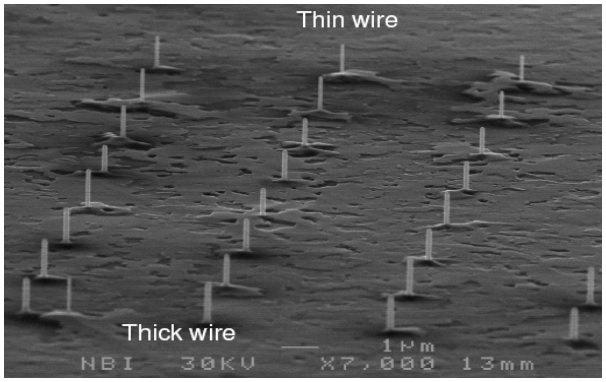
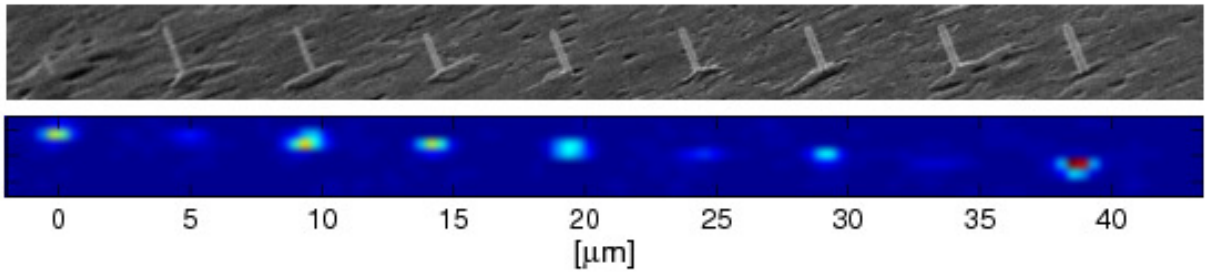
Beamtime report on experiment number SI-2019

We have performed diffraction mapping on InAs nanowires on InAs at beamline ID01 using an x-ray beam of 250 nm in diameter. The aim of the study was to to use diffraction mapping to determine the structure of individual NW in an ensemble. By scanning a micro-focused x-ray beam across the wafer, while keeping the diffraction conditions for a particular Bragg reflection, a map of the structures on the wafer matching the diffraction conditions will be highlighted. Samples were grown at NBI with InAs NW on an InAs substrate in arrays of 8 x 9 with a sufficient large spacing such that it was possible to illuminate only one NW with the x-rays beam. By placing a dense array of NW as a marker, it was easy to find the individual NW as their position was controlled by the fabrication technique. An example of a diffraction map of a row of eight wires is shown in figure 4. Diffraction contrast between the InAs NW and the InAs substrate was obtained using the 0.4 % difference in lattice constant. The wires were varied row by row having a diameter from 80 nm to 200 nm in order to see a transition from Wurtzite structure from the thin wires to a Zincblende structure for the thicker wires. We did not see that transition, the wires stayed Wurtzite and the integrated (integrated by rocking scans) increased linearly with the volume of the wires. But we were able to determine the individual lattice constant for the NW, which surprisingly varies slightly from wire to wire. The wires are also tilted slightly by about 0.04 deg with respect to each other.



Figur 1. Ensemble of InAs NW with varying diameters grown at NBI.



Figur 2. Upper: SEM image of a row of nanowires. Lower. Diffraction mapping of exactly the same nanowires using the wurtzite (333) Bragg peak.

We also studied longer wires (25 microns) by scanning along the wires, but these data are still under evaluation. A paper is under preparation, but not yet submitted.