# Strain induced defects at InAs/GaAs nanowire interfaces.

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Nanowires can host material combinations of very different lattice parameters owing to their small lateral size and high aspect ratio. Such geometry promotes elastic relaxation of mismatch strain on the nanowire sidewalls and allows to create dislocation free interfaces with no equivalent in traditional thin film epitaxy. Yet, strain affects the band structure of the final nanowire device and thus its electronic and optical properties. In this regard, it is important to understand how the strain distributes at the vicinity of the interface in axial nanowire heterostructures.

We use transmission electron microscopy to investigate the strain distribution in $In_{0.85}Ga_{0.15}As$/GaAs nanowires, which theoretical lattice mismatch is 6% [1]. We study nanowires with diameters below and above the theoretical critical diameter for dislocation free interfaces [2]. To do so, we combine high-resolution scanning transmission electron microscopy (HRSTEM) together with image processing (Geometrical Phase Analysis (GPA)). We observe that nanowires with diameters below 40 nm at the interface are free of misfit dislocations (Figure 1 a). A 20 nm-long region in the vicinity of the interface is 6% compressed. The strain is fully elastically released via crystalline planes bending close to the side walls. On the other hand, we found that nanowires with diameters above 95 nm at the interface exhibit strain relaxation both elastically and plastically, via plane bending close to the nanowire sidewalls and formation of misfit dislocations, respectively (Figure 1 b). Experimental results are compared with theoretical simulations.

[1] D. V. Beznasyuk et al., Nanotechnology, **28**, 365602 (2017)
[2] F. Glas, Phys. Rev. B **74**, 121302 (2006)

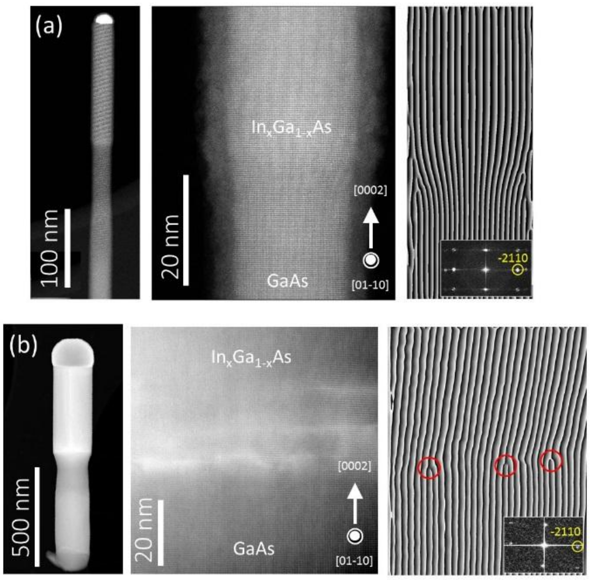


**Figure 1:** HRSTEM images of the wurtzite $In_{0.85}Ga_{0.15}$As-on-GaAs nanowires with (a) 22 nm and (b) 190 nm at the interface. HRSTEM images after Fourier filtering of (-2110) Bragg-reflection, displaying banding of planes. Misfit dislocations are marked with red circles.