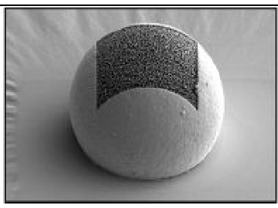
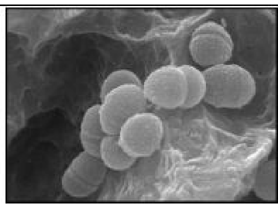
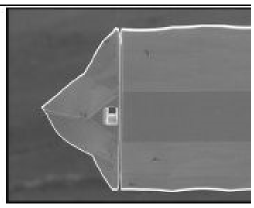
University of Basel
Swiss Nanoscience Institute

SNI
Swiss Nanoscience Institute
Exzellenzzentrum
der Universität Basel und
des Kantons Aargau

# NANO IMAGING LAB

## Newsletter

March 28, 2023

### Introducing FEI VERSA 3D Dual beam SEM/FIB


In order to relieve our FEI Helios NanoLab 650, which is pretty much used to it's capacity, we were very happy to just recently being able to purchase a used FEI Versa 3D dual

beam. In addition to the already existing Platinum Gas Injection System, we equipped it with a Gold Gas Injection System in combination with pure oxygen, which allows to grow highly conductive gold nanostructures via FEBID. The cutting accuracy of this machine is very much comparable with the FEI Helios NanoLab 650 system. Although this microscope will be mainly used for microfabrication of FIB lamellas for later observation in TEM, the FEI Versa 3D has a lot more to offer.
The large chamber of the instrument allows focused ion beam milling to cut or ablate samples, scanning electron microscopy for imaging and chemical EDX-Analysis. The SEM utilizes a Schottky thermal field emitter (FEG) with accelerating voltages from 200V to 30kV. A door mounting system to operate the Kleindiek nanomanipulator is installed.

<u>Main features:</u>

- 5 axis motorized stage
- High throughput ion column optics with a high-current ion column applying a Gallium liquid-metal ion source
- **Platinum**, **Gold** and pure **Oxygen** Gas Injection Systems (GIS)
- **Detectors: ETD** (Everhard-Thornley-Detector), **ICE** (Ion conversion and Electron Detector), **DBSE** (Directional Backscattered Detector, retractable) and ApolloX **EDX** Detector
- Micromanipulator from Kleindiek

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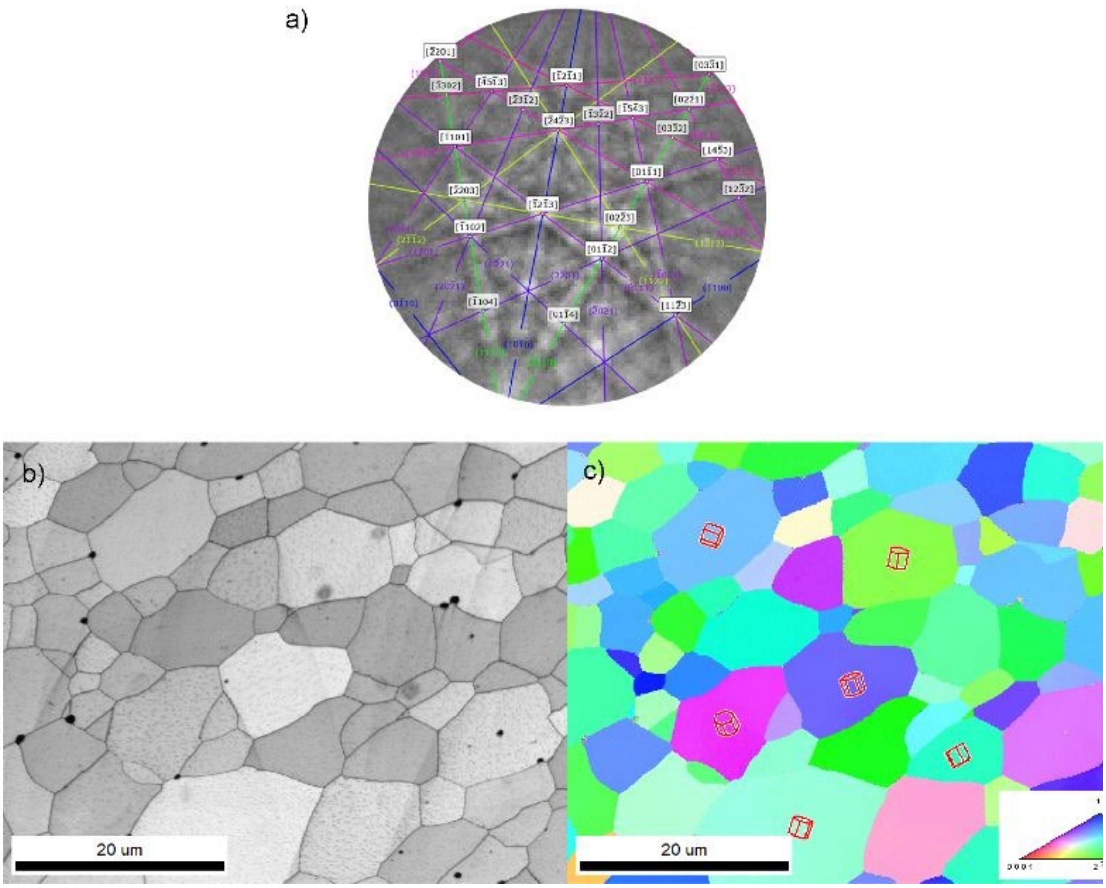
## Electron Backscatter Diffraction (EBSD)

This analytical method has been available in the NI Lab for a short time and therefore we would like to introduce it to you today. EBSD is a scanning electron microscope (SEM) based technique, which enables a crystalline sample’s microstructure to be analysed, visualised and quantified. Such a characterisation is fundamental for a complete understanding of a material and its performance.
The data acquired by EBSD analysis determine the crystal structure and its crystal grain orientations, grain sizes and their distribution in the material. It characterizes grain boundaries and the texture and identifies different phases.

Principle: accelerated electrons in the primary beam of a scanning electron microscope can be diffracted by atomic layers in crystalline materials. These diffracted electrons will be detected when they impinge on a phosphor screen and generate visible lines, called Kikuchi bands (a). The illustrations shown below derive from the measurement of a polycrystalline Zircon platelet. (b) shows the SEM picture overlaid by the crystal orientation map. The Kikuchi patterns are effectively projections of the geometry of the lattice planes in the crystal, and they give direct information about the crystalline structure and crystallographic orientation of the grain from which they originate. Crystal grains with different orientation are color coded and represented in a map (c). Small red symbols on some of the grains show the crystal orientation via a unit cell orientation.




Since the penetration depth of the electron beam is only a few nanometers, a good sample preparation is crucial. Sample surfaces need to be very planar, extremely smooth and without any damage to obtain reliable results.

If you have questions or would like to use this method, please contact Dr. Marcus Wyss (marcus.wyss@unibas.ch).