PHD GRANT

Growth and structural characterizations of InAs/GaAs axial nanowires heterostructures

CONTACT
moira.hocevar
@neel.cnrs.fr

Daria Beznasyuk (PhD student), Moïra Hocevar and Julien Claudon (thesis supervisors), Petr Stepanov, Martien Den Hertog, Jean-Luc Rouvière, Eric Robin

LABORATORIES : NEEL, INAC

Nanowires can host combinations of materials with very different lattice parameters: the mismatch strain is efficiently relaxed on the sidewalls, enabling the formation of dislocation-free interfaces out of reach with two dimensional thin films. It is important to understand how the strain distributes as it strongly influences the band structure, and consequently the electronic and optical properties of the final device. We grow GaAs-InAs nanowires by molecular beam epitaxy using the vapour-liquid-solid mechanism with gold catalysts. Nanowires diameter, length and density are readily controllable by adjusting the growth parameters and the catalyst diameter. We evaluate the strain and composition distribution by high-resolution scanning transmission electron microscopy (HRSTEM) together with Energy Dispersive X-ray spectroscopy. One of our important results is the observation of a 20 nm long strained region around the interface, where crystal planes bend close the sidewalls (Fig.1). Despite a 6% lattice mismatch, our structures show no dislocation when the diameter is less than 40 nm.

We are now working on the reverse structure, GaAs on InAs, in order to realize quantum dots integrated in nanowires, positioned on demand, for new photonic emitters.

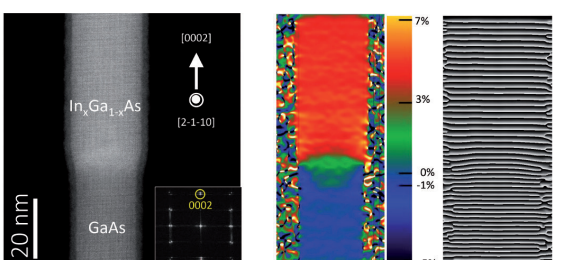

Fig. 1 : HRSTEM image of an InAs/GaAs axial heterostructure. Relative change in lattice parameter along the growth axis with respect to unstrained GaAs. HRSTEM image after Fourier filtering of the [0002] Bragg reflection.

OUTCOMES

Publications: Dislocation-free axial InAs-on-GaAs nanowires on silicon, Nanotechnology 28, 365602 (2017).

Oral presentations: Journées Nationales du GDR PULSE Paris, 2017 (invited) ; Journée Nationales Nanofils, Grenoble, 2017 ; MRS Fall Meeting, Boston, USA, 2016

Collaborations: Pierre Verlot, University of Notthingam, UK; Marcel Verheijen, Philips Research, Eindhoven, NL.

Leverage: AGIR pôle PEM 2015-2016