MS28 New approaches in electron crystallography

Chairs: Louisa Meshi, Xiaodong Zou

MS28-P1 Ni-rich phases identification in GaAs nanowire devices by mean of Electron Diffraction Tomography

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Rapid thermal annealing is a powerful tool for the preparation of ohmic contact at metal–semiconductor interfaces, and it can yield to complex inter-diffusion phenomena, as it has been extensively studied in the case of bulk GaAs[1]. We observed that the controlled thermal annealing of GaAs nanowire (NW) devices with Ni/Au electrodes promotes the diffusion of nickel into the nanowire, forming Ni-rich metallic alloy regions in the nanostructured body.

From EDS analysis, the content of nickel in the nanowires was variable, indicating the presence of different Ni-rich alloys in the transformed part of the NW. In order to identify which crystal phases form, the devices were designed on a 50nm SiN membrane transparent to a high energy electron beam, making the device observable in a TEM. Since the transformed part is very small, from 200 to 400 nm in the best scenario, phase identification using oriented zone axis patterns is critical. To avoid this problem we performed Electron Diffraction Tomography[2] data collection on the transformed region in parallel microdiffraction mode. In this experimental configuration a set of diffraction patterns are recorded while tilting the sample around the goniometer axis of the microscope, with a specific angular step (1° in this study) and within a variable angular range depending on the goniometer available. The illuminated area is minimized through a small condenser aperture, while the beam is kept always parallel. In our case with a 5 µm aperture we could illuminate a circle of 200 nm (see figure) in diameter, being sure that mainly the transformed region was diffracting. From the collected data the reciprocal space of the diffractive volume can then be reconstructed in three dimensions, allowing the determination of the lattice parameters of the diffracting crystal. For this purpose an angular range of only 60° was sufficient and although the patterns were noisy and “contaminated” by spurious spots coming from the surrounding part of the nanowire, the unit cell of several Ni-rich alloys could be determined.

Possible interpretation on which are the parameters that can play a role on the predominance of one of them over the others will be discussed.

[1] T.-J. Kim, P. H. Holloway, “Ohmic Contacts to II-VI and II-V Compound Semiconductors”, in Processing of Wide Band Gap Semiconductors, S.J. Pearton, 2001.

[2] U. Kolb, T. Gorelik, C. Kübel, M.T. Otten, D. Hubert, Ultramicroscopy 107, 507 (2007)

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