High Resolution Microscopy of Surfaces

Advanced structural resolution

Introduction

The microscopy services offered at PSI allow the characterization of material and nanostructured surfaces, with the availability of a wide range of microscopy techniques, namely optical Microscopy, Scanning Electron Microscopy (SEM) and Scanning Probe Microscopy (SPM) as highlighted below. Each of these techniques has specific capabilities for the surface characterization, leading to a complementary suite of measurement techniques for mapping of surface and interface properties from the microscopic scale down to the size of atoms and molecules. These techniques reach far beyond simple imaging, with the possibility to perform local experiments revealing a wide spectrum of materials properties. Consultation with the contacts listed below will allow a quick decision on which of these techniques can address a particular problem. In addition, the Molecular Nanoscience group offers its expertise to perform spectro-microscopy correlation experiments, also in combination with the powerful photon based analytical techniques available at the Swiss Light Source.

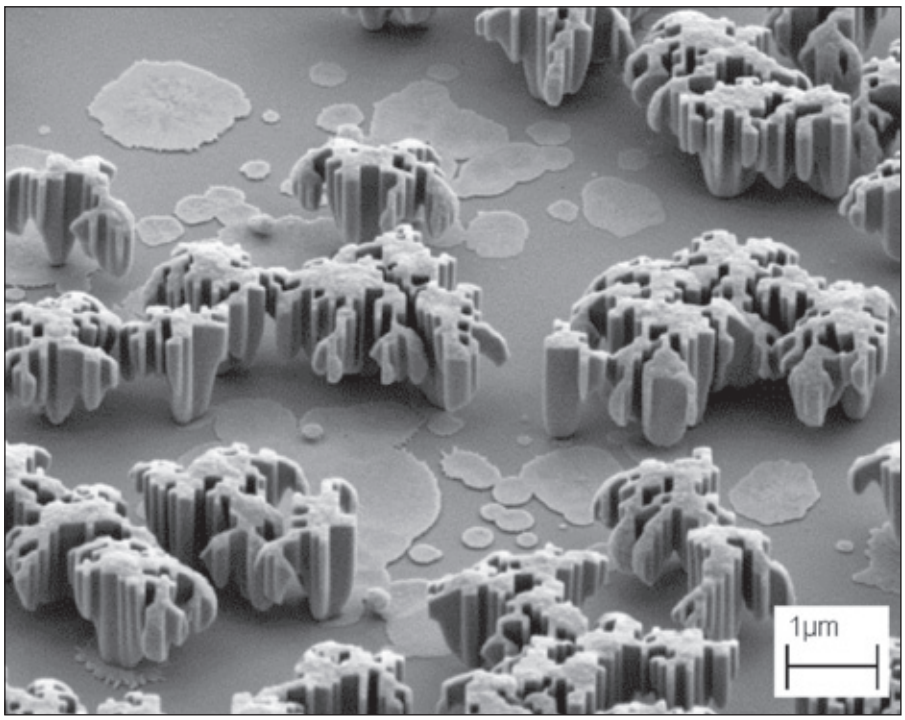

Figure 1: **Scanning electron microscopy (SEM) is an indispensable tool for the inspection of surfaces. The fascinating SEM image in Fig. (1) shows some sub-µm features, which are far too small to be visible in an optical microscope. The possibility to perform quality control of surfaces, with a rapid visualization of any defects allows effective surface processing, failure analysis, and development of sample preparation techniques.**

High Resolution Scanning Electron Microscopy (SEM)

The Zeiss Supra VP55 high resolution field emission scanning electron microscope (FE-SEM), provides rapid visualization of surfaces and interfaces at the nanoscale with following operation modes:

- In Lens detector for secondary electrons with highest spatial resolution of 1 nm at an acceleration voltage of 15 kV (gold on carbon sample).
- Everhardt Thornley detector for secondary electrons.
- Centaurus backscattered electron detector with enhanced material contrast, giving the possibility to distinguish between different materials at the nanoscale.
- Variable Pressure detector for imaging e.g. electrically insulating materials such as polymers, glass or quartz without the need for a metal coating. Spatial resolution approx. 3 nm at 15 kV.
- The sample size is limited to a maximum of 150 mm diameter.

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Scanning Probe Microscopy Service Lab

Scanning Probe Microscopy (SPM) is an invaluable tool for surface characterization. Two instruments, a Veeco Multimode and a Veeco Dimension Instrument, are currently operated at PSI and are available for external projects and services. SPM is capable of mapping a variety of surface properties including surface roughness, hardness, electrical properties and magnetic fields. Beyond imaging, local experiments with individual atoms and molecules can be performed and local materials properties can be determined and modified. Surfaces and interfaces in air, in liquids and at a variety of other conditions can be imaged and experimented with. A wide range of projects make beneficial use of this versatile technique, ranging from life sciences to material science, chemistry and physics, as well as surface and interface science and the engineering of surfaces and nanostructures.

In interaction with project partners we have successfully designed and implemented apparatus for very complex experiments. Do not hesitate to make an appointment for a discussion if you can imagine some benefit from nanoscopic images and experiments of your samples.

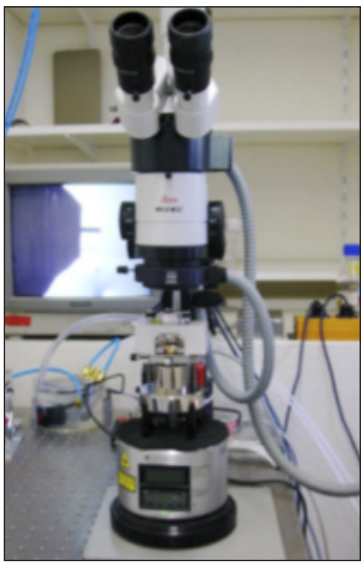

Figure 2: **Nanoscope Multimode**
Maximum scan-size: 130 µm,
Maximum sample size: 12 x 12 mm.
The instrument provides data on solid/air and solid/liquid interfaces in the following experimental modes:
– AFM Tapping Mode and Phase Imaging
– AFM Contact Mode
– MFM Magnetic Force Microscopy
– LFM Lateral Force Microscopy
– CAFM Conductive AFM
– STM Scanning Tunneling Microscopy

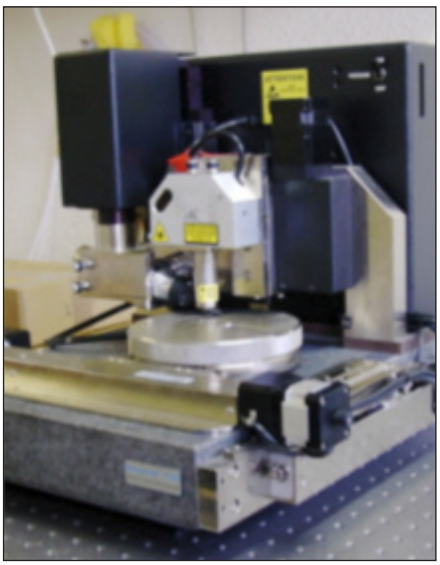

Figure 3: **Nanoscope DI 3100 Scanning Station**
Maximum scan-size: 130 µm,
Maximum sample size: up to 6" Wafer
The instrument provides data on solid/air and solid/liquid interfaces in the following experimental modes:
– AFM Tapping Mode, Phase Imaging
– AFM Contact Mode
– LFM Lateral Force Microscopy
– MFM Magnetic Force Microscopy

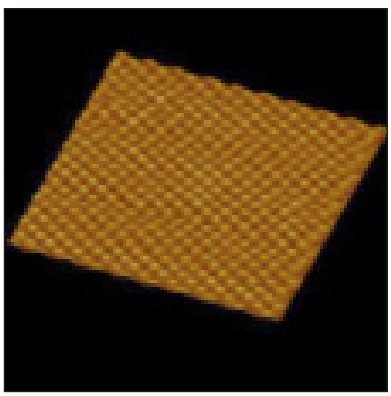

Figure 4: **"atomic resolution"**
Sample: mica
Detail width: 5 nm x 5 nm

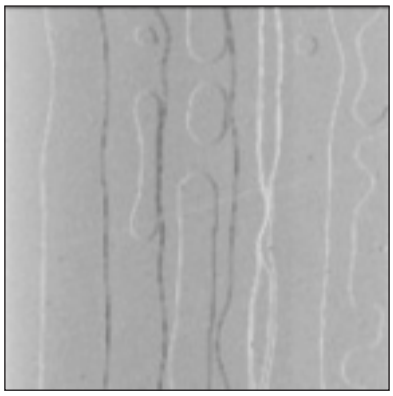

Figure 5: **Atomic steps on crystalline salt in surface chemistry**
Detail width: 10 um x 10 um

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