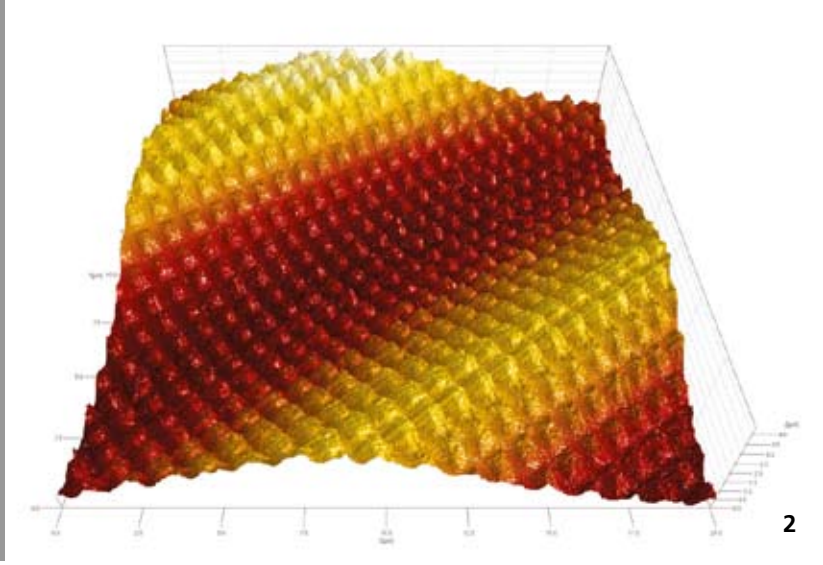

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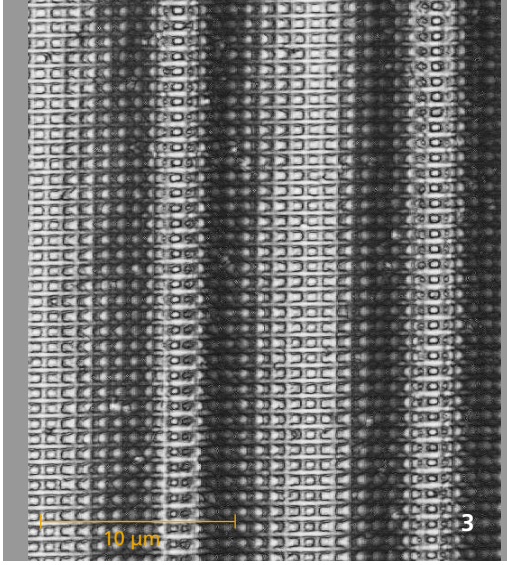

3

GENERATION OF HIERARCHICAL MICRO- AND NANOSTRUCTURES THROUGH LASER ABLATION

Task

The use of surface functionalization is becoming more and more important both in the industry as well as in research. Many of these functionalized surfaces imitate those found in nature, whereby the imitation of the lotus leaf with its hydrophobic properties counts among the most prominent examples. These surfaces are often double structures, i.e. they consist of a µm-scaled structure that is covered by a nanostructure. Surfaces generated technically mostly only implement single scaled structures, since conventional manufacturing processes cannot generate defined nanostructures on non-planar surfaces or can only do so with great difficulty.

Method

With a new approach, such hierarchical structures can be generated by a two-step laser process. In a first step, the microstructure is inserted in the surface with a UV picosecond laser. Through the use of pulse bursts, the minimally possible structural size can be reduced to less than 10 µm. In the second step, a nanostructure is applied to the microstructure with multi-beam interference. In this process the intensity created by the interference of coherent laser beams can be used to generate structures in the nm range. The advantage that this approach offers is that modulations appear in the entire overlapping volumes so that not only thousands of structures can be generated laterally and simultaneously, but also non-planar surfaces can be processed.

Result

With this two-step laser process, defined hierarchical double structures can be implemented successfully in the polymer polyimide. This process reached minimal structural sizes of 200 nm for the nanostructures on periodic microchannels in the single-figure µm range.

Applications

These results can be used for optimizing existing functionalized areas as well as for combining different functionalized areas in varying magnitudes. This way, on hydrophobic surfaces for example, the stability of the effect can be significantly increased by a double structure.

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2 Laser scanning microscope picture of a double structure.

3 Atomic force microscope picture of a flat double structure.