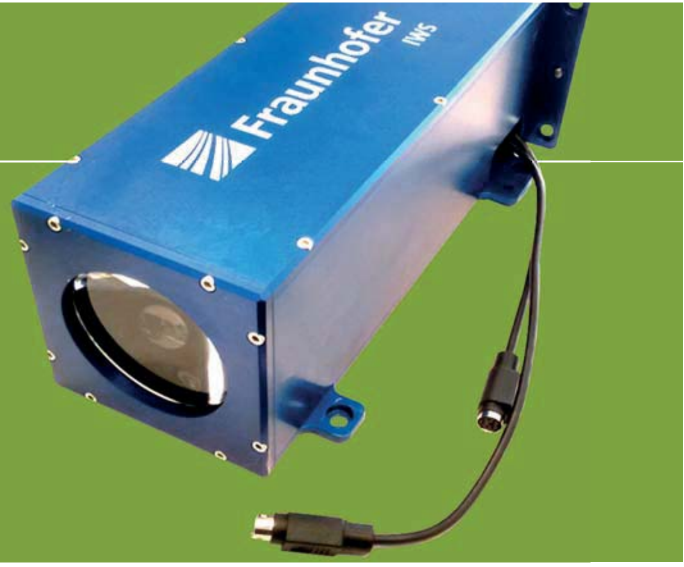


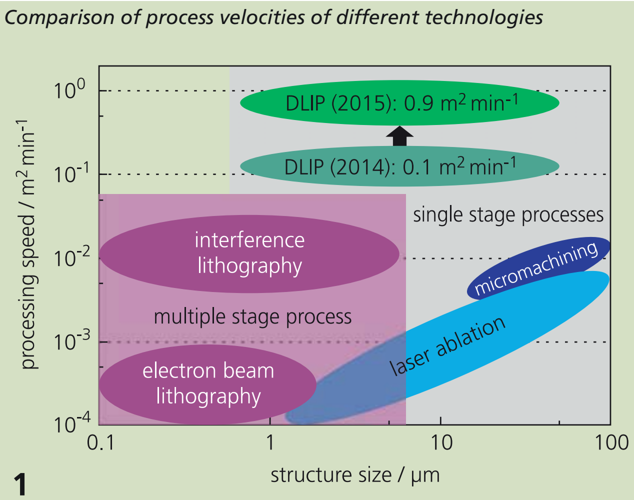
2

WORLD SPEED RECORD FOR DIRECT LASER MICROPATTERNING

THE TASK

Well defined micro- and submicron structures may be exploited to create innovative and application specific mechanical, biological and optical surface functions. Today such structures can be created by various technologies. Often it is critical to develop solutions that meet industrial demands in terms of efficiency and processing speeds (Fig. 1).

A technical challenge is to generate highly resolved structures over large areas while simultaneously achieving high processing speeds. The micro structuring technology of direct laser interference patterning (DLIP) represents a very promising solution concept that addresses the intrinsic technological conflict between achievable resolution, substrate area and processing speed. At Fraunhofer IWS it is an important commercialization goal to transfer the DLIP technology from the laboratory to industrial use. The focus is on developing high speed processing optical components and systems that can be deployed to industrial manufacturing environments.



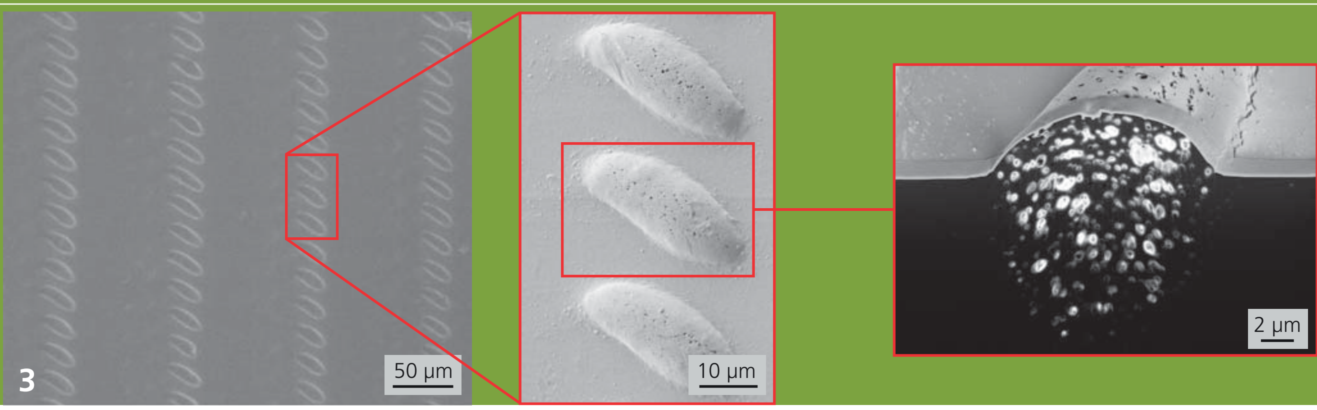
1

OUR SOLUTION

The direct laser interference patterning process is based on splitting a single coherent laser beam into two or more sub-beams, which are then recombined to form interference patterns on the treatment surface. Such interference patterns contain modulated regions of high laser intensities to process the substrate. The processing area corresponds to the entire overlapping region of the sub-beams. Areas up to several square centimeters can be patterned with a single laser pulse.

To make DLIP technology accessible to its customers, the Fraunhofer IWS offers a range of services including optical components for specific applications, process development and integration and complete DLIP processing systems. Various laser beam sources (IR, VIS, or UV) and part motion systems can be used depending on the application requirements.

The IWS team currently focuses on the development of compact DLIP processing heads (Fig. 2). The goal is to process various materials such as metals, ceramics or polymers in a single process step.



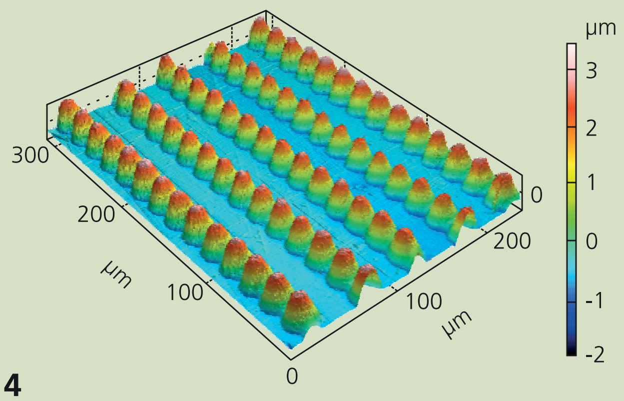
RESULTS

The Fraunhofer IWS DLIP technology is a flexible solution to pattern highly resolved sub-micron surface structures with high processing speeds approaching 1 $m^2\ min^{-1}$.

A system configuration, which was particularly optimized for high processing speeds, achieved 0.9 $m^2\ min^{-1}$ on polycarbonate and 0.35 $m^2\ min^{-1}$ on metal substrates. The patterned structures consisted of lines and dots with period lengths from 5 µm to 22 µm.

The achieved processing speeds prove the potential of the DLIP technology to efficiently manufacture highly resolved periodic surface patterns over large areas. Compared to conventional laser ablation processes it is possible to generate more structural elements per time, and thus leading to high efficiency. For example, laser ablation creates only one structure element per laser pulse whereas DLIP can produce 100 to 1,000,000 structure elements with a single laser pulse. In the future it will be possible to use higher power laser systems in combination with innovative beam shaping optics for DLIP. Processing speeds are expected to reach several $m^2\ min^{-1}$. Such processing speeds will make DLIP an attractive option for new mechanical, biological and optical applications such as in the automotive, medical devices and food industries.

Confocal microscopy image of a structured polycarbonate surface



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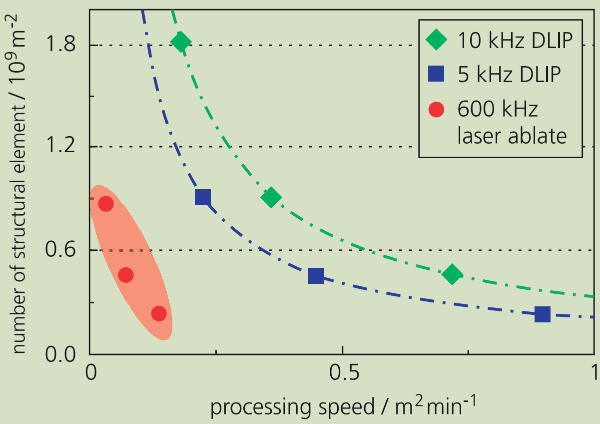
Comparison of processing speeds of DLIP with conventional laser ablation on polycarbonate substrates



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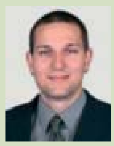
2 *DLIP processing optics*

3 *SEM image of a structured polycarbonate surface produced with DLIP*

CONTACT



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