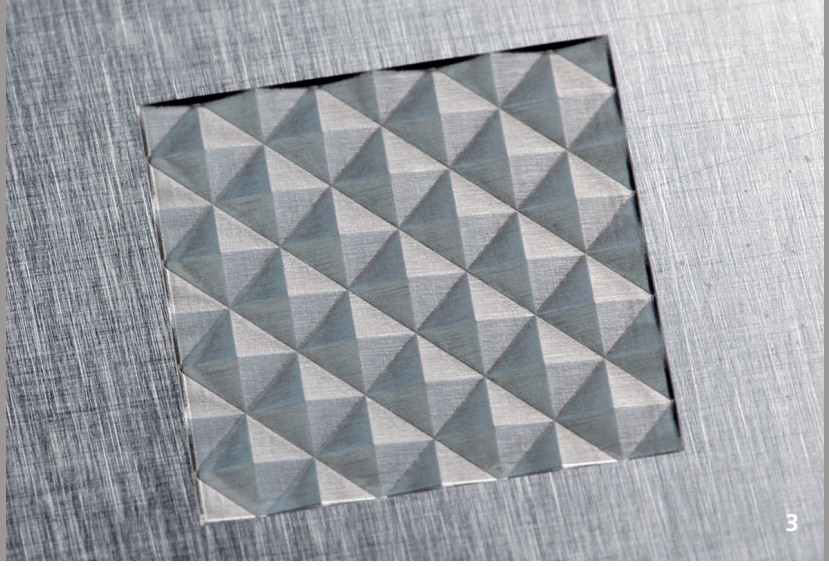

OPTICS FOR FLEXIBLE MULTI-BEAM PROCESSING

Task

Due to its very short light-matter interaction times, ultrashort pulsed (USP) laser radiation enables high-precision material processing with negligible thermal influence. While the quality for cutting or ablation processes is excellent, the productivity is still too low for many applications. Although USP beam sources with power up to the kW range are available, these power levels cannot easily be converted into productive processes. Since the power per laser focus is limited to a few watts of average power for reasons of quality, the power of a high-power beam source is split into multiple sub-beams by diffractive optical elements, and the productivity is scaled up by parallel processing with these multi-beams. The big deficit of these approaches is their low flexibility because the partial beams can only be switched together and the lateral distance is generally determined statically by the optics used. For this reason, only periodic structures can be generated.

Method

Fraunhofer ILT has developed an optical system that can selectively control and modulate the power of the individual partial beams. In combination with an FPGA-based control system, any structures, even non-periodic structures, can be produced efficiently.

Results

As a prototype, Fraunhofer ILT constructed an optic that generates four partial beams, each of which can be switched separately. The total efficiency is over 80 percent and the deviation of power between the partial beams is less than 1 percent. The individual partial beams are arranged linearly at a distance of 1 mm and the arrangement of the partial beams can be rotated by any angle. When the existing optics are extended, the number can be increased to eight partial beams.

Applications

The application addressed here is the precise, efficient production of non-periodic surface structures for tool and mold making. In principle, the optics can also be used to increase productivity for other USP applications such as cutting, drilling or thin-film ablation.

Contact

Dr. Johannes Finger
Telephone +49 241 8906-472
johannes.finger@ilt.fraunhofer.de

Dipl.-Phys. Martin Reininghaus
Telephone +49 241 8906-627
martin.reininghaus@ilt.fraunhofer.de

3 Surface texture generated by a USP laser.