An Upgrade Package for SEM-based Metrology and Inspection

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Monitoring and optimization of nano structures and devices require SEM investigation (scanning electron microscope) for imaging, metrology, and inspection. In particular, electron beam or laser beam lithography processes include careful calibration and modeling using sophisticated test patterns for different materials, doses, densities, thicknesses, or dimensions (CD). Therefore, acquiring and analyzing numerous scans is involved both with large image sets for routine calibration and inspection at critical positions of patterns or structures.

In R&D prototyping and small batch production, analytical SEMs are used instead of the CD-SEMs in high-volume production. While the versatility and flexibility of a conventional SEM is important for covering various applications, there is a growing demand for analyzing large areas and large numbers of structures requiring more advanced and automated SEM metrology capabilities.
With offline image analysis software (ProSEM), a first approach is available for supporting versatile SEMs with metrology functionality. Moreover, this allows for automated SEM image acquisition interfacing with the tool software.

Here, we will present a novel upgrade kit (InSPEC) which provides a more sophisticated software workflow of metrology capabilities and is more integrated with the SEM tool by hardware connections (Fig. 1). This includes stage control and other SEM settings via a data connection and most importantly, a direct access to column scanning and detector signals. The package includes a hardware unit and extensive software suite enabling improved scanning integrated with automation, metrology, and data processing. The metrology job is represented by a clean sequence of scans and other activities in multiple fields or chips, measurements are defined on and driven by a CAD layout, and more advanced techniques can be established in a modular flow diagram (Fig. 2). Overall, this provides a comprehensive workflow of a SEM for metrology and inspection, while the integrated control also enables compensation of effects like limited stage accuracy or focus/ topography changes.
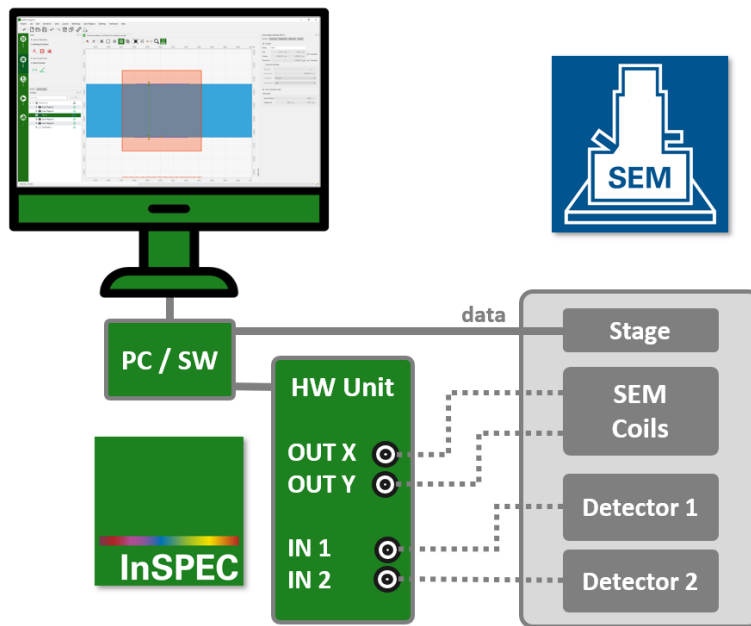
Figure 1: Schematic showing the general setup of the upgrade kit for metrology (InSPEC) as connected to a scanning electron microscope.
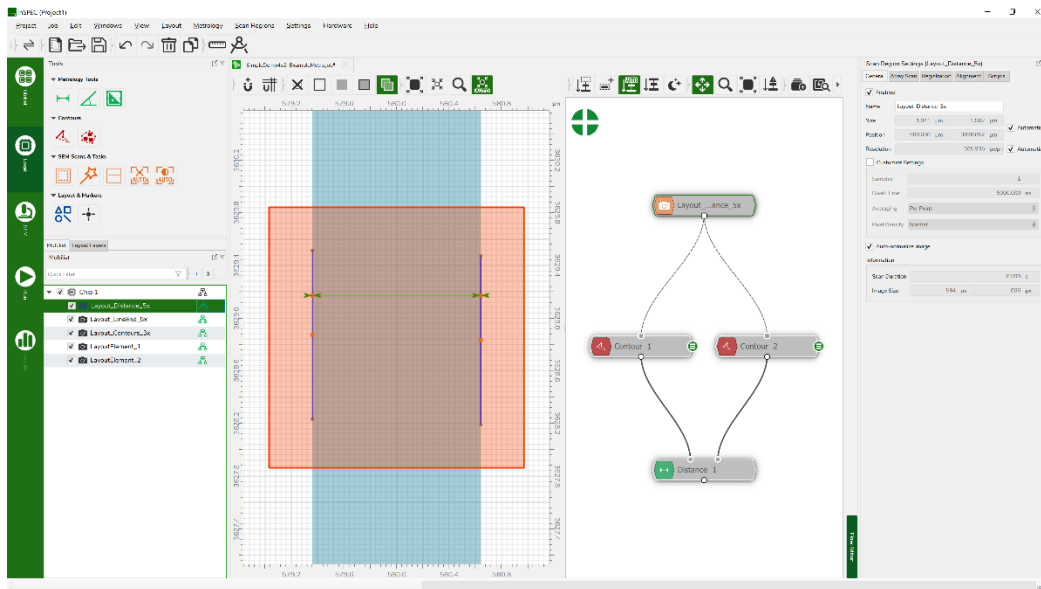

Figure 2: Screenshot of the integrated metrology user interface consisting of (from left to right): 5 main operation modes, key tools per mode, job sequence in list view, layout area with metrology activities (scans, contours, measurements), module flow editor for advanced methods.