

Combined aberration-corrected STEM and synchrotron nano-diffraction for crystal phase engineering in GaAs nanowires

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III-V semiconductor nanowires (NXs) obtained by the vapor-liquid-solid (VLS) mechanism exhibit a zinc-blende (ZB) or a wurtzite (WZ) structure [1] depending on the growth conditions, and more particularly on the amount of III and V element fluxes [2]. Controlling precisely the growth of the crystal phases of self-assisted GaAs NWs by molecular beam epitaxy (MBE) would be an important achievement for device applications [3]. Nevertheless, the optimized growth of WZ segments in NW geometry is still in its infancy, and major achievements have been reported only very recently [4-6]. Optimizing the growth of each crystal phase thus appears necessary to better understand the correlation between the nanostructures and the properties of the NWs.

In this work, we investigate the stress relaxation and strains induced by controlled phase changes in the NW, using the high reciprocal space resolution of the synchrotron nano-diffraction. We combined this technique with aberration-corrected scanning transmission electron microscopy (STEM) and dark-field transmission electron microscopy (DF-TEM) analysis performed on the same isolated NW and using the same diffraction spots as for the nano-diffraction. The combination of the synchrotron and the TEM analysis performed on the same NW precisely highlight the contribution of the ZB variants, the WZ structure and the stacking faults on the stress relaxation and strains observed in the NW.

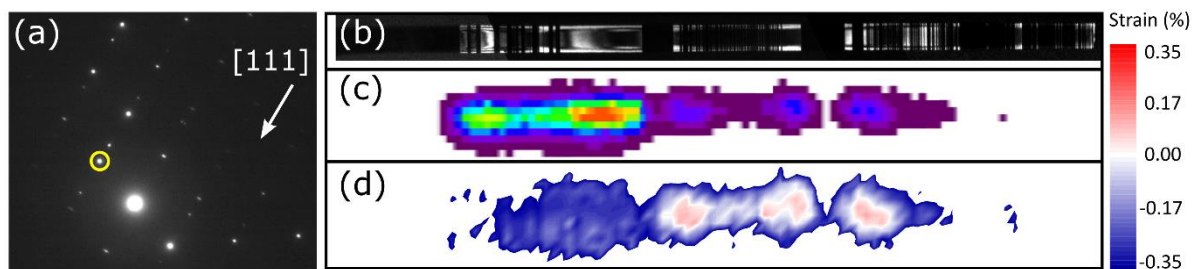


Figure 1 (a) Electron diffraction pattern showing the diffraction spot (circled in yellow) used to perform (b) DF-TEM imaging on the NW for the [-1-13] plans. (b) Integrated intensity and (c) internal strain measurements obtained by nano-diffraction of the [-1-13] plans, showing the contribution of the ZB crystal structures.

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