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Explore unlimited process pathways for FIB nanopatterning and ion imaging using VELION

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Focused Ion Beam (FIB) nano patterning has become established as a versatile and precise fabrication method of manifold features at the nanoscale. Applications in nanoscale science require high resolution fabrication techniques at high fidelity, accuracy and reproducibility over multiple write fields in an automated manner. VELION's configurable multi-ion species FIB technology enables tailoring of various nanostructures according to application related challenges. Various ion species can be selected from universal ion sources providing fast or slow and light or heavy ions from a single source [1]. This approach paves the way for unlimited process pathways based on a FIB system merged with a true lithography platform. Unmatched large-area FIB patterning and unlimited perfect write field stitching or patterning overlay facilitates various patterning strategies according to specific applications. As VELION utilizes comprehensive automation for unattended, uninterrupted reliable nanofabrication over several days, the instrument is the ideal companion for machine driven nanofabrication.

In this contribution we present the instrument concept, an overview of various nanofabrication approaches and application such as direct patterning, hard masking, or sample functionalization.

Beyond nanopatterning, VELION FIB with its Liquid Metal Alloy Ion Sources (LMAIS) provides excellent ion beam imaging capabilities [2]. Lithium is the lightest ion for LMAIS available from periodic table and provides sub 2nm lateral image resolution. Latest results of 3D Mill & Image sample analysis will be presented utilizing the best depth milling resolution with Bismuth and superior lateral resolution with Lithium ions.

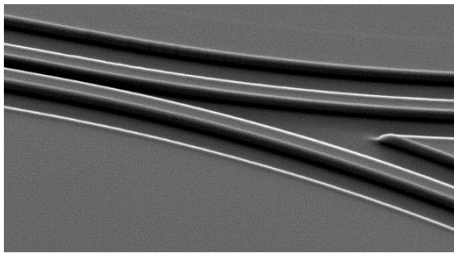
[1] J. Gierak, P. Mazarov, L. Bruchhaus, R. Jede, L. Bischoff, Review of electrohydrodynamical ion sources and their applications to focused ion beam technology, *JVSTB* 36, 06J101 (2018).

[2] N. Klingner, G. Hlawacek, P. Mazarov, W. Pilz, F. Meyer, and L. Bischoff, Imaging and milling resolution of light ion beams from helium ion microscopy and FIBs driven by liquid metal alloy ion sources, *Beilstein J. Nanotechnol.* 11, 1742 (2020)

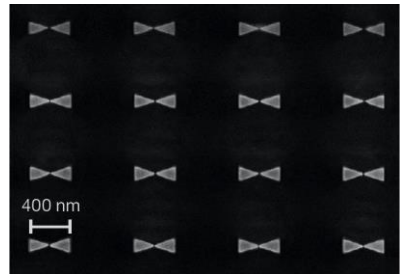


Left: General VELION setup with vertical FIB column, Laser Interferometer Stage and SEM

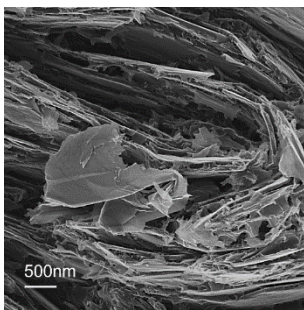
Right: Multi ion species FIB from Liquid Metal Alloy Ion Sources.



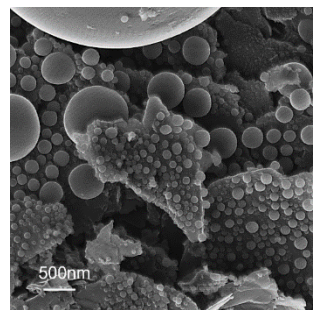
Waveguide coupler



Stepwise bowtie fabrication with Bi and Li ions



Lithium-ion image of graphite



Lithium-ion image of Sn/C