Investigations of Nanowire-Substrate Growth Interfaces

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Abstract
A common approach for analysing nanowires using transmission electron microscopy (TEM) involves removing them from their substrate and subsequently transferring them onto carbon films. This sample preparation method is fast and usually results in little structural change in the nanowires [1]. However, it does not provide information about the interface between the nanowires and the substrate, whose physical and electrical properties are important for many modern applications of nanowires. In particular, strain and crystallographic defects can have a major influence on the electronic structure of the material. An improved method for the characterization of such interfaces would be valuable for optimizing and understanding the transport properties of devices based on nanowires.

Sample preparation
- Sandwiched and cut in 1 mm thin slices.
- Glued to a Molybdenum washer.
- Thinned down to ca 15 μm.
- Polished down to ca 5 μm.
- Ion milled in two steps to get a thin area.

Chemical composition at the interface
- Energy dispersive x-ray spectroscopy

Strain analysis of the interface
Geometric phase analysis for strain information
As described by [2], using software from [3].
- Quick and easy
- Lattice resolution (the graph here is for demonstration)
- Software is readily available
- A thin sample is necessary

Convergent beam electron diffraction for strain information
As described by [4] and using the JEMS simulation software [5].
- Gives good results even for very thick samples
- Can be tricky to analyse
- Cannot be used close to interfaces between structures

Future outlook
- Improve reliability of the sample preparation.
- Examine and evolve the reliability of the strain methods.
- Examine more methods for strain analysis: Dark-field holography and Nano beam diffraction.

References

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