Application of vector scanning in FIB photomask repair system

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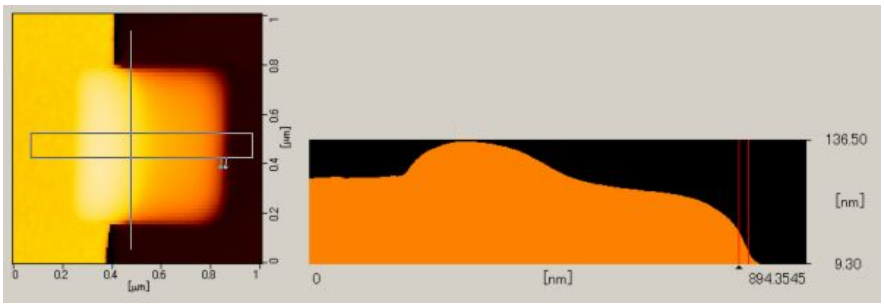
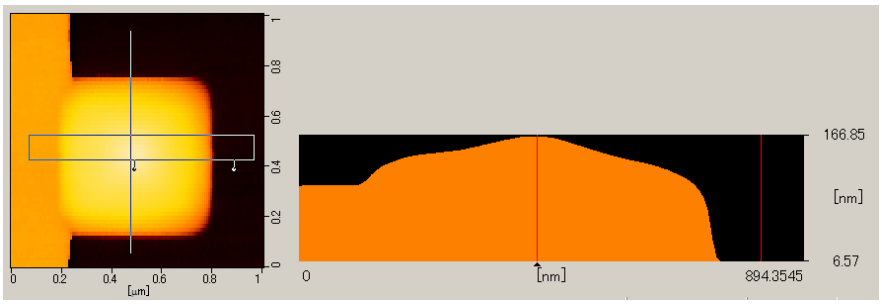
With continuous reduction of line width of the VLSI devices, the pattern integrity of photomasks becomes considerably more important than ever. Consequently, requirement for the defect repair technology on photomasks is more severe and strict than ever. Focused ion beam (FIB) technology has been widely used for defect repairing in photomask industry. Therefore, the performance of the FIB mask repair tool has to be improved especially in repair accuracy and precision.

The FIB repair processes are classified into two kinds; one is additive repair using FIB induced deposition for missing patterns, such as pinholes and intrusions, the other is subtractive repair using gas assisted FIB etching for extra patterns, such as pinspots and protrusions. In both processes, precursor gas is applied onto the processing area through a small nozzle. Thus, the repair processes are controlled by the FIB irradiation and the precursor gas supply. Important characteristics of the repairs, such as size, shape and placement of the repair area, are mainly defined by the FIB scanning control. As conventional FIB systems used raster type of beam scanning for the repair processes, the size, shape and placement could be controlled with the unit of pixel size (typically about 10-20nm). However, in order to satisfy the recent requirement, more precise beam control is needed. We have developed vector scanning system to meet the requirement. The vector scanning system enables us to control ion beams more precisely and more arbitrarily. For example, unicursal beam scanning can be applied to the repair processes, which minimizes beam blanking times. By adopting the vector scanning, repair precision is improved. Furthermore, side wall angle of the repair region is also improved because the repair shape is drawn without beam blanking, as shown in the attached figures.



(a)



(b)

Fig.1: AFM images of FIB deposited films:
500nm square films were deposited using FIB induced carbon deposition technique. (a) Conventional raster scanning method is used. (b) Newly developed vector scanning method is used. Both images are measured with the AFM using carbon nanotube probe.