ESONN'2022 Practical 22

BM02 / D2AM at the ESRF on September the 7th

X-ray diffraction for strain measurement in Ge microstripes

Strain engineering of nanomaterials is becoming a major field for micro- and nanotechnology offering new functionalities and improved performances achievable in micro- and optoelectronic devices based on such materials. In particular, strained Ge has recently attracted a vast interest.

High-resolution strain measurement became necessary for understanding and engineering the physical properties of individual structures. So far, this is essentially done using model-dependent techniques such as l-Raman spectroscopy and photoluminescence. While phonon shifts in l-Raman are interpreted as strain depending on biaxial or uniaxial strain field assumptions, photoluminescence is based on calculations of optoelectronic properties. In contrast, x-ray diffraction gives access to lattice tilt and provides a model-free characterization method for strain measurements as it probes directly the lattice spacing in crystalline samples.

During this practical, a sample of Ge microstipes deposited on an SOI wafer, fabricated using only CMOS qualified materials, will be investigated. Strain was induced by a top SiN stressor layer. You will learn how to align a sample under a focused X-ray beam, to manipulate a 6 circle diffractometer and most importantly, to manage a beamtime. A 2D fast photon-counting detector will be also used in order to record the diffracted intensity. You will explore the sample and identify strained regions and perform reciprocal space mappings over specified regions and compounds. You will measure the lattice parameter and extract the out-of-plane strain component. You will then perform data analysis on the 2D recorded images using the inhouse developed tools to get a direct visualization of the mapped reciprocal space.