

Location of the infrastructure :

Trondheim, Norway

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Objectives :

- Silicon characterization, including raw material, ingot and wafer characterization

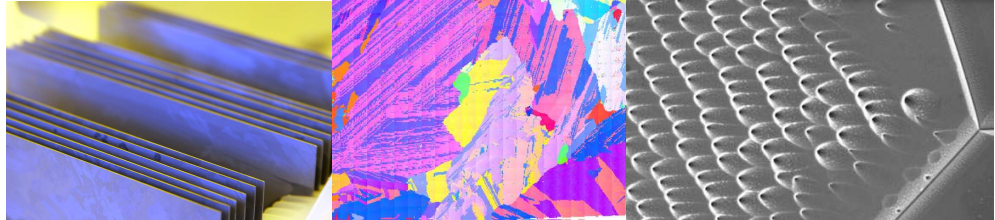
Main features :

- Sample preparation: We have in-house laboratories dedicated for sample preparation, such as cutting, grinding, mechanical- and chemical polishing of wafers and other samples. Our state of the art etching facilities includes two etch benches dedicated for silicon etching with automatic filling and careful temperature control for chemical polishing, defect etching and texturisation as well as dissolution of silicon matrix to study inclusions.



- Structural properties of mc-Si: Our laboratories include an extensive electron microscopy laboratory with both SEMs and TEMs and other specialised instruments, for studying microstructures in mc-Si ingots, blocks, wafers and other samples. The use of large scale mapping techniques (such as PVScan for mapping of dislocation densities, high resolution EBSD for grain orientations maps of areas up till 5x5 cm² and IR camera) combined with several high resolution techniques and accurate sample preparation (including FIB) makes it possible to map structures of interest throughout a whole ingot as well as study features in detail.
- Structural properties of mono-Si: Characterization of defects in monocrystalline silicon requires a different set of dedicated techniques as compared to multicrystalline silicon. To detect voids, interstitials and oxygen precipitates, the following techniques are available in our laboratories.
 1. Flow pattern defects (FPD)
 2. FCu decoration
 3. FOxygen induced stacking fault (OiSF)
- Chemical analysis: In our laboratories we can measure dopants and metallic impurity elements in silicon matrix of solid- or dissolved samples on a 0.1 ppbw level (GDMS and high resolution ICP-MS, respectively). Oxygen and Carbon concentrations are measured by FTIR and LECO. Impurities may form inclusions and precipitates, and these are detected and measured with respect to the types, forms and density of inclusions by:
 1. Near IR screening of Si blocks
 2. PVScan on polished wafers
 3. SEM with Energy Dispersive Spectroscopy detector
- Electrical properties: Properties such as resistivity (4pp) and minority carrier lifetime (QSSPC and CDI), are measured on a macroscopic scale where whole wafers or other large samples are mapped with respect to the property of interest. On a microscopical scale (probe electrical structure), electrical properties can be measured by:
 1. Electron Beam-Induced Current (EBIC)
 2. Photoluminescence Spectroscopy (PLS)
 3. X-ray photoelectron spectroscopy (XPS)
 4. Auger Spectroscopy (AES)

- Characterization equipment relevant for mechanical properties of wafers: At our laboratories, standard techniques, such as 4 point bending test, have been adapted for silicon wafers. Bending tests of wafers have also been developed for use with near IR ellipsometry for in situ inspection. Further, a high speed (visual light) camera, that is able to take up to 500 000 frames/second can be used e.g. for inspection of fracture initiation point and fracture propagation in 4-point bending test. Acoustic emission is also used for sensing of microcracking during e.g. handling operations on wafers.
- Surface metrology: A finite focus microscope makes us able to create 3D images of surfaces, allowing for detailed measurement of roughness, TTV etc. The lateral resolution is 400 nm and the depth resolution is 10 nm.



Limitations or constraints :

The access will be allowed with technical and scientific assistance from SINTEF.

Typical services or results :

In our laboratories we are able to follow one defect or type of defects from macroscopical scale down to atomic scale. Typical services are microstructure characterization, characterization of defects in monocrystalline silicon, measurement of dopants and metallic impurity elements and surface metrology

Examples of research projects :

Experimental studies of material from our crystallization laboratory. Fundamental studies of defects in silicon material