XRnanotech: Advanced nanolithography - Unlocking unprecedented potential of nanostructured optical elements

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At XRnanotech, which is a spin-off company from the Paul Scherrer Institut in Switzerland, we use different nanolithography approaches to structure optical elements down to the single-digit nanometer scale. We use electron-beam nanolithography, two-photon polymerization, direct laser writing and combinations of these techniques to offer outstanding solutions mainly in the field of diffractive optical elements. Such nanostructured diffractive optical elements enable experiments at many large-scale research facilities and are a hot topic in many industries. Our goal is to push the limits of diffractive optics especially in the X-ray regime by continuously improving the resolution and efficiency for applications in fields like microscopy, scattering and spectroscopy. X-rays are of great interest as these beams offer elemental and chemical sensitivity along with high penetration depth. They represent excellent probes for research and investigation of matter. However, they are challenging to focus using standard refractive optical elements. This is necessary as the ongoing development of accelerator-based photon sources like synchrotrons or X-ray free-electron lasers (XFELs) led to a strong increase in X-ray brilliance over the last decades and enabled ever-new experimental techniques with unprecedented spatial, temporal and spectral resolution. Apart from X-rays, we pursue applications of diffractive optics from infrared to the ultraviolet by exploring new fabrication methods, materials, processes, and designs.
We exploit the fact that diffractive optics have a fundamental advantage over other kinds of optical elements like mirrors and refractive lenses, which is the possibility to precisely control and manipulate the optical wave front. This allows realizing complex optical functionalities like efficient beam-shaping optics for transmission X-ray microscopes, spiral zone plates for generating beams with an orbital angular momentum, off axis zone plates in order to combine microscopy and spectroscopy, beam-splitting zone plates that combine focusing and beam-splitting as well as achromatic optical elements for high-throughput microscopy [1-6].
In this contribution, we will highlight the latest developments in fabricating diffractive optical elements at XRnanotech aiming at best resolution, efficiency and optical functionality.

References:
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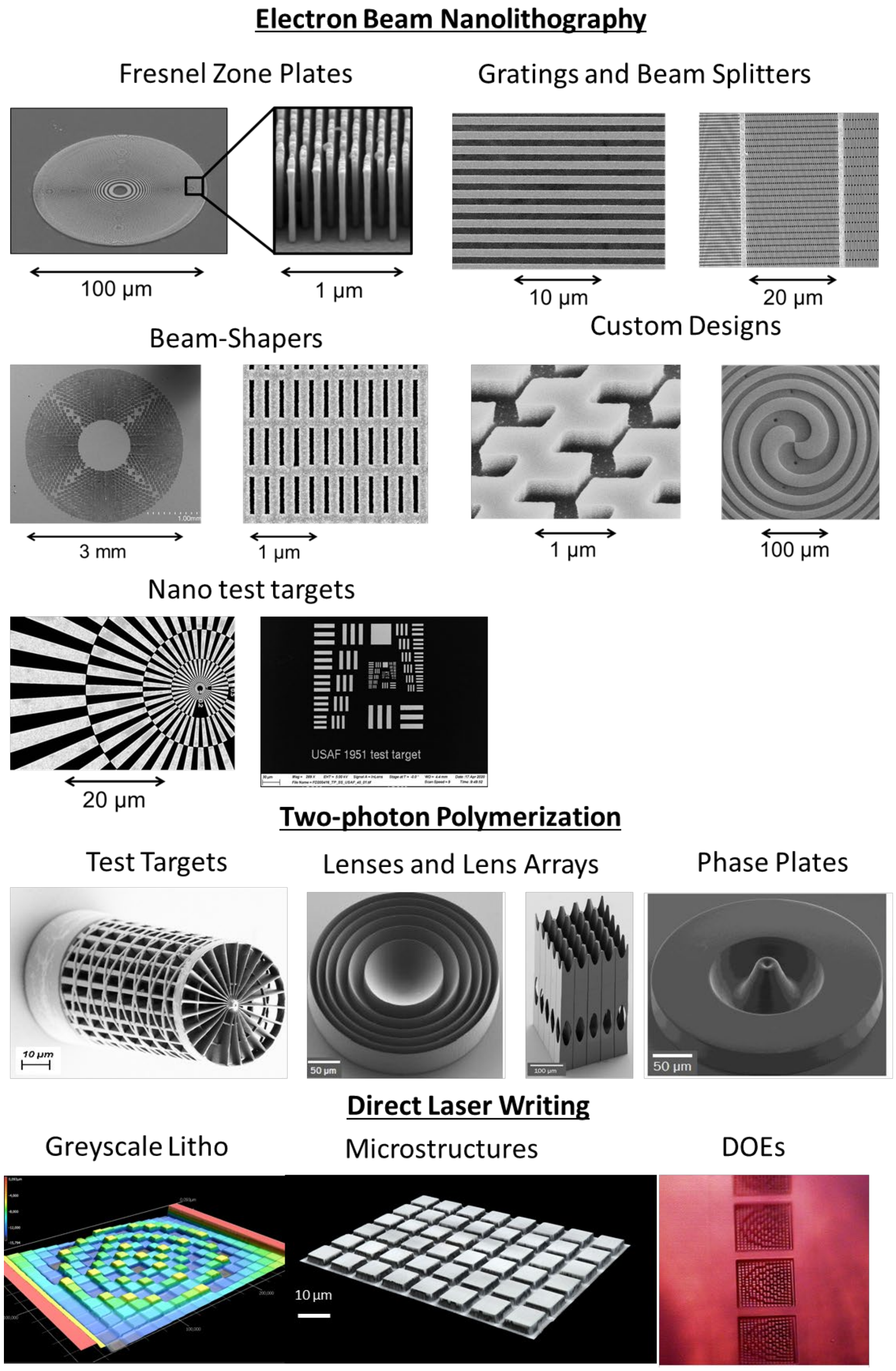

Figure 1: Fabrication capabilities at XRnanotech: We use different approaches in the field of nanolithography to structure diffractive optical elements.