Light Microscopy and Atomic Force Microscopy (AFM)

Biomedical Research at the Nanoscale

Veeco

Leica
MICROSYSTEMS

Light Microscopy and Atomic For

Integration of Veeco BioScope™ II with Leica DMI Series

In recent years the powerful combination of AFM with light microscopy has opened a new dimension for Life Science Research. Multiple application benefits of combining optical microscopy and AFM have been demonstrated:

- Optical navigation of AFM probe to a region of interest
- Additional 3 D high resolution structural information of cells or molecules
- Mechanical probing of elasticity, affinities and intramolecular forces
- Mechanical manipulation with optical observation
- Ultraprecise tool for nanolithography
- Registration and overlay of optical/fluorescence images and high resolution AFM topographs

Typical biological samples are:

Living and fixed cells, bacteria, viruses, tissues, membranes, lipid bilayers, filaments, single molecules (DNA, RNA, proteins), 2D and 3D protein crystals

Combined Excellence

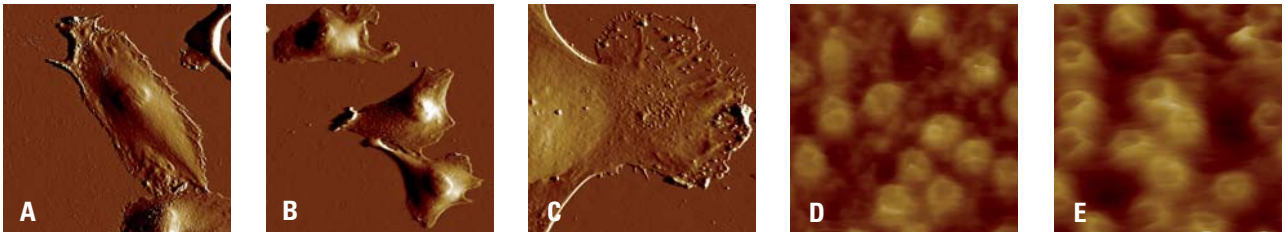
Veeco Instruments Inc., a leading provider of instrumentation to the nanoscience community, and Leica Microsystems, a leading designer and manufacturer of microscopy imaging systems, have established a collaboration to drive research in the biological and nano-medical community. It is a technology and marketing partnership. The initial phase of the collaboration focuses on the innovation and integration of Veeco's BioScope II AFM with Leica's DMI series of inverted microscopes with the benefit of imaging, probing and manipulating biological systems: from the living cell down to single molecules. In this way, both companies support high resolution imaging for biological and nanomedical research applications investigating human diseases.

The combined system

The BioScope II has been integrated to fit into the optical path of the Leica DMI inverted microscopes without compromising optical functions. This results in a new high performance research tool, which is intuitive and easy to use. The AFM stage accommodates high magnification objectives up to 100x. All contrasting methods such as bright-field, DIC, phase contrast and fluorescence are fully available.

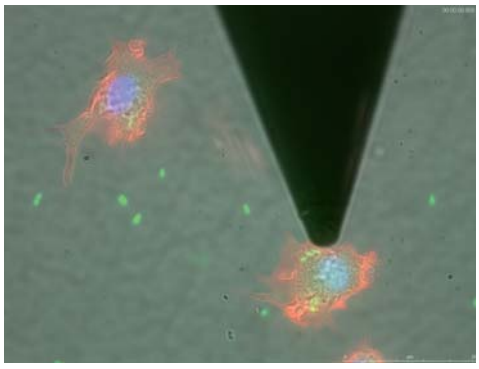
The user-friendly setup of the BioScope II allows quick sample insertion and exchange of AFM probes, including a fully controllable motorized stage and an automated approach mechanism. The open design of the Bioscope II AFM head provides free access to the sample in order to add substances such as inhibitors, drugs, etc. to the experiment. Measurements can be performed under physiological conditions including temperature, pH, humidity control and perfusion. Image overlay software allows direct correlation of optical with AFM topography and mechanical information.

Atomic force microscopy can provide spatial resolutions of a few nanometers and below. The actual achievable resolution depends on the size of the AFM tip (a few nm in radius) and the mechanical properties of the biological sample.



(A-C) Fixed dog epithelial cells in buffer solution. Scan size A & B: 180 μm; C: 70 μm.
Cells courtesy of Anke Fabian & Christoph Riethmüller, Institute of Physiology II, University of Münster, Germany.
(D-E) Studying the nuclear envelope of X. laevis with AFM. D: nucleoplasmatic side, E: cytoplasmatic side. Zoom into the area of 1.2 μm x 1.0 μm.
Cells courtesy of Prof. H. Oberleithner, Armin Kramer & Victor Shahin Institute of Physiology II, University of Münster, Germany

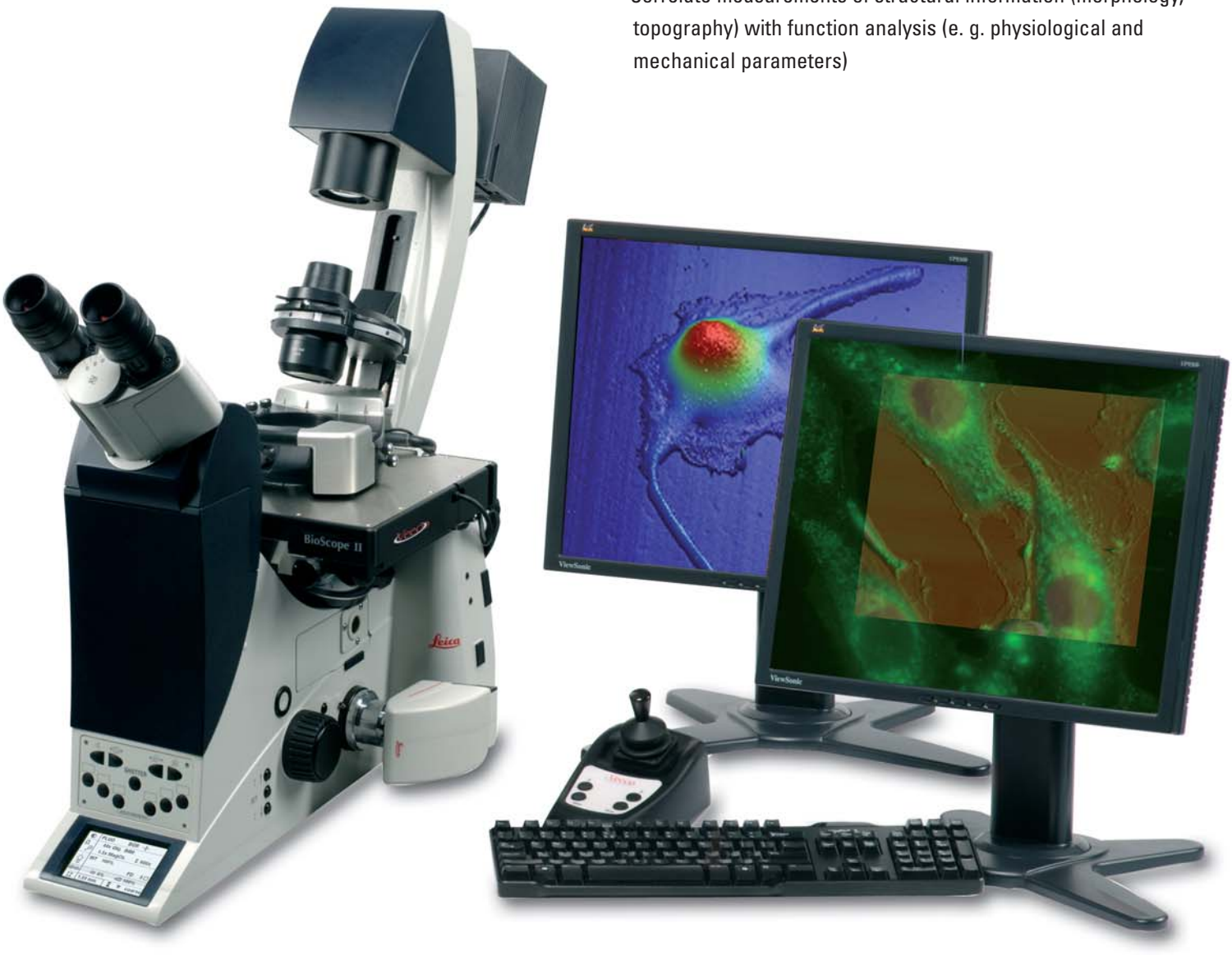
ce Microscopy (AFM)



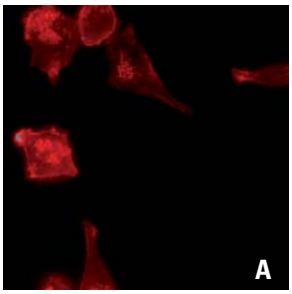
AFM tip probing a human triple labeled dendritic cell infected with bacteria

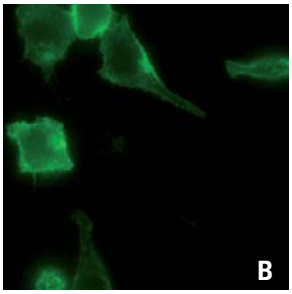
User benefits

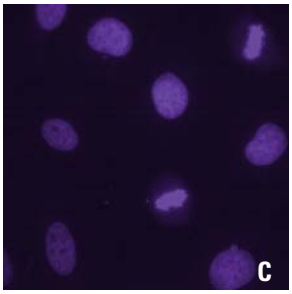
- Consistent sharp images
- Resolution from µm to nm scale
- Use of advanced optical techniques including DIC and fluorescence in combination with AFM
- Studying biological samples in real-time and under physiological conditions
- Unique access to the sample/tip
- Versatile and easy to use
- Supporting a variety of AFM measurement modes, including Contact Mode and TappingMode™, PhaseImaging™, force probing modes and Force Volume mapping
- Compatible Contrasting Methods: BF, PH, DIC, FLUO, DF, IMC
- Real-time overlay of optical image and high resolution AFM
- Correlate measurements of structural information (morphology, topography) with function analysis (e. g. physiological and mechanical parameters)

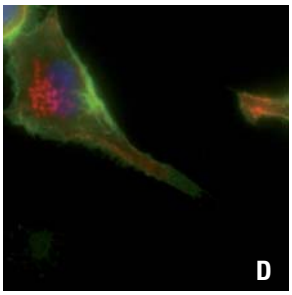


Two Companies. One Solution.









Application example

Analysis of lamellipodia of moving macrophages. Correlation of structures visualized by fluorescence microscopy and AFM.

A – **C**: Epifluorescence

A: Red: Phalloidin – Actin

B: Green: Alexa 488 – Membrane

C: Blue: DAPI – Nucleus

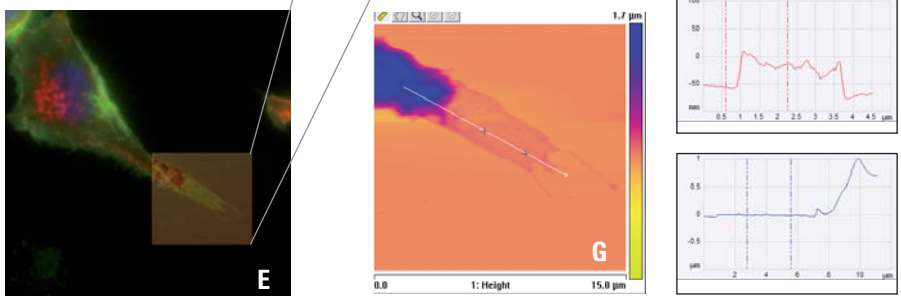
D: Fluorescence overlay

E: Correlation of AFM topography with triple fluorescence labeled cells

F: AFM topography, liquid contact mode

G: Corresponding height profiles

Labelling: Triple labeling of cultured macrophages



www.leica-microsystems.com
www.veeco.com