

Scanning Probe Microscopy Equipment (SPM)

Scanning Probe Microscopy (SPM) is the general name for a whole range of versatile microscopy techniques which have as basic feature in common that the images are produced by scanning a solid probe in close contact with the specimen surface and detecting some signal from the interaction between the probe and the surface. The probe consists of a cantilever on which is attached a very fine tip to increase the lateral resolution of the technique. Depending from the desired material information, different signals will be detected under different SPM methods. The SPM equipment is used for high resolution characterization in many research domains (materials science, life science, polymers,...).

Atomic Force Microscopy (AFM) is the most established technique yielding two-dimensional mapping of sample surface morphology and mechanical properties. Several scanning operating modes are available such as contact, non-contact, intermittent, tapping and resonant mode to reveal the topography of the material under study. Provided an additional phase imaging mode, elasticity variations can also be visualized.

In addition to AFM, there are interesting new Scanning Probe Microscopy (SPM) techniques likely to measure for instance mechanical (e.g. lateral force microscopy (LFM)), magnetic (magnetic force microscopy (MFM)) and electrical properties of the sample surface. For the local characterization of electrical properties several methods are available such as electric force microscopy (EFM), Kelvin probe force microscopy (KPFM), conductive-AFM (C-AFM), tunneling AFM (TUNA), scanning spreading resistance microscopy (SSRM) and scanning capacitance microscopy (SCM). Combination of the above mentioned SPM methods with a heating facility and an environmental chamber can further expand the types of characterizations required by the materials under study.



System description and specifications

IMEC has a Veeco Multimode SPM microscope with a NanoScope IIIa SPM controller and a Quadrex module. The available SPM modes and probes are :

SPM methods:

- Atomic force microscopy (AFM) in air (Contact and non-contact (tapping) modes)
- AFM in liquid
- Electrostatic force and scanning surface potential microscopy (EFM, SSPM)
- Magnetic force microscopy (MFM)
- Conductive AFM (C-AFM) by means of the external C-AFM/TUNA module (sensitivity [100 fA; 200 nA]).

Probes: Nanosensors GmbH

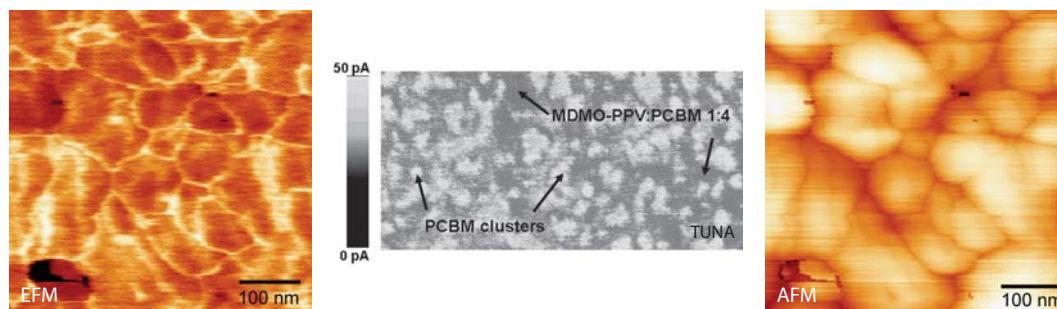
- Etched Si probes (tip radius: ~5 nm) for tapping and contact AFM
- PtIr5 metal coated etched Si probes for EFM, SSPM and C-AFM/TUNA. Very low cantilever spring constant for C-AFM/TUNA measurements (0.1 to 0.3 N.m⁻¹).



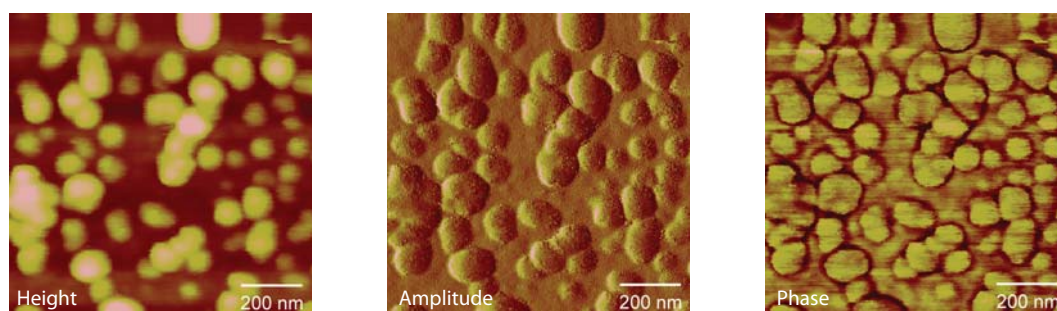
Measurement example

Some typical applications are :

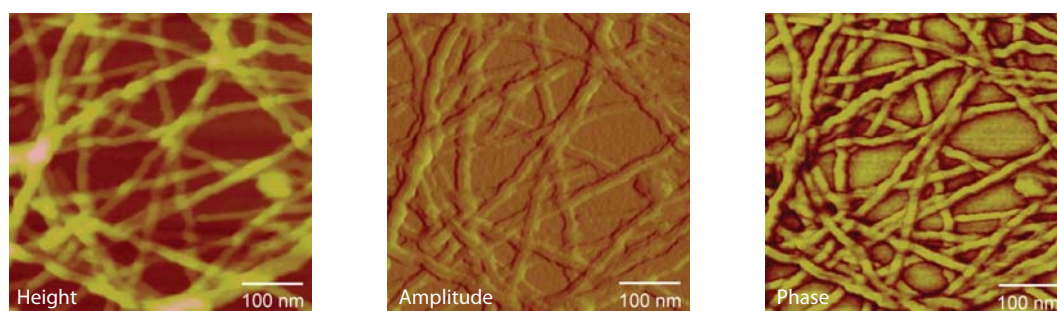
- Ultra-high-resolution topographical profiling (AFM under different scanning modes)
- Measurement of variations of bulk heterojunction blends for organic solar cells (EFM mode)
- Measurement of variations in sample resistivity or conductivity (C-AFM/TUNA mode)
- Study of biomaterials



SPM modes on bulk heterojunction blends for organic solar cells



Dispersity of nanodiamond: SPM on seeded nano diamonds



Tapping mode AFM of nano-fibrillate P34T-0,1% px 1 min (nanostructured photovoltaic material)