Revisiting Inversion Domain Boundaries in MOVPE GaN wires

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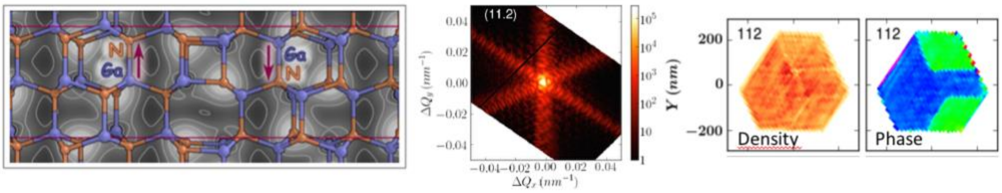
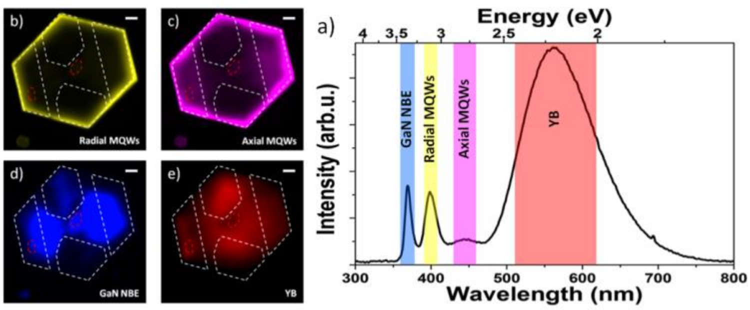
One-dimensional nitride heterostructures demonstrated novel optical and electronic properties making use of quantum confinement effects and strain engineering. The emergence of disruptive functionalities is strongly related to the growth and technology controls [1-5], but also to the development of advanced characterization techniques having high spatial resolution. Focused X-ray beams provide innovative solutions to analyse quantitatively the morphology, defects, strain and composition of these materials. We will present recent breakthroughs obtained at the European synchrotron radiation facility on nitride wires grown by Metal Organic Vapour Phase Epitaxy and their core-shell heterostructures.



The structure of single defects such as Inversion Domain Boundaries (IDB) inside n-doped GaN wires has been determined from *X-ray coherent diffraction imaging* [6] with an unprecedented accuracy. The complex 3D IDB configuration inside a single wire is measured without any slicing in contrast to electron microscopy and the lattice displacements along/across the wire length is deduced from the analysis of the Bragg peak intensity by *phase retrieval* methods with pm resolution. We will show that the measured atomic configuration corresponds to a refinement of the usual IDB* model that is in full agreement with new electronic structure *ab initio* calculations [7].



The IDB* separates opposite polarities of GaN crystals that may impact the wire growth and the photoluminescence properties of GaN/InGaN Multiple Quantum Well (MQW) core-shell heterostructure deposited on m-plane sidewalls [2-5]. This system is first studied by scanning and transmission electron microscopy and then by *X-ray excited optical luminescence* and *X-ray Fluorescence* with multimodal hard X-ray nanoprobe [8]. It is shown that the optical luminescence of the near band edge of the GaN core is directly related to differential Si incorporation in N- and Ga-polar parts of thick wires, and that core-shell and top axial MQW luminescence can be analysed.

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