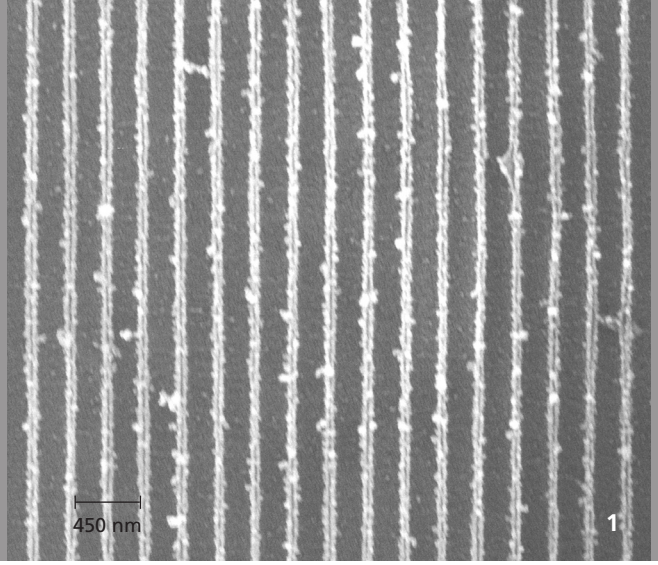

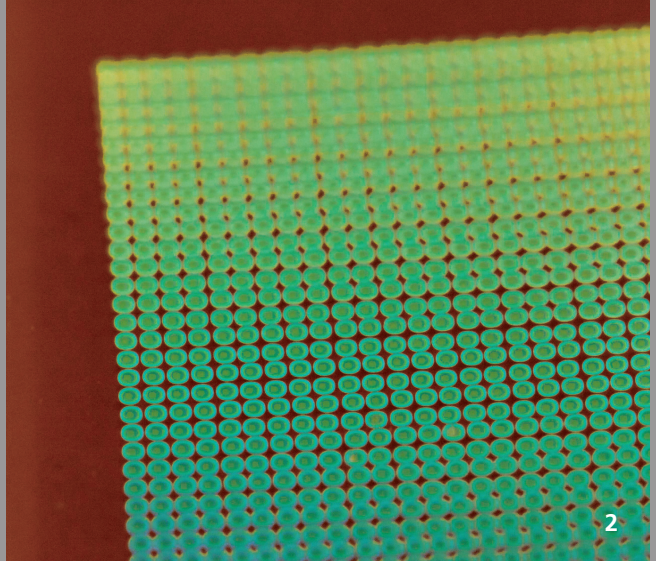

NANOSTRUCTURING WITH A MULTI-BEAM INTERFERENCE PROCESS

Task

Functionalized surfaces with structures in the nanometer range are of great interest for many applications. As an example, antireflection layers in particular require a structural size below the wavelength of visible light. Generating such structures is, however, very costly since their production is typically based on complex, multi-stage lithographic processes. Direct multi-beam interference ablation, however, makes it possible to reach significantly more cost-effective, direct nanostructuring without further process steps.

Method

To structure a surface, multi-beam interference uses an intensity modulation in the superposition of two or more coherent partial beams of a laser. The periodicity of the corresponding pattern can be flexibly adjusted by the angle of incidence of the partial beams and lies in the range of the wavelength used. In this technology, the structure size is not diffraction limited so that structure sizes below the wavelength used are possible. In the results presented here, Fraunhofer ILT used a UV-ns laser with a two-beam interference setup. At an incidence angle of about 50°, the interference pattern has a periodicity of 230 nm, which is transferred in a polyimide surface by laser ablation.

Result

With this multi-beam interference technique, deterministic nanostructures could successfully be introduced directly into the plastic in a simple process step. The structures shown in the picture were simultaneously generated with a single nanosecond pulse that has a spot diameter of 700 µm. The generated structures have a line structure with a ridge width in the 100 nm range and with a maximum depth of 120 nm.

Applications

The work presented here focuses on generating cell guiding structures for bone marrow, blood and induced pluripotent stem cells (iPSCs) within the DFG research priority program SPP1327. Thanks to its cost-efficient, flexible nanostructuring, this technology lends itself to other potential applications in optical functionalization, such as the antireflection coating of surfaces to increase input or output efficiency.

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1 SEM image of a nanostructured surface.

2 Macro image of a structured sample.

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