Nanostructural Analysis of Nanofeatures in Semiconductors

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The swift developments in nanotechnology and the miniaturization of devices raise the need for detailed bi and three-dimensional characterization of nanostructures. Transmission Electron Microscopy (TEM) is a basic tool to study the structure of materials at nanometric scale. Within TEM techniques, electron tomography (ET) is standing as one of the techniques that allows obtaining three-dimensional information. Sample preparation is a key step in TEM and the ideal geometry of a specimen to be studied by ET is one where the thickness remains invariant along tilting series. Nowadays, the advances in focused ion beam equipment allow making progress in this essential stage, obtaining right quality and good geometry of the samples. The ideal geometry of such samples has been achieved with the needle-shape sample preparation using focused ion beam (FIB) of a dual-beam FIB/Scanning EM system [1].

In this communication, we study by ET a number of semiconductor nanostructures inside electron-transparent needle-shape samples. We demonstrate the capacity of FIB to prepare needle-shape samples with nanostructures inside the needles, which is not possible by using conventional TEM preparation methods. We also present the usefulness of the ET combined with Z-contrast scanning transmission electron microscopy imaging to obtain 3D information of nanofeatures in semiconductors materials.

Our sample preparation procedure consists of sculpting nanofeatures containing the volume of interest, a particular semiconductor nanostructure in our case, in the FIB instrument. FIB conditions are selected in such a way that the prepared needles have a good quality for ET studies, that is, a small diameter (some tens of nanometers) and a minimum thickness of amorphous layer at its surface. For this, a lamella is fabricated and needles are milled by Annular Milling Method from it. Figure 1 shows an example of a series of nano-needles prepared by this procedure.

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References

[1] Larson, D. J., Foord, D. T., Petford-Long, A. K., Liew, H., Blamire, M. G., Cerezo, A. and Smith, G. D. W., Ultramicroscopy, **79** (1999) 287.

Figures

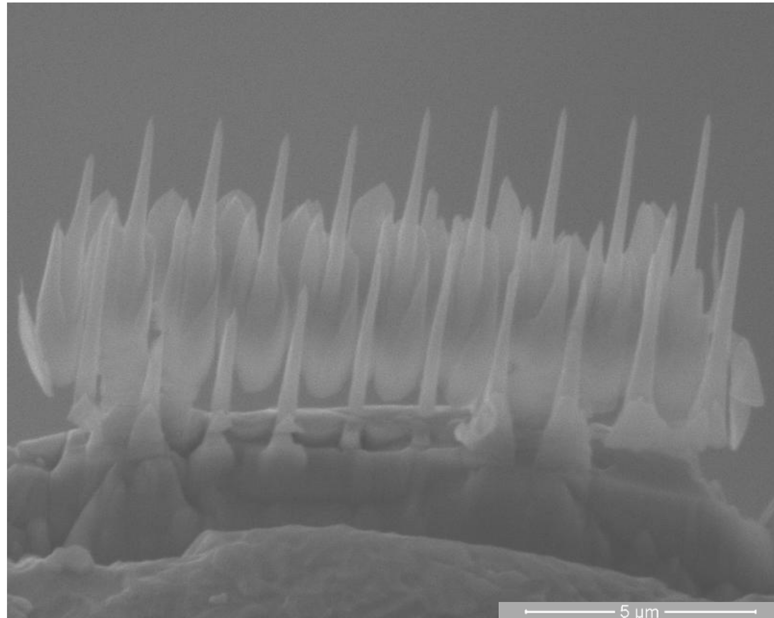

Figure 1. SEM image of a series of needles fabricated by Annular Milling Method with a FIB equipment.