

life

AFM for biological applications





LIFE setup and measuring head lifting mechanism

Development of an AFM for biological applications is always a tricky problem because it requires AFM integration with an Inverted Light Microscope.

LIFE is a fully automated, ILM-compatible system that saves all functionality of both AFM and ILM

AFM and ILM integration

Integration of two powerful research instruments is usually a point of compromise. ILM functionality is often obstructed by AFM integration in terms of either optical methods available or limited condenser aperture.

The LIFE is not the case. The whole variety of powerful ILM methods (dark field, phase contrast, fluorescence imaging, etc.) is still available with LIFE. It is compatible with 0.55 NA ILM condensers and ready for integration with Olympus IX71/IX81, Zeiss Axio Observer, Nikon Ti. Integration with other ILMs is available up on request.

DirectDrive cantilever excitation system

Amplitude modulation AFM modes are of great importance for investigation of soft biological specimens. Because of the low Q-factor of the cantilever and complex mechanical design of cantilever/sample holders, a number of spurious resonances of the cantilever occur making it difficult to operate in AM-AFM modes in liquid.

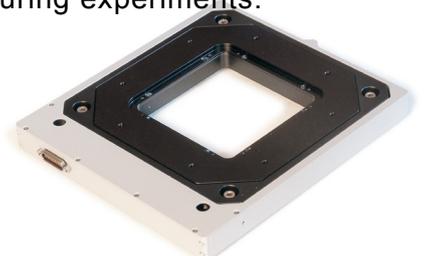
The LIFE uses the specially developed DirectDrive cantilever excitation system that allows to avoid these problems and to get clear cantilever resonance curve. Corresponding cantilever holder is completely disassemble and washable, that allows to hold high level of cleanness during experiments.



DirectDrive cantilever holder and glass block



Closed perfusion liquid cell. Temperature range 10 .. 60 °C



LIFE replaceable sample flexure scanning stage

Fluid cell

The LIFE perfusion fluid cell provides precise sample temperature control in the range from 10 to 60 °C. It operates with standard glass bottom Petri dishes or regular microscopy cover glasses. Careful selection of materials cell made from allows keeping high pureness of the experiment. All fluid cells parts are fully washable.

6 scanning axes

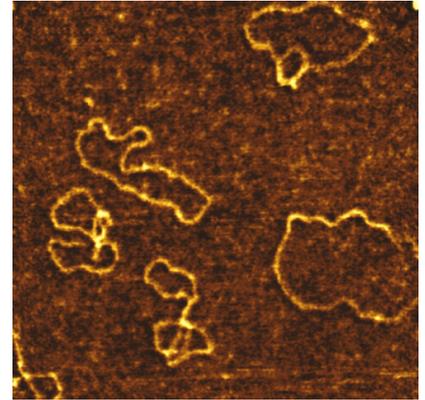
PX Pro controller allows closed loop operation with up to 6 scanning axes. Basic XYZ scanning is done by the probe and provided by decoupled flexure stage. In addition, either 100 100 μm XY stage or 100 μm Z stage can be installed into the base of the unit. One of scanning axis is kept for the ILM objective scanner.

Automation and precision

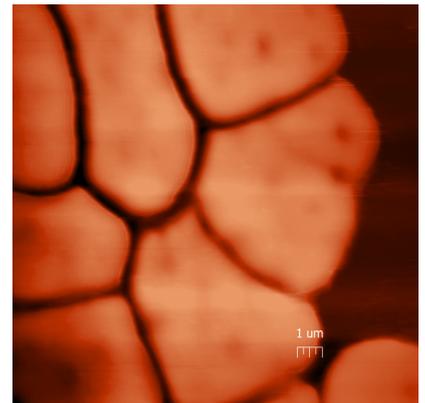
The LIFE is a fully automated AFM. Automation of laser-cantilever-photodiode optical chain alignment is very convenient for operation in liquid, where such alignment is quite tricky usually. Automated XY sample positioning table provides fast, precise and easy sample positioning. In addition, the XY sample table can be equipped with optical encoders that allows precise scanning of up to ~ mm field with AFM. The specially designed LIFE measuring head lifting mechanism makes sample/cantilever exchange much easier compare to other commercial biological AFMs.

Panoramic optical view, MultiScan and ScanStitch

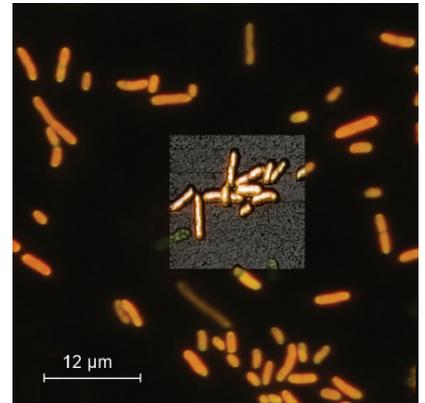
The Nova PX software provides many features based on high automation level of the LIFE. Panoramic optical view allows collection of high resolution, large scale images of the sample and then operation with these data is the same as one operates with interactive maps. Multiscan and ScanStitch provide easy acquisition of scans with ~ mm scan size and overlay AFM scans with the optical image.



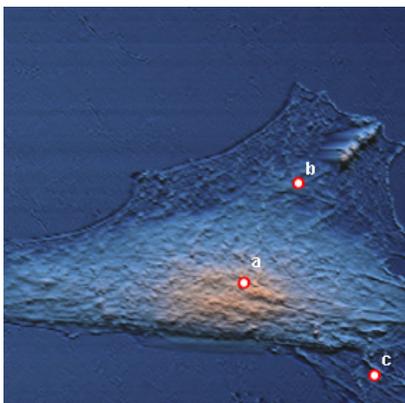
DNA on mica surface, AM-AFM.
Scan size 650x650 nm



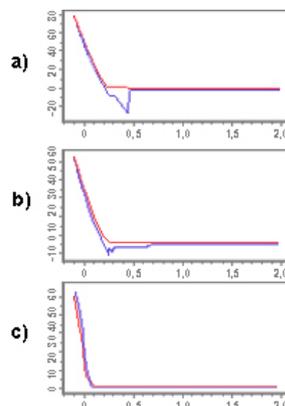
Human blood cells, AM-AFM in liquid. Scan size 16x16 μm



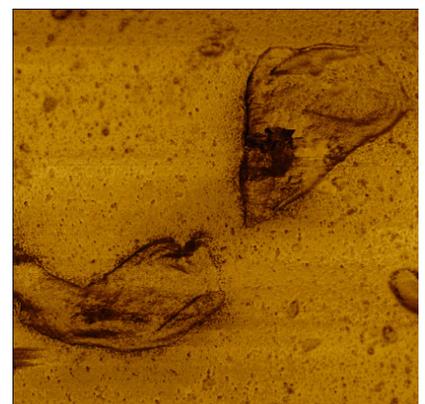
E. Coli cluster. Fluorescence image with AFM topography overlaid



Osteoblast cells, Contact AFM.
100x100 μm scan size



Force curves on Osteoblast cells for a, b, c positions



Live Tunica mucosa oris. RSI mode, adhesion map.
20x20 um scan size.

Specifications

General

ILM compatibility

Zeiss: Axio Observer
Olympus: IX product line
Nikon: TE 200, Ti

AFM measuring head

CL scan range: X,Y 100 × 100 μm, Z 20 μm
Linearity: 0.03%
OBD sensor alignment: automated
OBD sensor laser wavelength: 850 nm

Motorized stage

Sample positioning range: 20 × 20 mm
Measuring head positioning range: 3 × 3 mm
Min step: 0.3 μm
Optical encoders: available up on request

Replaceable sample scanning stages

XY CL scanning range: 100 × 100 μm
Z CL scanning range: 100 μm

Objective scanner

CL scanning range: 100 μm

Fluid cell

Perfusion and gas flow: available
Temperature range: 10 .. 60 °C
Temperature control accuracy: 0.1 °C

Modes

in air and liquid:

Contact AFM

Topography
Feedback
Lateral Force (LFM)
Force Modulation (FMM)

Amplitude modulation AFM

Topography
Phase
Feedback

AFM spectroscopy

Force-distance
Amplitude-distance
Phase-distance

Raster Spring Imaging

Nanolithography

Force

AFM Nanoindentation

Elastic modulus mapping
Work of adhesion mapping

in air:

Magnetic Force Microscopy

Electrostatic Force Microscopy

Kelvin Probe Force Microscopy

PFM & Switching Spectroscopy

Scanning Spreading Resistance Microscopy