From FIB to advanced FIB Nanofabrication: Taking advantage of multiple Ion Species and large Area Nanopatterning

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Multi-technique nanofabrication instrumentation comprising both an electron and an ion beam optics (FIB-SEM systems) have proven to be flexible multi-purpose tools enabling a broad range of nanotechnology applications. They are regarded as a "must have" in today's research and development based laboratories of various disciplines. These techniques routinely provide nanopatterning resolution with sub 10nm feature sizes and are well suited for nano-research - excellent beam control provided.
In order to fully unlock their true nanopatterning potential and to secure stable, reproducible, highest precise and efficient operation for optimum results and device performance - also over large areas - advanced hardware, patterning control and strategies for these tools come into play.
That has been accomplished with our latest generation of FIB (and SEM-) technology integrated into a true lithography platform optimized for nanometer scale patterning over large areas and extended periods of time. 2D-and 3D-applications in quantum technologies, optics, telecommunication, plasmonics, nanofluidics and nanobiotechnology, such as X-ray zone plates [1], large area gratings [2], plasmonic arrays, and wafer-scale nanopore devices have successfully been demonstrated. Innovative stitching error free patterning modes enabled by a high precise laserinterferometer controlled stage provide access to nm-scale patterning in the cm-regime.
Since the type of used ion species has dramatic consequences on the nature of the interaction mechanism with the sample and thus the resulting nanostructures, we have extended the ion column towards the long-term stable delivery of multiple species for a nanometer-scale focused ion beam employing a liquid metal alloy ion source (LMAIS). The column is equipped with a mass filter capable of selecting from various ion species [3]. This provides single and multiple charged species of different mass without changing the source. We present the capabilities of the multiple-species FIB instrument for sub-20 nm nanofabrication employing ions like Si and Au.

References

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[2] S. Tripathi, D. Scanlan, N. O'Hara, A. Nadzeyka, S. Bauerdick, L. Peto and G. Cross, J. Micromech. Microeng. 22 (2012) 055005. DOI:10.1088/0960-1317/22/5/055005

[3] S. Bauerdick, L. Bruchhaus, P. Mazarov, A. Nadzeyka, R. Jede, J. Fridmann, J. Sanabia, B. Gila and Bill R. Appleton, JVST B 31 (2013) 06F404. http://dx.doi.org/10.1116/1.4824327

Figures

Figure 1: True 3D in one go: micro-fluidic mixer by simultaneously controlling both lateral shape and depth of the structure, fabricated with FIB.

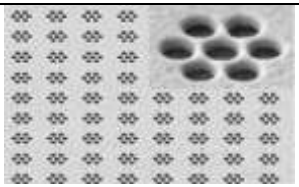

Figure 2: Plasmonic structure with sub 30nm rims between the circles, nanofabricated by FIB with extremely low intensity beam tails