V/III flux ratio effect on faceting for nanoscale selective area growth of InAs and InP by molecular beam epitaxy

M. Fahed*, L. Desplanque, C. Coinon, J.L. Codron, D. Troadec, and X. Wallart

I.E.M.N., UMR CNRS 8520, Av. Poincaré CS 60069, 59652 Villeneuve d'Ascq Cedex, France

**Email: maria.fahed@ed.univ-lille1.fr*

Semiconductor nanostructures with well-defined dimensions and mastered position are of interest for a number of microelectronics and optoelectronics applications. One of the most common ways to reach this goal is to combine top-down and bottom-up approaches using the selective growth on a pre-patterned substrate. It has been already demonstrated for arrays of quantum dots or nanowires.

In this work, we explore such approach to study the faceting of InAs and InP nano-ribbons grown by Molecular Beam Epitaxy (MBE). Homoepitaxial growth of InAs and InP is performed inside 200 nm wide and a few micron long stripe openings in a 10 nm-thick SiO_2 film deposited on an InAs or InP(001) substrate [1].The stripes are oriented either along [110] or [1-10] azimuths. We particularly emphasize the role of the V/III flux ratio on the faceting of the nanostructures.

When varying the V/III flux ratio, cross section Scanning Transmission Electron Microscopy images evidence a shape difference for [110] oriented apertures for which (111)B facets are more prominent for large V/III flux ratio values. On the other hand, no major differences are observed in the shape of [1-10] oriented apertures [2].

These results are consistent with existing theoretical calculations of the surface energies of different low index InAs and InP surfaces as a function of the arsenic or phosphorus chemical potential, directly related to the V/III ratio [3-4].

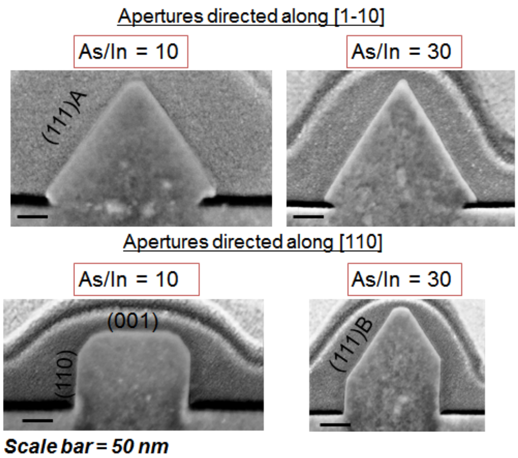

FIG-STEM images recorded after 100 nm InAs growth in apertures directed along [1–10] and [110] for As/In = 10 and As/In = 30.

1. Desplanque L, Fahed M, Han X, Chinni V K, Troadec D, Chauvat M P, Ruterana P and Wallart X 2014 Nanotechnology **25**, 465302
2. Fahed M, Desplanque L, Coinon C, Troadec D, and Wallart X 2015 Nanotechnology **26**, 295301
3. Moll N, Scheffler M, Pehlke E and Liu Q K K 1999 Phy. Rev. B **60**, 24
4. Moll N, Scheffler M and Pehlke E 1998 Phy. Rev. B **58**, 8