ESRF	**Experiment title:** Coherent X-ray Diffraction Imaging of single heterogeneous nanowires	**Experiment number**: HS-3779
Beamline: ID01	**Date of experiment**: from: 29/04/2009 to: 04/05/2009	**Date of report**: 08/2009
Shifts: 18	**Local contact(s)**: Ana Diaz	*Received at ESRF:*

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Title: Coherent X-ray Diffraction Imaging of single heterogeneous nanowires

Report:

The goal of this experiment was to measure the coherent X-ray sctarreing from indivdual, heterogeneous nanowires in order to reconstruct the structure (chemical & strain map) at the interface. This experiment used the new focusing setup of the ID01 beamline, which uses a Fresnel-Zone-Plate (FZP) and a new monochromator, yielding a much smaller beam size as well as a higher flux (300x500 nm^2) than during previous experiments.

While the higher flux was very beneficial to this experiment, it turned out to be quite difficult to keep a found nanowire at the focal point during a rotation scan – which is necessary in order to collect a full 3D scattering pattern. A partial solution involved using a translation scan to re-ecenter the object, at each step of the angular scan. This is set to improve in the future with the use of goniometer designed for diffraction with a nano-beam.

During this experiment we measured scattering pattern on six different samples:

- (E1884) GaN nanowire with an 8 nm AlN insertion
- (E1918) GaN nanowire with 20 AlN insertion near the top of the wire
- (t497) GaN nanowire with an InGaN insertion near the top
- (1513C) InSb/InP nanowires (see figure 1)
- (SiGe07) Si/Ge nanowire with a gold droplet (catalyst)
- (N564P) horizontal Si stripes strained on SiO2 and Silicon (see figure 2)

For all the samples we searched for nanowires by translating the sample until it diffracted on the 'maxipix' detector (placed at the correct Bragg angle), and then the scattering was accumulated with or without an oscillation scan. This was repeated for several wires on each sample. The most interesting results come from two different samples :

- The InSb/InP nanowire, in which we measured the scattering pattern by translating vertically near the heterogeneous interface (fig. 2), with clear fringes appearing at the interface. This data is still in analysis and should yield information about the structure at the interface
- The strained silicon line (fig. 3), for which a diffraction pattern was recorded reflecting the strain state of an individual line. Data analysis is also in progress and should yield the deformation map along the vertical direction

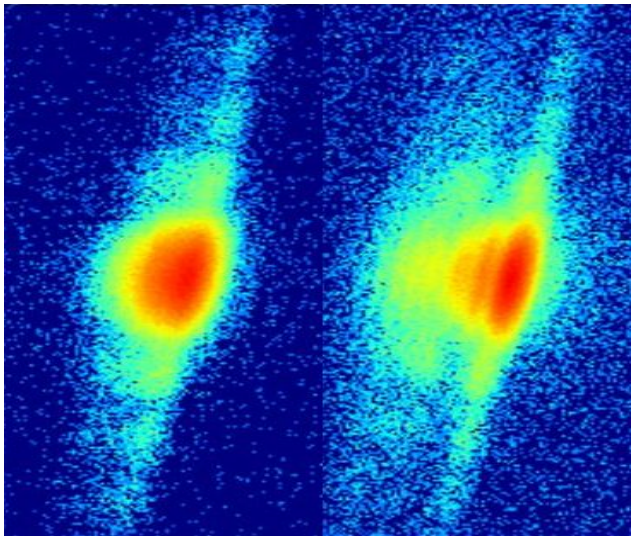

Figure 1: Coherent scattering pattern near the (333) reflection of the InSb part of a single InSb/InP nanowire. The scattering pattern was collected at different height in the wire: the image on the left was taken 0.5 microns above the image on the right, which is therefore closer to the InP/InSb interface. This should yield information about the structure (strain) at the interface.

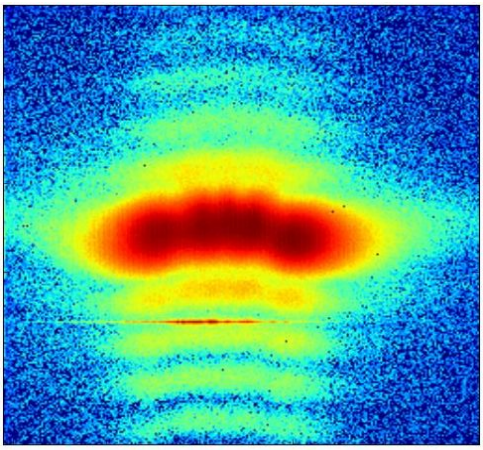

Figure 2: 2D scattering pattern from a single strained silicon line (of 70 nm x 200 nm cross-section) on SiO2 and Si substrate (the fine horizontal line at 1/3rd from the bottom is due to the substrate). This diffraction pattern was measured on the (113) reflection (the line being parallel to the (110) direction), and is directly related to the displacement field projected on the vertical direction (u_z), which will be recovered from this data.