Development of Bragg coherent X-ray diffraction and ptychography methods

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PHD GRANT

LABORATORIES : INAC, ESRF

Optimising the performance of semi-conductor nanostructures, developed for existing and future electronic and optoelectronic devices, relies on a precise control of the strain. This PhD topic focuses on the study and use of Coherent X-ray Imaging techniques, which allow to reconstruct single objects with a resolution of 5 to 10 nm. Beyond the results in terms of materials knowledge, the main motivation is to develop a technique expected to become a reference metrology method for the study of strained nanostructures, down to objects with a thickness of 10-20 nm. Therefore, three guidelines are identified: the development of 2D and 3D strain mapping using coherent X-rays, taking into account all the characteristics of the focused X-ray nano-beam; the quantitative study of objects, including non-isolated ones such as in a complex device; the application to axial and radial nanowire heterostructures grown at INAC and SiGe strained nanostructures, developed by a CEA-LETI/ STMicroelectronics collaboration.

This PhD is co-financed by the European Synchrotron, with the prospect of the « Extremely Brilliant Source » upgrade, which will provide in 2019 a 100-fold increase of the coherent X-ray flux.

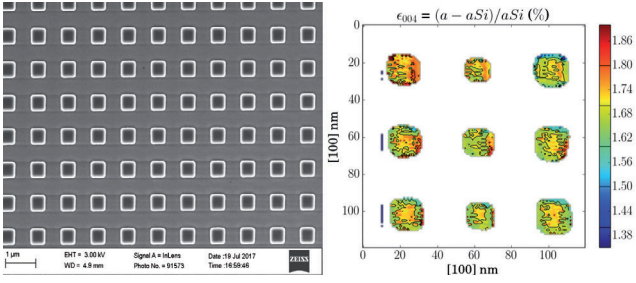

Fig.: Left: SEM image of strained SiGe islands; Right: Strain map relative to Si lattice parameter on a patterned zone of 2x2 µm² square islands

OUTCOMES

Software: PyNX python library, http://ftp.esrf.fr/pub/scisoft/PyNX/

Poster presentation: RX2017, Lille, France, 2017.

Collaboration: ESRF co-financing, XNP group, ID01 beamline.