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DOI: 10.1017/S1431927606065561

Microsc Microanal 12(Supp 2), 2006
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New Developments in CrossBeam® Technology

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As we approach the 65 and 45 nm technology nodes, challenges arise in virtually every aspect of the semiconductor-industry. The push to ever smaller dimensions present challenges in lithography and mask generation, as well as etching. The push to new materials to reduce time delays creates challenges with deposition, patterning, integration and inspection, as well as packaging. Fab automation continues to be important, not only in terms of optimizing yield and fab efficiency, but in terms of supply chain management. Equipment and materials suppliers, and their further suppliers of components and subsystems, are working to meet these challenges.
Without doubt, process control is a major metrology obstacle facing those considering technology requirements for work at the 45 nm node levels. When design engineers contemplate working at dimensions below 50 nm, they must deal with tolerances in the range of 5 nm.
These requirements put a high demand on the inspection tools in respect to accuracy and resolution.
These demanding requirements can be met if a FIB column is combined with a high resolution SEM that is used to monitor the FIB structuring on a nm scale.
Such an integrated CrossBeam® tool (see fig.1) enables the high resolution observation and direct control of the FIB process in real time. Using this concept it is possible to prepare site specific TEM samples and x- section with nm scale accuracy in a reliable manner.

The major bottleneck for high throughput in the sample preparation is the speed of the ion milling process. To increase throughput either innovative gas chemistry or increased current density of the ion beam can be employed. [1]

The gas chemistry can be addressed by sophisticated gas injection systems that allow the mixture of different chemicals to target the specific needs of a certain sample material for enhanced etching.

It is theoretically possible to improve the ion beam performance by converting the ion lenses from the conventional decelerating to accelerating lenses [2]. Such optics, however, require demanding levels of lens voltages that have proven difficult to implement. On the other hand throughput can be dramatically improved by innovative software routines, which allow for fully automated sample preparation using optimised parameters.

We will present new concepts for improving the accuracy and throughput of CrossBeam® instruments. In this context we will explicitly address current needs for high throughput TEM sample preparation and ion beam nano scale machining.

https://doi.org/10.1017/S1431927606065561 Published online by Cambridge University Press

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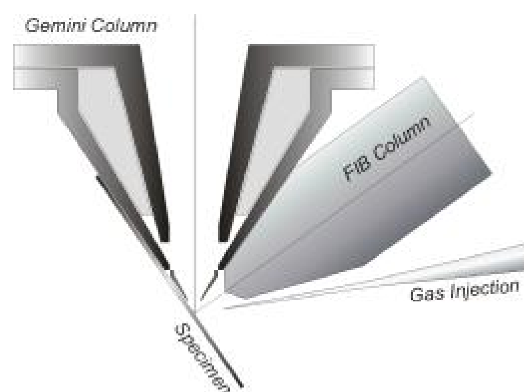

Fig. 1: Schematic layout of a CrossBeam® tool. The electron and the ion beam coincide at a coincidence point 5mm below the final lens of the SEM.

https://doi.org/10.1017/S1431927606065561 Published online by Cambridge University Press