Innovations in photoresists and photopolymers for 2D / 3D micro and nano fabrication

Anja Voigt, Arne Schleunitz, Christine Schuster, Maria Russew, Martin Herder, Jan Klein, Martin Messerschmidt, Mirko Lohse, Manuel Thesen, Susanne Grützner, Johannes Wolf, Marina Heinrich, Gabi Grützner

micro resist technology GmbH
Köpenicker Str. 325, 12555 Berlin
Germany

High fidelity 2D and 3D structures at the micro and nanometer scale are facilitated by a growing number of progressive fabrication methods which employ numerous concepts of lithographic patterning. For the manufacturing in an industrial environment, all processes require a specific material solution when process technology needs to be advanced beyond its state-of-the-art status. At the same time reliability and scalability of processes and therefore materials is expected to be high.

As a commercial supplier for innovative photoresists and photopolymers, micro resist technology aims at providing such industrial solutions. They comprises of both, materials and technology support, and are tailored for diverse micro and nano fabrication In our contribution to the industrial highlight session we seek to review our material innovations which meet both, scientific work where emerging nanofabrication is employed as well advanced production with industrial relevance. The following highlights will be addressed:

- E-beam lithography is a versatile patterning method for the generation of high resolution nano patterns. Combining stepwise greyscale exposure and pattern reflow with a positive tone resist results in greyscale patterns of small dimensions.
- Greyscale UV lithography of up to 100 micron thick resist films, either by direct laser writing or by conventional mask aligner exposure and a greyscale mask, can generate exceptionally deep greyscale micro-patterns. Successful fabrication of complex pattern is shown with adjusted resist formulations and tailored processing techniques.
- Laser interference lithography is another method which allows the manufacture of nanoscale and periodic patterns even on very large substrates. Whereas two photon absorption (2PA) allows the generation of real 3D patterns at micro and nanoscale.
- Nanoimprint lithography (NIL) is driven by the need for alternative patterning techniques outperforming generic lithography approaches. The ability to directly pattern “functional” materials that cannot be processed by standard lithography techniques is an exclusive asset of NIL. This will be shown with recently developed bio-functional NIL resins.
- Mix-and-Match approaches will be presented in conclusion where processes are smartly combined with each other (incl. inkjet printing) allowing completely novel additive manufacturing schemes.

In this and other contexts, micro resist technology has been developing resists, polymers and photopolymers advancing micro and nanolithography and its diverse applications over almost three decades. Addressing the crosscutting challenges that find its origin in the highly diversified technology as well as in its manifold practice, we have been constantly innovating materials by translating technology demands into polymer chemistry.

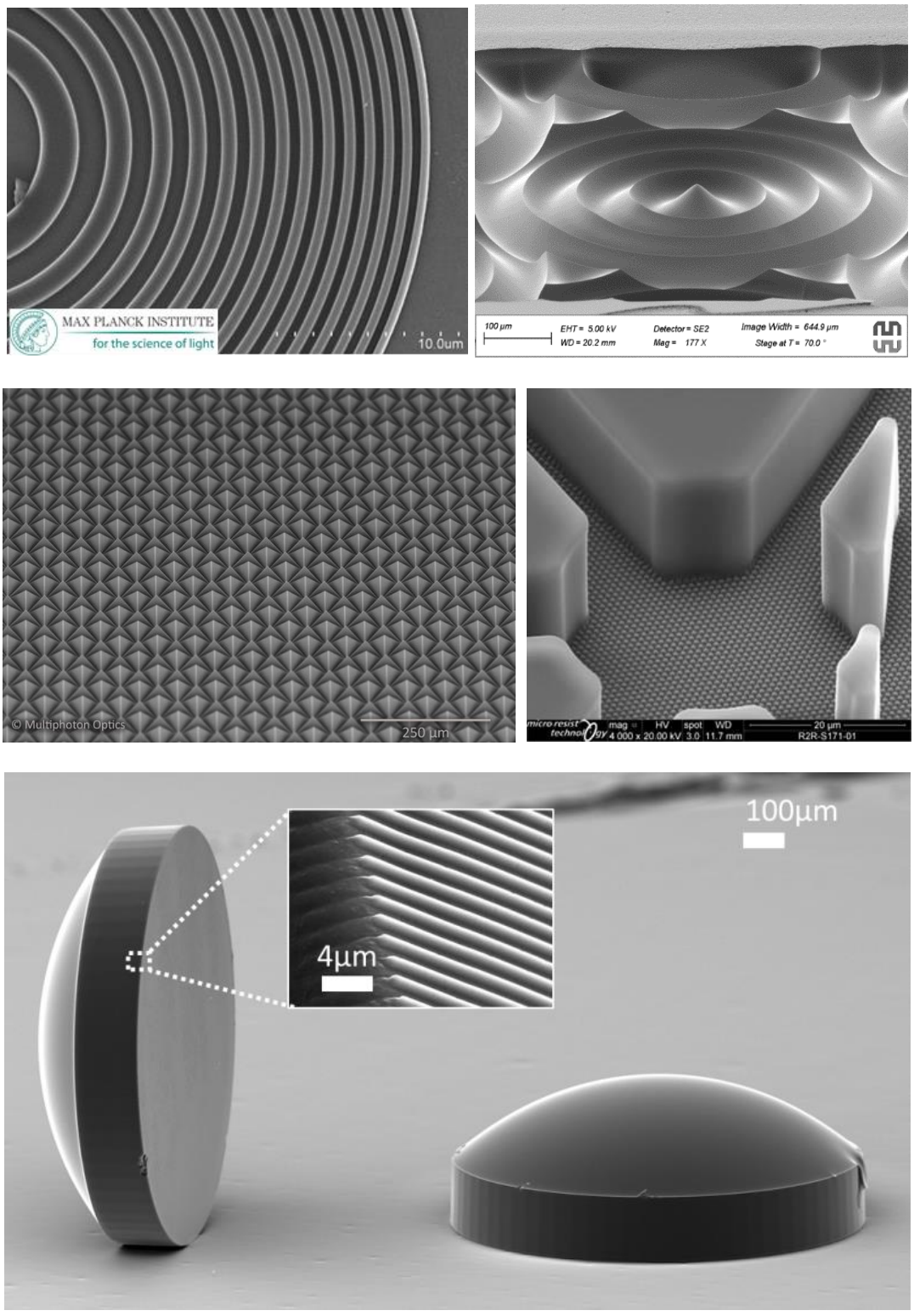

Figure 1. Set of exemplary SEM micrographs for 2D and 3D pattern at micro and nanometer scale in innovative photoresists and photopolymers which enable different fabrication processes such as e-beam (top left), greyscale (top right), two-photon absorption (center left) and nanoimprint lithography (center right). Mix-and-match approach allows complex pattern in additive manufacturing schemes (bottom line).