Transmission images of a 196 beam scanning electron microscope

Ali Mohammadi-Gheidari and Pieter Kruit

Delft University of Technology, Lorentzweg 1, 2628 CJ Delft, the Netherlands

We have developed a Multi Beam Scanning Electron Microscope (MBSEM) which can deliver an array of focused beams onto a sample with a resolution and current per beam comparable to a state of the art SEM. Although this system is mainly developed for high throughput fabrication of sub-10 nm structures by electron beam induced deposition (EBID) where resist based electron beam lithography fails [1], it may also be used for high throughput electron lithography and inspection (the latter of course only after a multi detector has been developed) . Our system consists of a Nova nano 200 SEM (FEI Co.) optics column equipped with the multi electron beam source module (see fig. 1). The source unit splits the beam of a high brightness Schottky source in many sub-beams [2].

One of the crucial characteristics of the MBSEM is that it is designed to deliver an array of beams (for now; 14 x 14) in which all of them have the same current, size and brightness. Currently the first experiment has been carried out to measure the performance of the MBSEM. Fig.2 shows an image of the beam array in the chamber. To make this image a YAG and CCD camera is used as specimen to show an image of de-focused array of beams in the chamber.

In other to measure the size of individual beams, all beams are scanned simultaneously over an aperture as specimen. This aperture is a 400 nm hole made by focused ion beam (FIB) on a thin membrane. By integrating a YAG / photodiode under this aperture each beam makes its own image of transmitted current through the aperture. Analyzing the intensity variation of the transmitted current for each beam can give a measure of the size and the pitch between two beams. Fig. 3 shows an image of this single aperture made by MBSEM.

Fig. 4 shows an example of the analysis. In this experiment the objective lens is the high resolution lens (HR) with limited demagnification. To have smaller pitches and beam sizes the ultra high resolution (UHR) lens will be used. We have found the performance of the MBSEM promising but for more accurate measurements of the beam size the quality of the aperture plays an important role. More comprehensive results on the measurements and improvements will be presented.

References

[1] A. E. Grigorescu, M. C. van der Krogt, E. W. J. M van der Drift, C. W. Hagen, J. Micro/Nanolith. MEMS MOEMS, Vol. 7**,** 013005 (2008).

[2] Yanxia Zhang, Pieter Kruit, Physics Procedia 1,553 (2008).

e-mail: A.M.Gheidari@tudelft.nl

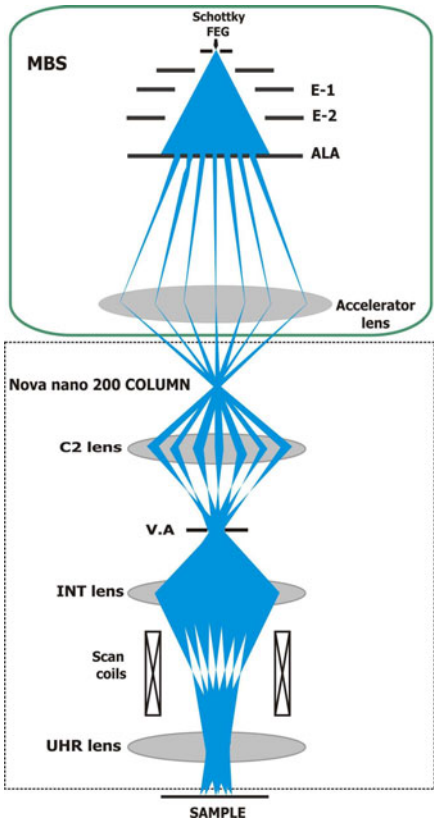

Fig. 1: MBSEM overview

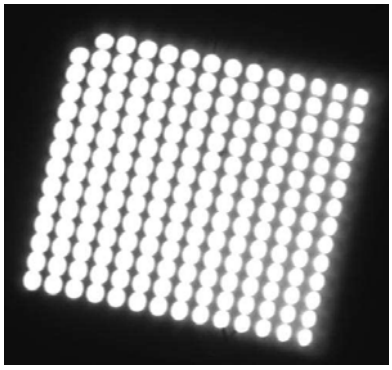

Fig. 2: YAG/CCD as specimen (scale: 1mm x1 mm)

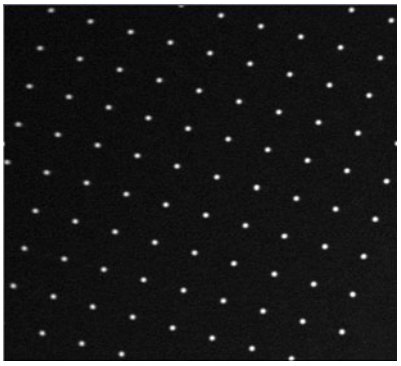

Fig. 3: an image of one single aperture with MBSEM (the pitch between two beams is 4um)

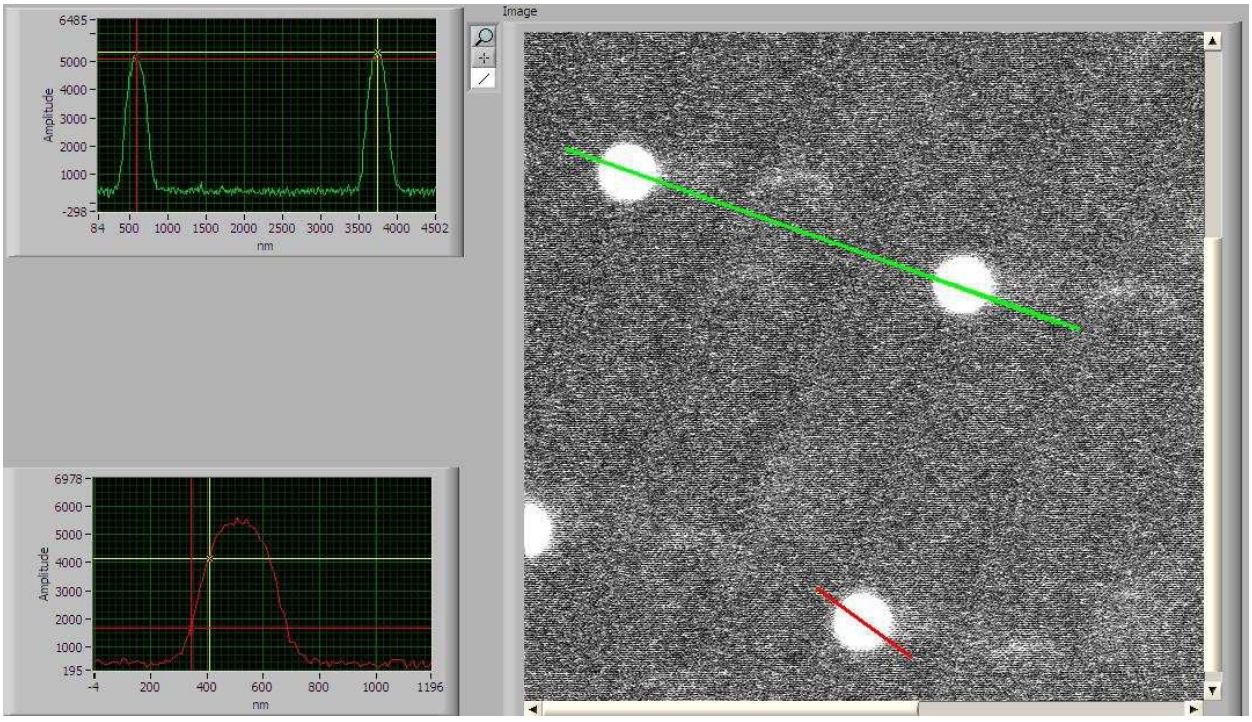

Fig. 4: an example of the analysis of beam size and pitch between two beams (here the pitch between two beams is ≈3.5 um.