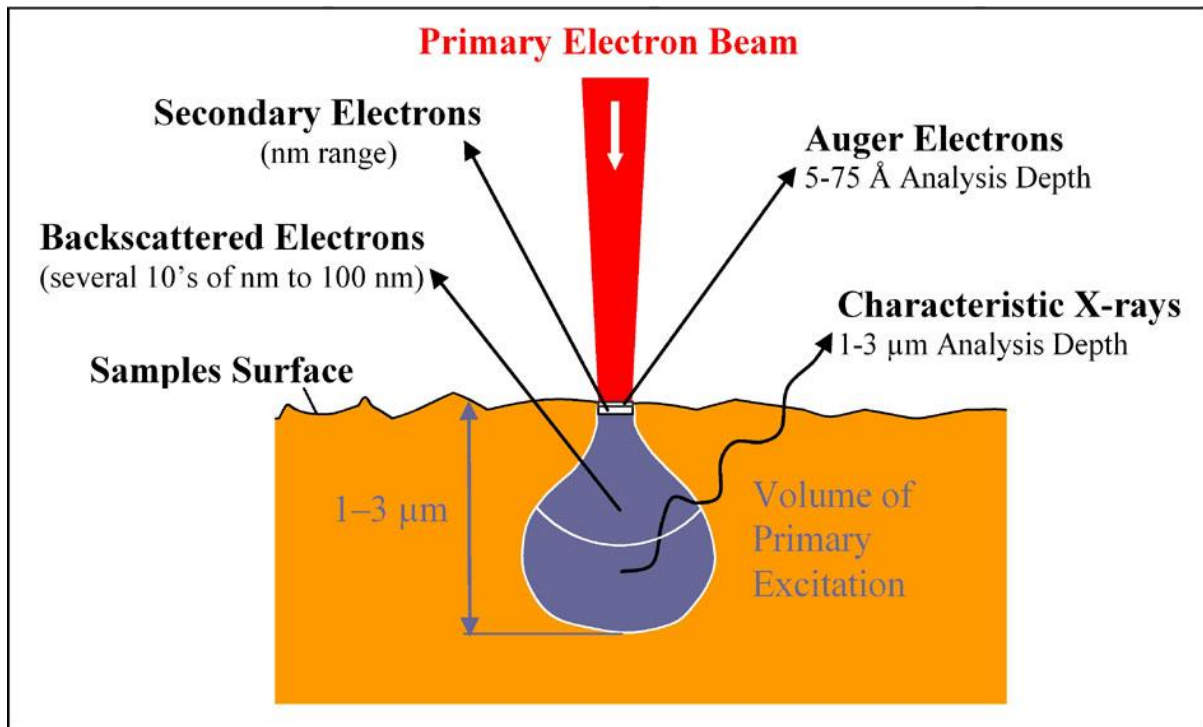


Scanning Electron Microscopy & Energy Dispersive X-Ray Spectroscopy



In the scanning electron microscope a stream of primary electrons is focused onto the sample surface resulting in a number of different particles or waves being emitted (secondary electrons, backscattered electrons, X-rays, photons, Auger electrons...). The secondary and backscattered electrons are used for imaging while the X-rays give characteristic chemical information of the emitting atoms. The probed depth in EDX analysis is around 1-3 μm.





Instrumentation @ SURF:

- The JEOL JSM-7100F field emission SEM is a full analytical ultrahigh resolution instrument, with a lateral resolution of 1.2 nm at 30 kV, 3 nm at 1 kV and 3.0 nm at 15 kV, with working distance = 10 mm and a probe current of 5 nA. The instrument is also equipped with a Through the Lens (TTL) system that provides high resolution at very low landing electron energy (as low as 100 eV). It's coupled with an Oxford Instruments WDX Spectrometer system WAVE, with four analysing crystals and an integrated SDD X-MaxN 20 mm² EDS detector. The energy resolution ranges from 127 eV for the EDS to 10 eV for the WDS system.

- The JEOL JSM-IT300 SEM is equipped with a Tungsten filament source. A low-vacuum module allows operation with a pressure in the chamber of up to 650 Pa, for the observation of poorly conductive samples without applying a coating. In high-vacuum mode, the resolution ranges from 3.0 nm at 30 kV with a working distance (WD) of 8 mm till 15.0 nm at 1 kV with a WD of 6 mm (SE image). In low-vacuum mode, the resolution is 4.0 nm at 30 kV with a WD of 5 mm and a pressure in the chamber of 10 Pa (BSE image). The instrument is coupled with an Oxford Instruments SDD X-MaxN 80 mm² EDS detector for X-ray analysis, with an energy resolution of 127 eV.

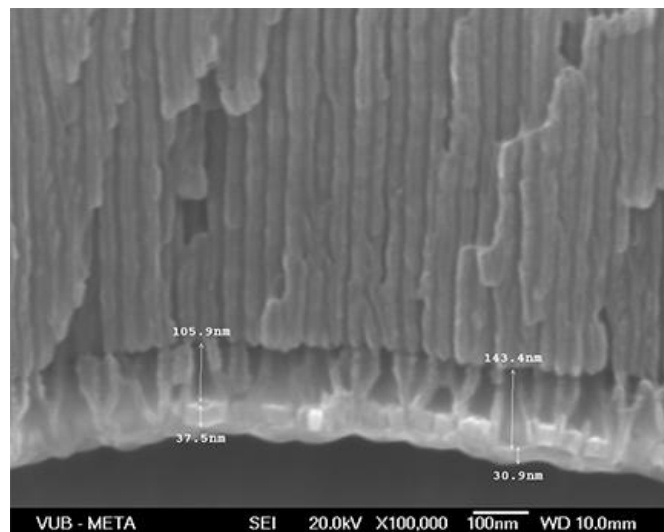
Sample requisites:

- samples can be both conductive or poorly conductive (a thin C, Au or Pt-Pd layer is applied in the latter case);
- maximum sample size for the JSM-7100F is 100 mm (diameter) x 40 mm (height) and up to 50 mm height with the 32 mm diameter sample holder;
- maximum sample size for the JSM-300IT is 200 mm (diameter) x 80 mm (height).

Examples of previous or on-going case studies:

- corrosion studies on various alloys;
- electrochemical colouring of anodized aluminium;
- growth mechanism of thin films on different metallic substrates (Al, steel, Cu, Zn...);
- oxidation and hydration of aluminium;
- oxidation of differently thermally treated steel substrates...

In the figure below a field emission SEM image of the cross-section of electrochemically coloured aluminium is shown. Thanks to the high magnification, the modified structure of the porous oxide layer is clearly visible. Also the Sn filling at the bottom of the pores can be observed on the image.



Cross-section of electrochemically coloured Al