Algorithmic Patterning Workflow for EBL, a new FIB-SIMS System and massive parallel Laser direct Write – Latest Raith Innovations for Nanofabrication and -Analysis

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Metalenses have turned out to be very promising to potentially revolutionize a lot of sensing and imaging applications in consumer electronics, medicine, autonomous vehicles, AR/VR displays, and more. Their nanofabrication however implies some significant challenges due to the nature of their very complex design. Corresponding (GDSII) design data files can grow up to several hundreds of GB making it extremely challenging if not impossible to be processed efficiently with conventional EBL systems.
Here, we present a lean, fast and extremely efficient innovative EBL workflow that circumvents the necessity for generating a flat GDSII design by exploiting the algorithmic (formula-based) description of the metalens pattern. This new concept results in much reduced patterning overhead such that a prominent metalens design with 1mm diameter as described in [1] can be exposed in less than a minute.

With nano- and microfabrication systems now also comprising single or multiple laser beams, Raith has recently added a new technology to its product portfolio. In this talk, we will demonstrate that multibeam laser beam lithography (LBL) can produce photonic devices with controllable submicron feature sizes as small as 600 nm with high fidelity and remarkable 10% CD uniformity over a whole 120 mm x 120 mm photonic crystal array. Our results highlight the potential of multibeam laser lithography as a powerful method for industrial scale technology showing an excellent throughput being 50 times faster compared with a single laser beam lithography approach.

The Raith VELION FIB system serves a variety of applications in focused ion beam nanofabrication, imaging and nano-analytics. Its new GaBiLi source is emitting both light and heavy ions (Lithium, Gallium, and Bismuth) that can be exploited for new nanofabrication strategies, ion imaging, and secondary ion mass spectrometry (SIMS). First results of the latter will be presented.

Finally, all micro- and nanolithography results and subsequent process steps need to be verified and qualified with respect to pattern fidelity and lithography process repeatability. Here, the Raith CHIPSCANNER is helping to bridge the "death valley from lab to fab" with its capabilities for fully automated large area SEM imaging and metrology.

[1] Mohammadreza Khorasaninejad, Federico Capasso et al., "Metalenses at visible wavelengths: Diffraction-limited focusing and subwavelength resolution imaging", Science, Vol. 352, issue 6290, 1190–1194, 2016