

# Cryo-Cathodoluminescence Integration, multiple Ion Species and a new EBPG: About Highlights from dedicated and multifunctional Raith EBL and FIB-SEM Systems

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Multifunctional EBL systems qualify by their capabilities to provide more than EBL only. Oftentimes, additional integrated functionality is required for sample relocation, high resolution inspection, modification or analysis, that is mandatory for a specific workflow in a unique nanofabrication process.

Here, we present the world's first EBL system with integrated cryo-cathodoluminescence analysis functionality for quantum communication technology applications [1,2,3]. The new and unique EBL system, based on a most recent multifunctional eLINE Plus tool, enables identification of quantum dots, emission spectra analysis and subsequent EBL for 3D nanolens fabrication, all performed in situ at cryogenic temperatures without breaking the vacuum.

Nanofabrication requirements for FIB technologies are specifically demanding in terms of patterning resolution, and the support of new processing techniques. Therefore we have extended our FIB technology towards the stable delivery of multiple ion species selectable into a nanometer scale focused ion beam by employing a liquid metal alloy ion source (LMAIS).

This LMAIS provides single and multiple charged ion species of different masses, resulting in significantly different interaction mechanisms to tailor the chemical and physical properties of the resulting structures.

Dedicated electron beam lithography needs machines like the Raith EBPG, that can handle the ultimate requirements resulting from a large bandwidth of state-of-the-art applications around compound semiconductors, communication technology, quantum technology, optoelectronics, photonics, micro- and nanoengineering, fundamental nanoscience, MEMS/NEMS etc.

By focussing on what really matters for professional EBL - ultimate performance with regard to precision, stability and repeatability paired with optimum throughput at all exposure conditions - we have just launched the best EBPG we ever build: the EBPG Plus system. We introduce superior world class performance specs and new SW/HW features coming with the new release.

[1] M. Gschrey et al., APL 102, 251113 (2013)

[2] P. Schnauber et al., Nano Letters 18, 2336 (2018)

[3] M. Gschrey, A. Thoma, P. Schnauber, M. Seifried, R. Schmidt, B. Wohlfeil, L. Krüger, J. H. Schulze, T. Heindel, S. Burger, F. Schmidt, A. Strittmatter, S. Rodt, and S. Reitzenstein, Nature Communications 6, 8662 (2015).