MICROSCOPY

Focused Ion Beam

Dualbeams (FIB-SEM) FEI

FEI HELIOS NANOLAB 600



The FEI Helios Nanolab 600 combines emission scanning electron microscope (SEM) with focused ion beam (FIB). It allows the characterization of materials in 2D and 3D (tomography), TEM sample preparation (Lamella), observations at the subsurface of the specimens (cross section imaging) and structural modification of surfaces at the micrometer to nanometer scale. This technique is used in the semiconductor industry, materials science and increasingly in the biological field for site-specific analysis, deposition, and ablation of materials. It is present, in Italy, in few research centres because of its high costs and of the high specialization it requires in the use and interpretation of the results. Nevertheless, because of its potentialities, it is today an indispensable instrument in modern characterisation facilities.

The instrument features an ultrahigh-resolution field emission SEM column, with a Field Emission Gun (FEG) electron source, combined with FIB column and gas chemistries. Imaging with a resolution better than 1 nm at 15 kV and 2.5 nm at 1 kV beam energies can be obtained. The Gallium ion beam can image and remove material down to 5 nm resolution levels.

The FIB is also equipped with Pt and C gas injection systems (GIS) for deposition of protective layers, and a Omniprobe micromanipulator which allows to pick up the lamella and to transfer it on the TEM grid always inside the chamber.

The electron column features unique technologies, such as constant power lenses for higher thermal stability, electrostatic scanning for higher detection linearity and speed, and unique column design for pin sharp imaging in all conditions. The signal produced by the impact of charged particles on the sample is collected by a detector, the Everhart-Thornley (ETD). The signal can be further enhanced by the Through-Lens Detector (TLD), set for highest collection efficiency of secondary electrons (SE). The FIB is also equipped with an on-axis BSE (backscattered electrons) detector and a multi-segment STEM detector that can acquire multiple signals, such as BF/DF/HAADF imaging.

The instrument is also equipped with Oxford INCA EDS that utilizes an 80 mm^2 silicon drift detector, characterized by high stability and accuracy. The detector permits high-count rate mapping at low and high energies, can detect lighter elements with accuracy starting from Be, can perform chemical analysis on rough surfaces, and can identify phase composition for submicron particles.

Materials

- Metals
- Polymers
- Ceramics
- Composites
- Coatings
- Multilayers
- Conductive and non-conductive samples

Applications

- High resolution imaging at nanoscale resolution
- Elemental analysis and characterization of materials at micron to submicron scale
- Preparation of ultrathin samples and materials for other analysis—e.g, preparation of selected regions for transmission electron microscopy (TEM) and atomic probe tomography (APT)

Specifications

- **Electronic gun**
  Schottky thermal field emitter
- **Ionic gun**
  Gallium
- **Deposition capabilities**
  Pt, C and W
- **Beam tension**
  SEM: 350V – 30kV, FIB: 500V – 30 kV
- **STEM detector resolution**
  0.8 nm
- **SEM resolution**
  0.7 nm at 15 kV, 1.4 nm at 1 kV
- **FIB resolution**
  5 nm at 30 kV
- **EDS resolution**
  < 30 nm on TEM lamella
- **Sample stage**
  5-axes stage with -10 – +60° tilt range, infinite rotation
- **Gas (GIS)**
  4 gases: Pt (deposition), SCE, IEE Enh Etch, (etching)
- **Software**
  AutoFIB, AutoTEM, AutoSlice&View
- **Micromanipulator**
  Omniprobe (3-axes) for the extraction of TEM lamellae
- **Detectors**
  ETD, CDEM (ions and electrons), TLD, STEM, IR camera
- **Detector EDS**
  Oxford INCA, resolution 133eV



