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Effect of an Electric Field within Microscope Monohaz FIB Between a Micro Manipulator Sharp and the Ion Trap of the Electron Detector

Jorge Alberto Gómez*, Antonino Pérez Hernández* Alberto Duarte*

* Centro de Investigación en materiales Avanzados (Unidad Chihuahua), Chihuahua Chih. México.

The mono beam FIB is extremely complicated transport and maneuvers of the pieces to be carve in normal direction of the visual plane. In subsequent work, we tried to model the electric fields that cause deviations in the secondary electrons that form the images in FIB to be used for sharp-specimen height detectors. The manipulation in the normal axis of the observation plane is blind in these equipments. For this disadvantage, the application of a negative potential to the sharp of the micro manipulator was considered. In principle, when the ion beam interacts with the grounded specimen, secondary electrons are aside of the specimen, which are used in the image. These secondary electrons are attracted by the +300V potential applied to the detector. In the fig 1A show an image in mono beam FIB (JEM-9320FIB), where the micro manipulator sharp is observed in greater brightness with a potential of -25V. The sample is observed with little brightness is a TEM grid with some carbon nanotubes forming a membrane. In this image show a small dark halo projected on the sample surrounding a small region in the neighborhoods of the micromanipulator sharp generated by potential by -25V, which deflected the secondary electrons which aside of the specimen and forming a dark halo, which causes a poorer contrast than in the image. Fig. 1B is an image where the sharp touch some carbon nanotubes ropes. The brightness is now uniform due to deflector electric field in the sharp is grounded and an image with the same brightness is observed, because the electrons do not have any impediments to arrive at the detector. In SEM microscopy mentioned that the topographic contrast depends on the number of trajectories of dispersed electrons. In each point where the scanning electrons impact, the number of backscattered electrons have direct information of the tilts of the specimen [1]. The secondary electrons generated in the FIB [2], are attracted towards the electron detector in the same way that a microscope SEM. In principle if a topographic tilts affects the contrast of the image, an external electric field carries out the same task to expelling the electrons in the neighborhoods. In the image 2 show a representation of an electrical simulation model of the FIB vacuum camera, which includes a micro manipulation sharp with a potential of -25V, the electron detector is found a greater distance with a +300V potential applied to the Faraday cage of the detector. The micro manipulation sharp without charge is showing in the figure 2A in the neighborhood of the specimen. Observe the lines of the electric field aside to the sharp and the specimen area. In figure 2B, the deformation of the electric field around of the manipulator sharp occurs. Figure 2C shows less deformation effect of electric field due to a mayor distance between specimen and manipulator sharp which causes a minor contrast difference. The differences of differential potential between the detector and the specimen is minor than the difference of potential between the detector and the manipulator sharp, this will cause that the electrons that aside from the specimen, undergo a greater deviation.

[1] Goldstein. Scanning electron microscopy and X- Ray microanalysis. ED. Plenum. ISBN 0-306-44175-6.

[2] S. T. Davies and B. Khamsehpour. Focused ion beam machining and deposition for nanofabrication. Vaccum/Volume 47/number 5/ pages 455 to 462/1996.

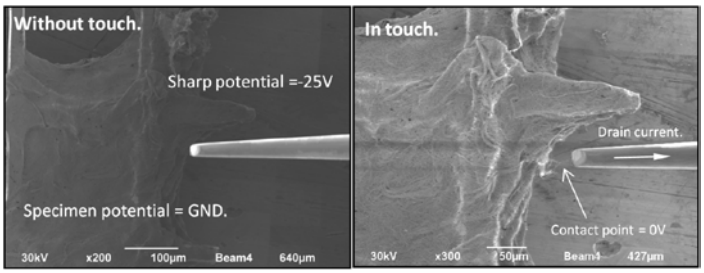

Figure 1. Image in FIB show the effect in the image of the applied electrical potential in the sharp of the micro manipulator. 1A shows the sharp a considerable distance without touch the specimen where a dark halo appears due the secondary electron deflection. 1B show the sharp of the micro manipulator in touch to a small carbon nanotubes ropes. In this case the specimen and the sharp are now at the same potential.

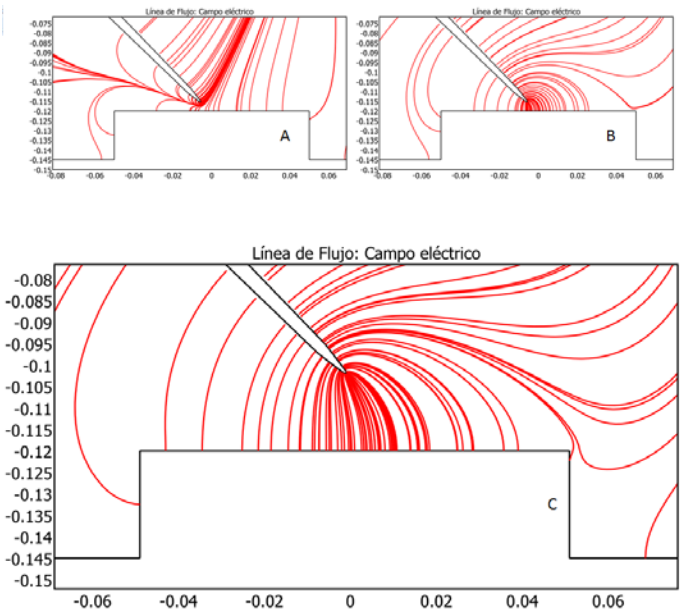

Figure 2. A finite element model (COMSOL) of the electric fields between the sharp of the micro manipulator, specimen and secondary electron detector. (A) Image without difference of potential on the end (Normal mode operation). (B) Image to small distance between charged sharp of the micro manipulator with and the specimen. (C) Image to greater distance between charged sharp of the micro manipulator with and the specimen.

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