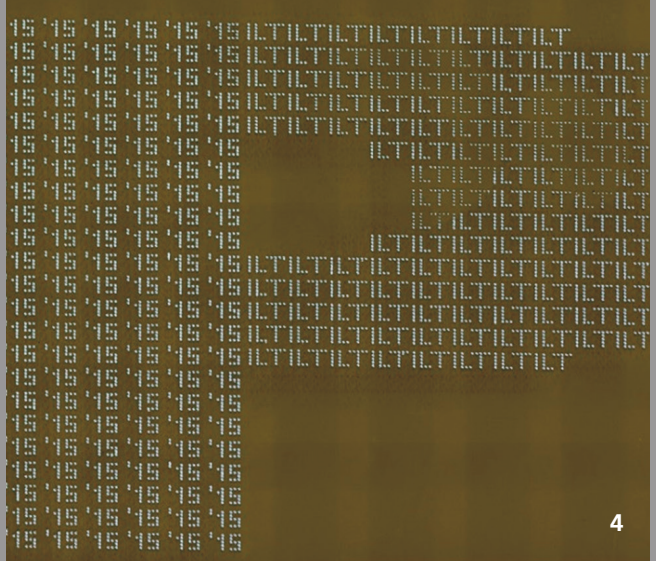
3



4

MULTI-BEAM PROCESSING

Task

The use of ultra-short pulsed (USP) lasers in materials processing makes a wide field of applications possible. Thanks to their high pulse intensities and the short interaction times, USP lasers can be used to process a variety of materials with the highest precision and almost damage-free. For economical use in direct production, however, ultra-short pulsed processes have previously been far too time-consuming, which is why they often were used only for indirect manufacturing (e.g. tool structuring).

Results

For the high-performance scaling of USP processes, Fraunhofer ILT has developed a technology with which surfaces can be processed in parallel and simultaneously with a large number of partial beams. These beams can be generated by diffractive elements. For static distributions, so-called DOEs can be used. For flexible beam shaping, a programmable diffractive optical system (PDO) has been developed, with which almost any intensity distribution can be produced with high efficiency and uniformity. The PDO is based on a spatial light modulator, which can be used to generate arbitrary beam patterns, in combination with a galvanomer scanner for fast laser deflection and, thus, fast processing speeds. These beams can also be changed dynamically, i.e. during processing, so that an extremely flexible working tool can be created. Thus, it is possible to retain the high level of machining quality (low thermal load, low surface roughness, high precision) of the USP process and to be able to increase the economical efficiency through increased productivity.

Applications

In all structures that exhibit symmetry or regularity, USP processes can be significantly accelerated by the use of multi-beam technology. In particular, in the processing of thin films and materials in which little energy for ablation is necessary, the process speed can be increased by up to two orders of magnitude.

Possible uses for this process range from structuring thin films in photovoltaics and for flexible electronics to the processing of masks and films with a high degree of periodicity.

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3 Parallelization with dynamic beam splitting into 950 partial beams.
4 Structuring of thin films with variable beam splitting.