Karlsruhe Institute of Technology

Workgroup Prof. Th. Schimmel
Institute of Applied Physics
Institute of Nanotechnology

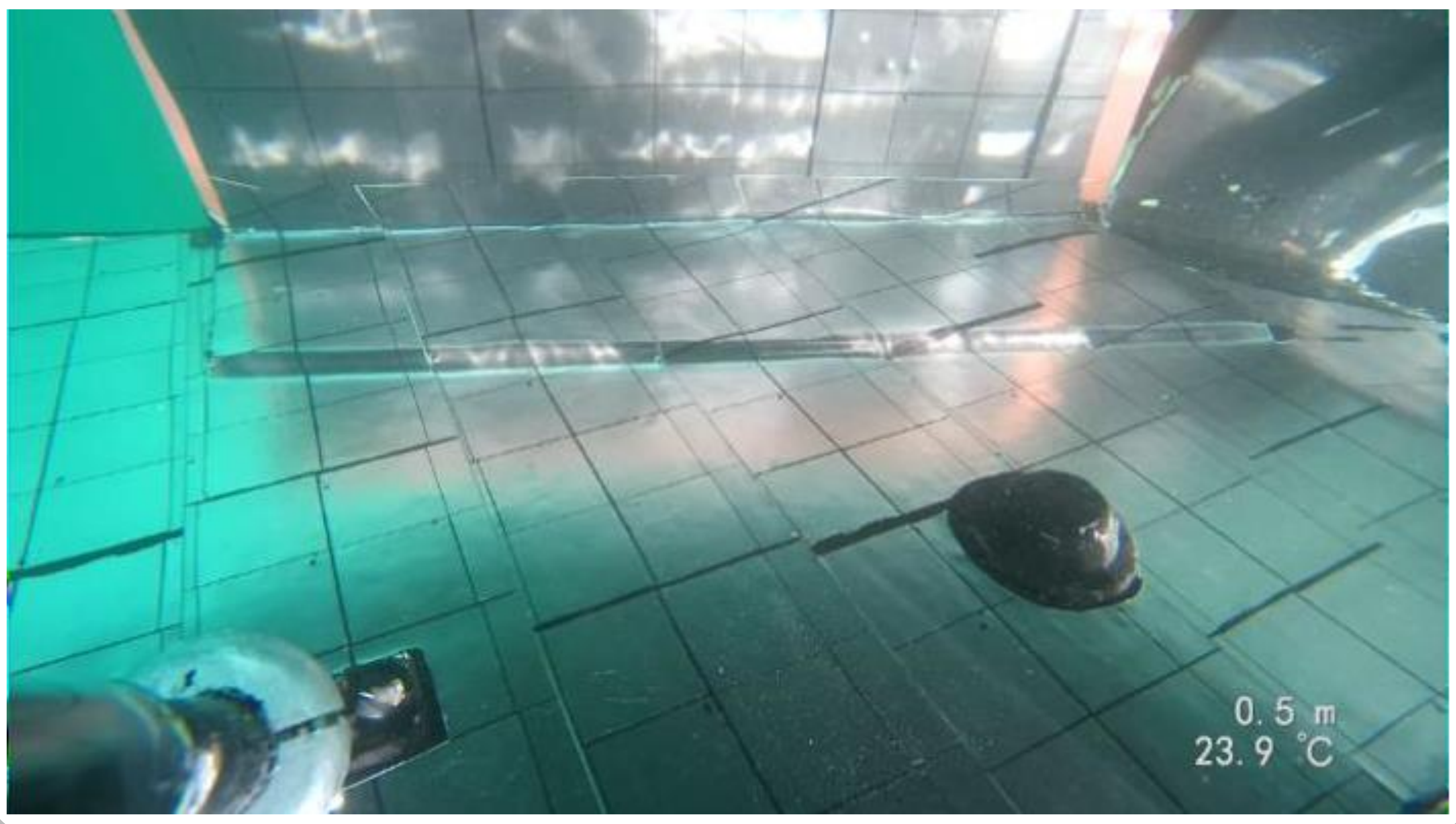
Scaling on a new level – Continuous production process for large area nanogratings

The combination of a recently available method of nanofabrication and an existing scale-up process makes large area diffraction gratings conceivable

R. Droll, L. Speichermann-Jägel, M. Barczewski, R. Gröger, Th. Schimmel, S. Walheim

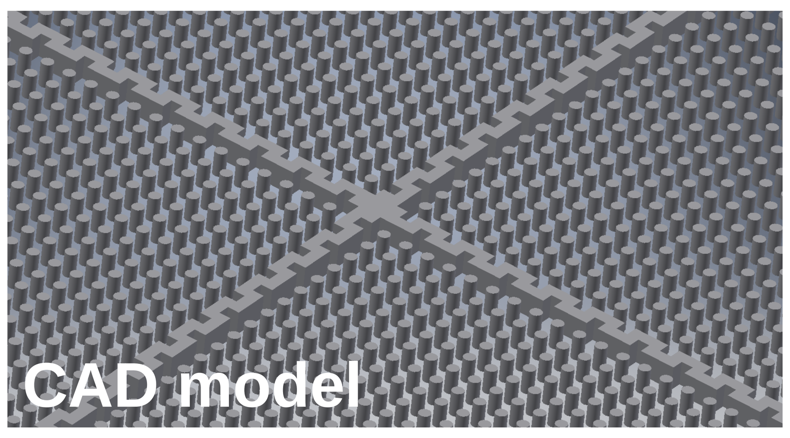
From microstructure: Air retaining surface

During the EU funded project AIRCOAT, a continuous production process was developed for patterning a hydrophobic foil with Ø2.5 µm pillars. The applied foil on a ship hull showed remarkable air retaining properties.

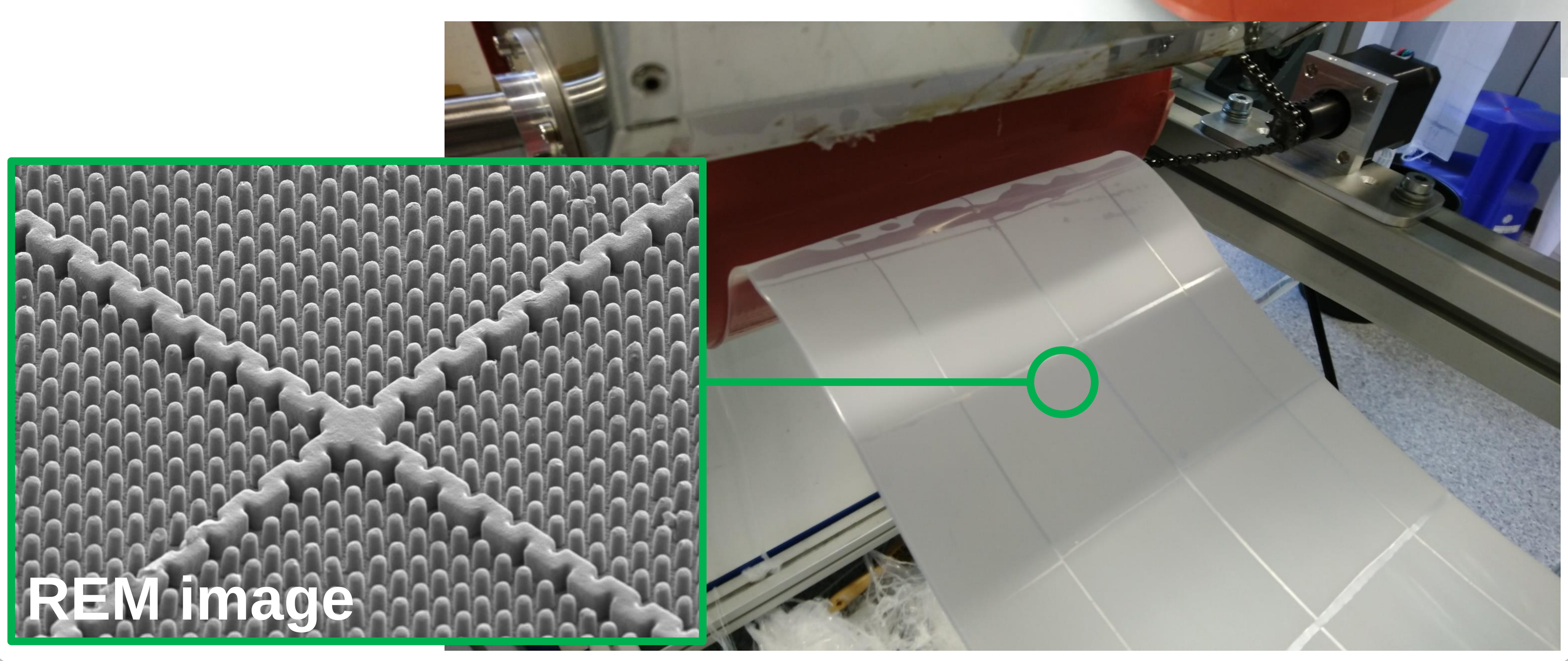


Continuous production process

Coming from a CAD model, a structure master was fabricated using direct laser writing (DLW) in an area of 6.25 x 6.25 cm^2.



Core of the production process is a elastomer sleeve, which was formed by a stitching process after molding the master multiple times. During the production process, a thermoplastic material is molded by an extruder and formed to a foil. The pillars are shaped by the cavities in the sleeve and can be observed in the foil using a microscope.

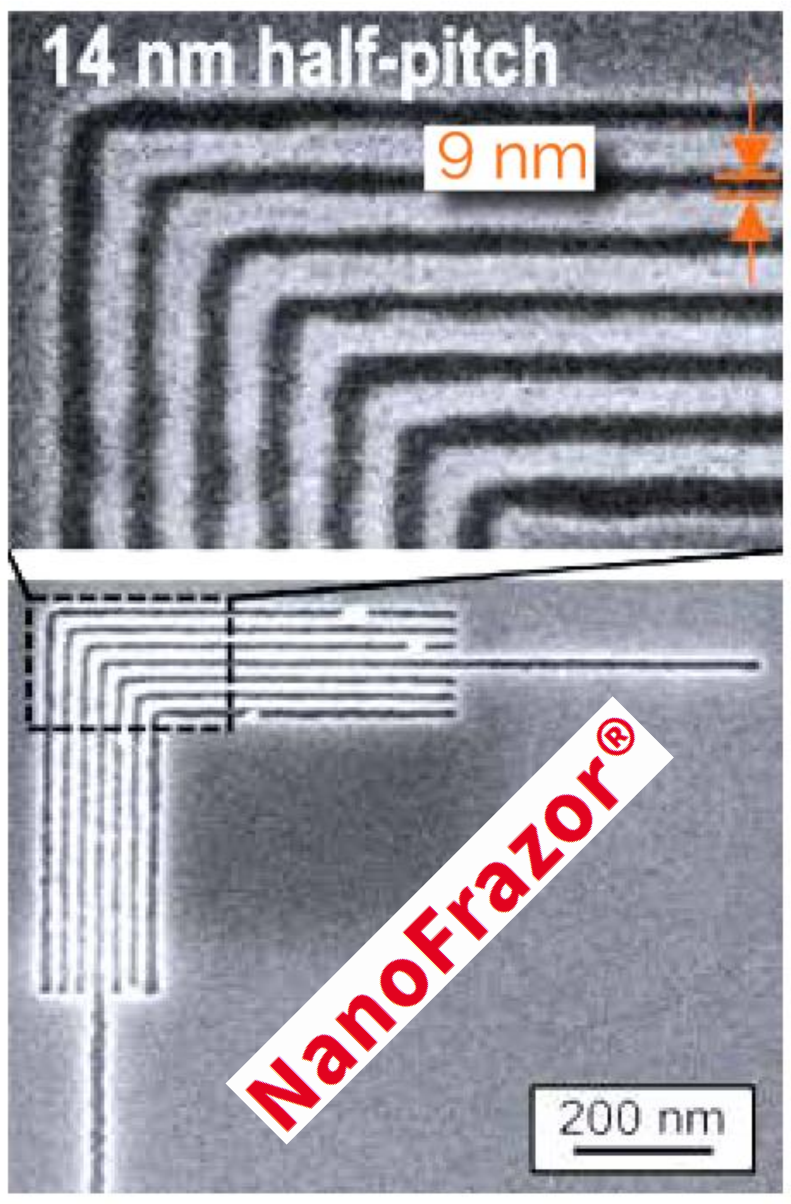


To nanostructure: Diffraction gratings

Reference: *https://heidelberg-instruments.com/wp-content/uploads/2022/03/fact-sheet-NF-Explore.pdf*

Perspective

In optoelectronics, diffraction gratings for (visible) light are very common in analysators or monochromators. While the structure size using DLW is limited to 1.5 µm (half pitch), a recently introduced scanning probe lithography (SPL) system *NanoFrazor* (by *SwissLitho / HeidelbergInstruments)* can easily achieve structure sizes below 100 nm in PPA (Polyphthalaldehyde). „Core of the NanoFrazor® technology is an ultra-sharp heatable probe tip which is used for writing and simultaneous inspection of complex nanostructures." Also greyscale lithography is possible, as well as in situ imaging by the SPL tip. This makes the NanoFrazor well-suited for fabrication of a nanograting master structure.



Continuous production of nanogratings

Combining the existing continuous production process, demonstrated with various structure sizes from 2.5 µm to 50 µm, and the master fabrication method provided by the SPL, large area nanogratings become conceivable. Again coming from a CAD model, a structure master will be produced using the SPL with an aimed structured area of 30 x 30 mm^2. The surface structure will be transformed into a sleeve and mounted to the continuous production process.