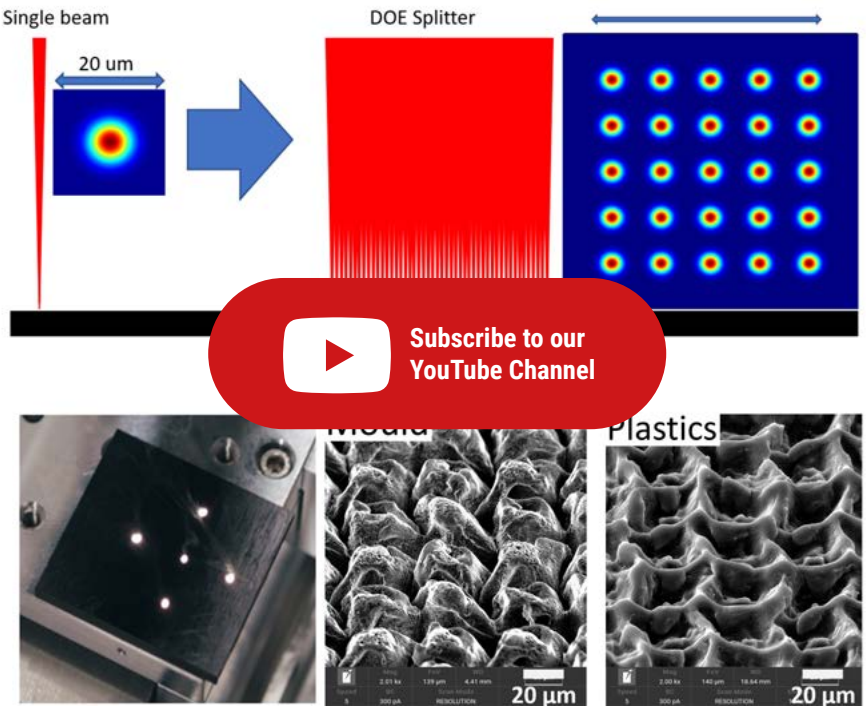
hilase

SUPERLASERS FOR THE REAL WORLD

Laser microstructuring

AN EFFICIENT TOOL TO FUNCTIONALIZE PLASTICS

WHITE PAPER



INTRODUCTION

The functionality of many industrial parts and products depends on how their surfaces interact with their surroundings. Laser structuring offers a simple contactless one-step process for controlling the surface morphology of almost arbitrary materials. Therefore, a smart surface functionalization by laser-made micro and nanostructures is a suitable tool to maximize the value of a product and enable new properties for common materials. Fine surface features have been exploited to modify friction, adhesion, wettability and self-cleaning, aesthetic and optical properties, cell growth and bacterial retention.

PROBLEM

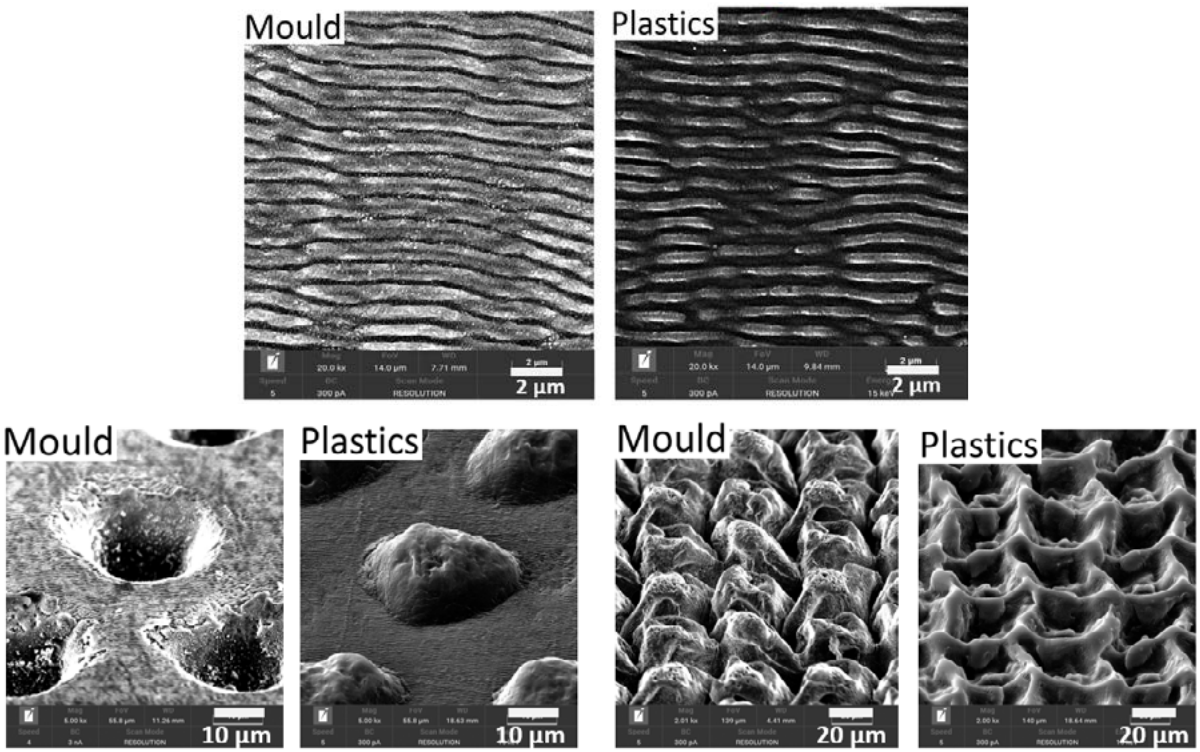
Despite this progress, the capacity to produce microscale surface features over large areas represents a significant challenge in terms of production technology, throughput and cost. Generally, throughputs only up a few cm^2/min are reached by conventional single beam approaches for structure detail in several µm. In the last years, HiLASE multi-beam technology was proved to significantly improve productivity by parallelization into more than 1000 simultaneously structuring laser beams. However, for components with a complex 3D geometry lower number of beams or complex strategies have to be applied, which decreases the throughput.

From a manufacturing point of view, the capacity to produce micro and nanoscale surface features over large and complex 3D parts represents a significant challenge.

SOLUTION

Mass production techniques such as injection molding are suitable for the production of functionalized 3D parts with complex 3D geometry. The ability to transfer micro and nanoscale morphology from metallic molds to polymeric components with standard production processes greatly improves productivity. This solution was identified as the most cost-efficient way to produce functional micro/nanostructures. This technology enables the mass production of complex polymeric components with micro- and nano-structured surfaces.

To structure the moulds micromachining laboratory has been established at HiLASE, providing efficient laser surface micro/nanostructuring with state-of-the-art precision (< 1 µm) and productivity (> 100 cm^2/min). The micromachining laboratory benefits from the unique multi-beam infrastructure and an advanced beam positioning system and 5 axis stage system to enable precise texture placement over complex parts. Making it suitable for direct plastics structuring or structuring of metallic moulds.



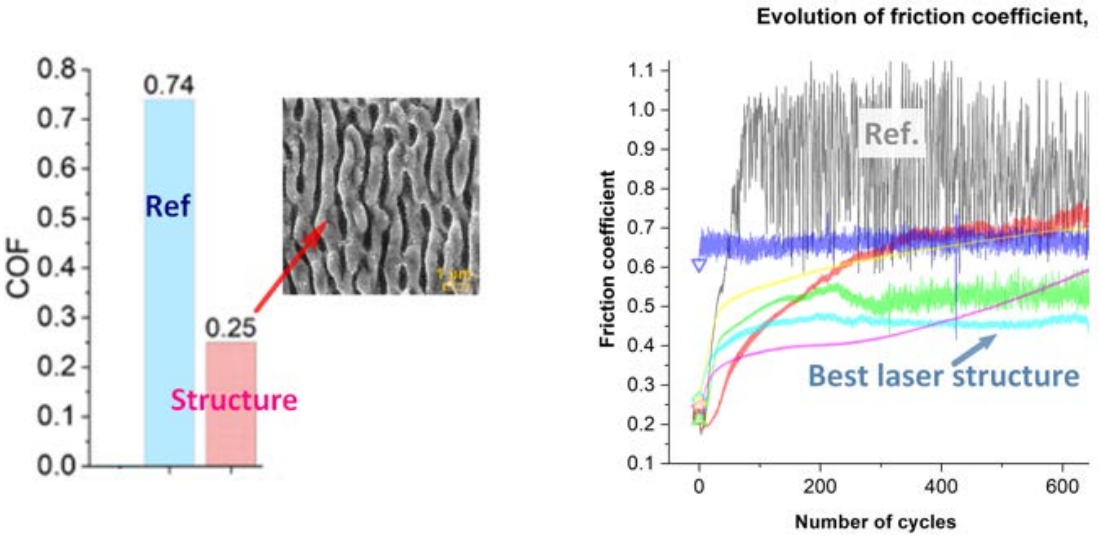
A PLASTIC PART WITH REPLICATED MICRO/NANOSTRUCTURES PROVES THAT THIS METHOD IS SUITABLE TO PRODUCE PLASTIC PARTS WITH MICRO/NANOSTRUCTURES ON A LARGE SCALE.

SUMMARY

Precise laser micro/nanostructuring of metallic moulds enables the mass production of complex 3D polymeric components with an added value of a product which may include:

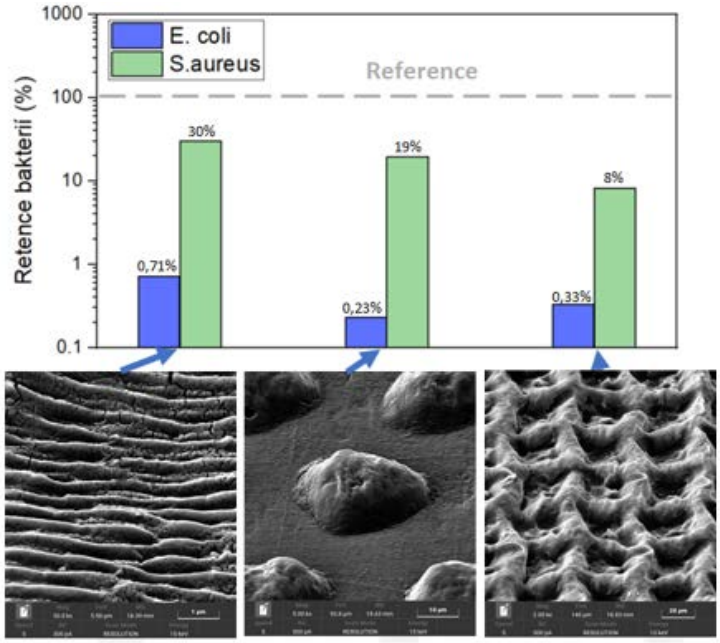
- Friction reduction
- Increasing surface adhesion
- Modification of optical properties
- Antibacterial properties, biocompatibility
- Wettability modification

With high resolution of replicated structures < 1 um HiLASE centre is offering top-class accuracy, a deep understanding of the phenomena and the possibility to customize the mould´s microtexture regarding a particular application. Our unique background and know-how allow us to provide laser texturing service with maximum confidence. Furthermore, recently HiLASE team achieved a world record in productivity of nanostructuring by using 40000 beams at the same time.

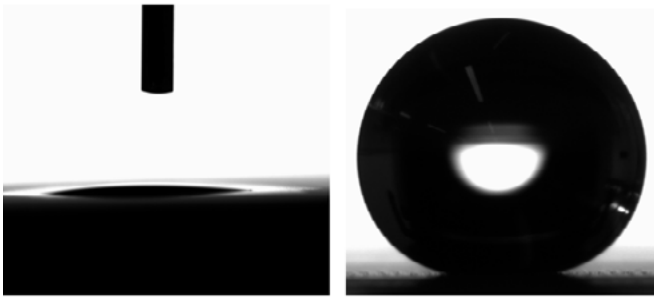


FRICTION REDUCTION PROPERTIES: COEFFICIENT OF FRICTION DECREASED FOR 66%

OPTICAL PROPERTIES: NANOSTRUCTURES ACTING AS DIFFRACTION GRATING FOR HOLOGRAMS AND STRUCTURAL COLOURS



ANTIBACTERIAL PROPERTIES PA66, ABS, PP: BACTERIA TYPES: STAPHYLOCOCCUS AUREUS (CCM 4516) A *ESCHERICHIA COLI* (CCM 4517). ACCORDING TO ISO 22196 & ČSN 56 0100 – BACTERIA COUNT REDUCED FOR MORE THAN 99.8%



WETTABILITY: SUPERHYDROPHOBIC OR HYDROPHILIC SURFACES FOR ADHESION MODIFICATION, CORROSION RESISTANT OR SELF-CLEANING SURFACES.

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