III-V nanowire growth mechanisms investigated with markers

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The mechanisms of III-V nanowire growth are complex. The precise control of their crystal phase and the formation of abrupt heterostructures demand a deep understanding of these mechanisms. The insertion of chemical markers during nanowire growth and the ex-situ observation of these markers by TEM can enlighten much on these mechanisms. Analyzing these experimental data provides detailed information on growth, such as pathways of feeding species [1] or surface diffusion lengths of adatoms [2]. When markers are inserted at short time periods, the effect of controlled growth parameter variations on growth kinetics can be followed with an excellent accuracy. Kinetic and statistic aspects can be quantitatively reproduced by developing models which consider the various growth steps [2-4]. Important parameters such as catalyst super-saturation or surface energies can be evaluated.

We will present a few examples illustrating the potential of this method. This will include Au-catalyzed $InP_{1-x}As_x$ nanowires with small As/P modulations (Fig. 1a), self-catalyzed GaAs nanowires with thin $Al_xGa_{1-x}As$ marker layers (Fig. 1b) and catalyst-free GaN nanowires with AlN markers (Fig. 1c). In the first example, we deduce that the axial growth is driven by the group III atoms. On the contrary, in the second example the axial growth is driven by the group V atoms. The markers can also inform on radial growth as will be shown in the third example [5].

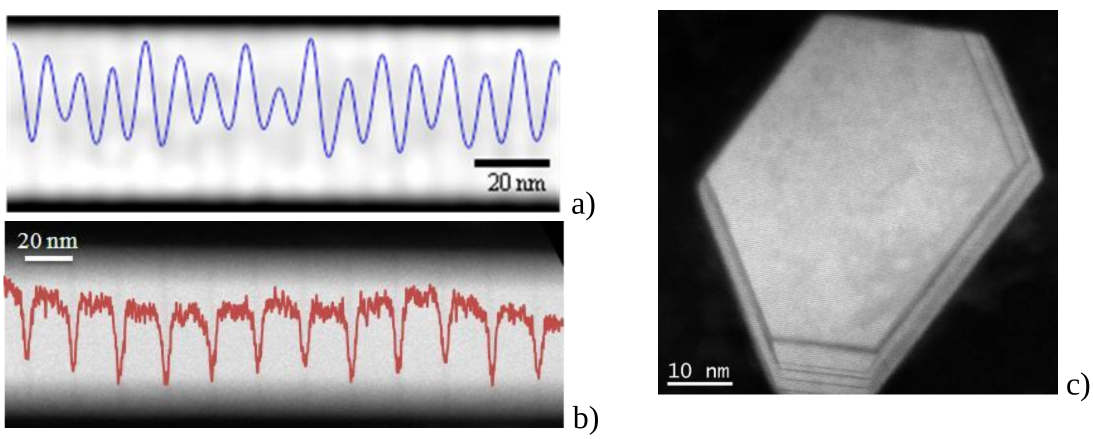

Figure 1: Nanowires with chemical markers: a) $InP_{1-x}As_x$ nanowires with small As/P modulations; b) GaAs nanowires with $Al_xGa_{1-x}As$ marker; c) radial cross-section of GaN nanowires with AlN markers.

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[3] F. Glas, J. C. Harmand, and G. Patriarche, *Phys. Rev. Lett.* **104**, 135501 (2010).
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