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Institut d'Electronique, de Microélectronique et de Nanotechnologie
UMR CNRS 8520

Master and Engineer Internship: 2018-2019

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Research group : Epiphy

Title : Selective area growth of III-V material based nanostructures for optoelectronics or quantum technologies

Abstract :

Molecular Beam Epitaxy (MBE) is a technique of choice for the elaboration of III-V based heterostructures with a very high crystal quality. In most cases, the fabrication of a nanoscale device from these heterostructures implies a top-down approach consisting in etching the layer to form in-plane nanostructures. However, this step results generally in a poor surface quality for the side-walls (roughness, impurities...) resulting in a degradation of the material properties.

Another approach consists in defining the shape of the in-plane nanostructures by patterning a dielectric mask before the epitaxy. This special growth mode allows the bottom-up fabrication of very small devices whose dimensions are only limited by e-beam lithography. For instance, nanowire MOSFETs with a 20 nm gate length can be obtained by this method. It is also a way to accommodate the lattice mismatch between a semiconducting layer and the substrate. For instance, it is possible to grown high quality InSb nanostructures on a GaAs substrate, thus associating very dissimilar materials in terms of electronic or optical properties. This method is very promising for the fabrication of complex quantum devices since the dimensions of the nanostructures can be comparable to the ballistic length of electrons. It is also very appealing for the realization of optoelectronic high speed detectors.

During the training period, the candidate will participate to the growth of the nanostructures by Molecular Beam Epitaxy and use the microfabrication facilities of IEMN to prepare the samples before and after the epitaxy. He/she will also be involved in the structural, electrical or optical characterizations of the nanostructures by means of scanning electron microscopy, X-ray diffraction, low temperature electrical characterization or photoluminescence.