GaAs Core / SrTiO$_3$ Shell Nanowires Grown by Molecular Beam Epitaxy


$^1$ Institut des Nanotechnologies de Lyon (INL), UMR 5270-CNRS, Université de Lyon, Ecole Centrale de Lyon, 36 avenue Guy de Collongue, F-69134 Ecully Cedex, France
$^2$ Institut Lumière Matière (ILM), UMR5306 Université Lyon 1-CNRS, Université de Lyon, 69622 Villeurbanne Cedex, France

Auteur contact : jose.penuelas@ec-lyon.fr.

Mots clés: Core / shell nanowires, hybrid nanowires, functional oxides, semiconductor, interface

Perovskite oxides possess a wide range of properties [1, 2] which can lead to the development of multifunctional devices when coupling with III-V semiconductor nanowires (NWs). However the epitaxial growth of perovskite oxides on III-V NWs is still rather challenging. By the As capping / decapping method (Figure 1a), the GaAs NWs (or GaAs / AlGaAs NWs) could be transferred among different separated reactors without oxidizing or contaminating the GaAs (or AlGaAs) facets [3], which is of great necessity for the further functional oxide shell growth. Then, by means of the two-steps SrTiO$_3$ growth method [4], we have obtained a partially oriented SrTiO$_3$ shell covering the GaAs NWs (Figure 1b), proving the possibility to fabricate the monocrystalline epitaxial shell of functional oxides integrated on semiconducting NWs [5]. As revealed by XPS spectra and TEM images, the interface is not abrupt, which probably prevents a perfect epitaxial growth. The GaAs / SrTiO$_3$ NWs also showed a good thermal tolerance to an annealing up to 500 °C, benefiting the further growth of another functional oxide, such as the ferroelectric BaTiO$_3$, to construct the core / multi-shells NW array and the further practical devices.

Figure 1: a) the As capping / decapping method for GaAs NWs against the surface oxidation and contamination. b) the two-steps method for the growth of the SrTiO$_3$ shell.

References: