Multi-electron-beam technology with applications in microscopy, inspection and lithography

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More than 50 years of development in focused electron beam instruments has resulted in a resolution performance that is hard to improve on. However, there is plenty of space for improvement of throughput, or imaging speed. High throughput machines in which not one, but many electron beams travel in parallel were first conceived for applications in the semiconductor industry. For electron beam lithography to play a role in the production of integrated circuits, multi-beam technology is essential. At present day feature sizes inspection of full wafers will only be possible with multi-electron-beam technology. Multi beam systems could also have a big impact in biological microscopy, for 3D imaging and for large area imaging.

Most of the developments in multi beam technology over the last 15 years have been reported here at EIPBN, so it is fitting to review the lessons learned (or rather, the lessons I learned) and see in which direction the field is going. Lesson one is that there is no single solution that fits all applications. Each instrument needs to be designed for its specific purpose, which is reflected in the choice of electron source, micro-lenses versus macro-lenses, cross-over versus cross-over-free, etcetera.

Recent results with the MAPPER lithography tool and the Delft Multi-Beam scanning electron microscope will be presented.

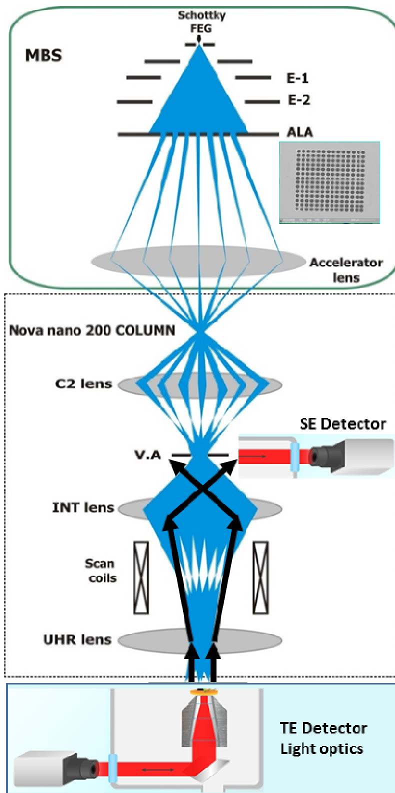

Figure 1

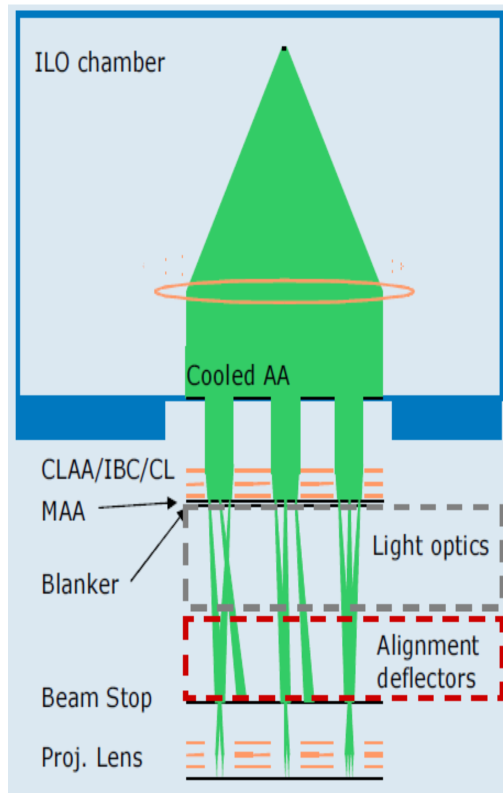

Figure 2

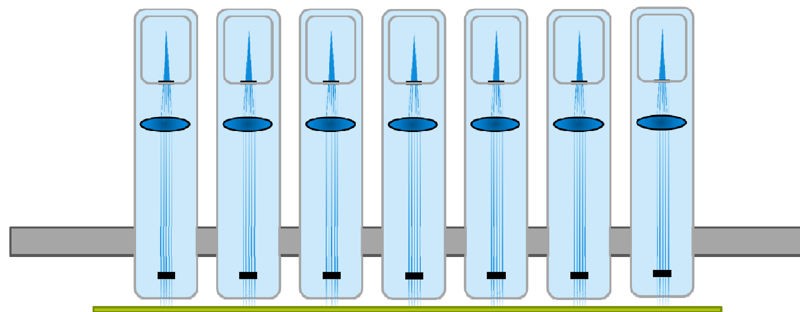

Figure 3

Figure 1: Delft Multi-Beam Scanning Electron Microscope with transmission electron detection and secondary electron detection.

Figure 2: MAPPER tool for direct write e-beam lithography.

Figure 3: Proposal for multi-beam-multi-column inspection system.