

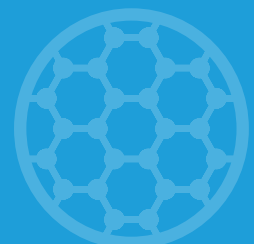
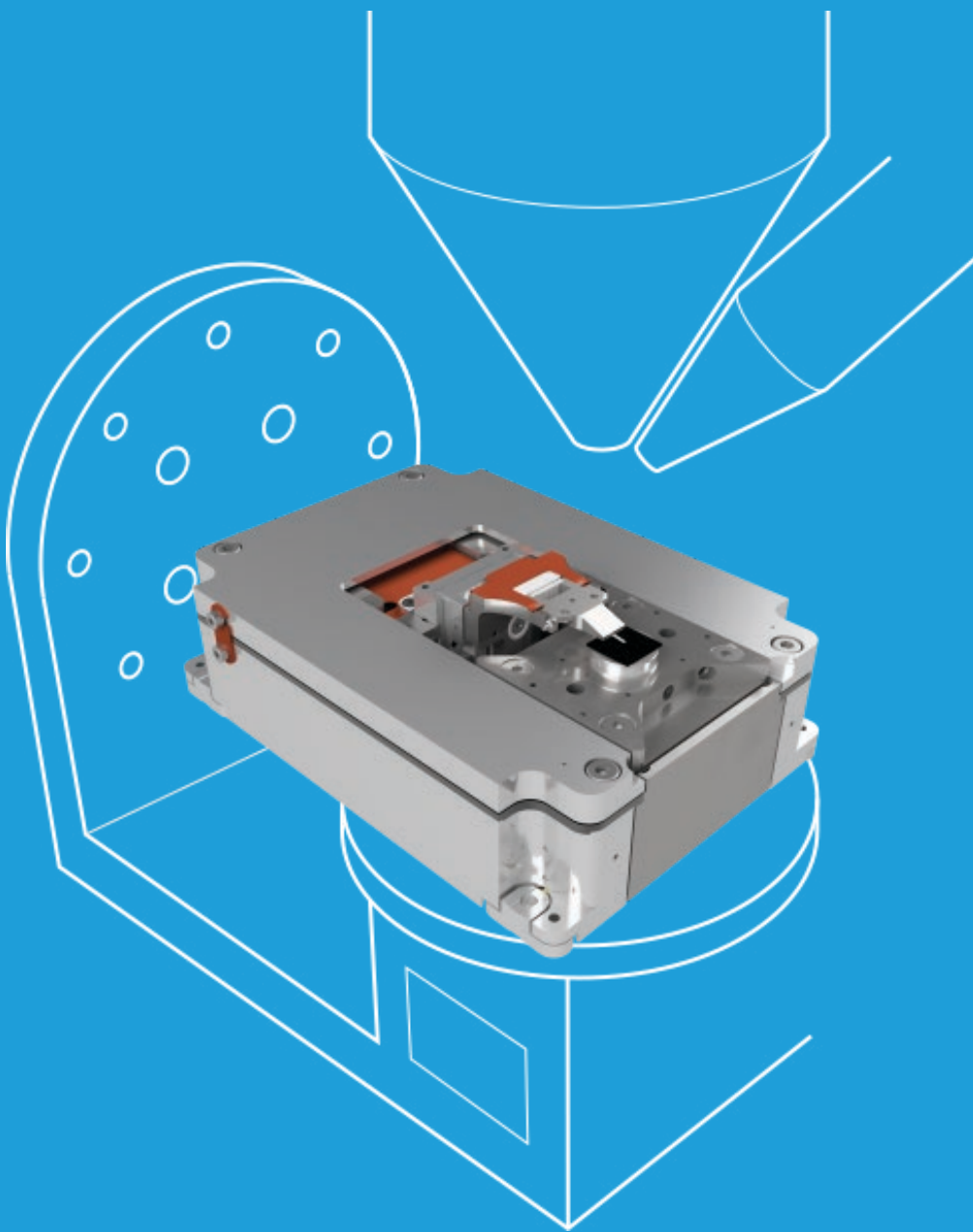


NenoVision

Next level of imaging

# LiteScope 2.0

An AFM designed for integration into a SEM



## Why AFM in SEM?

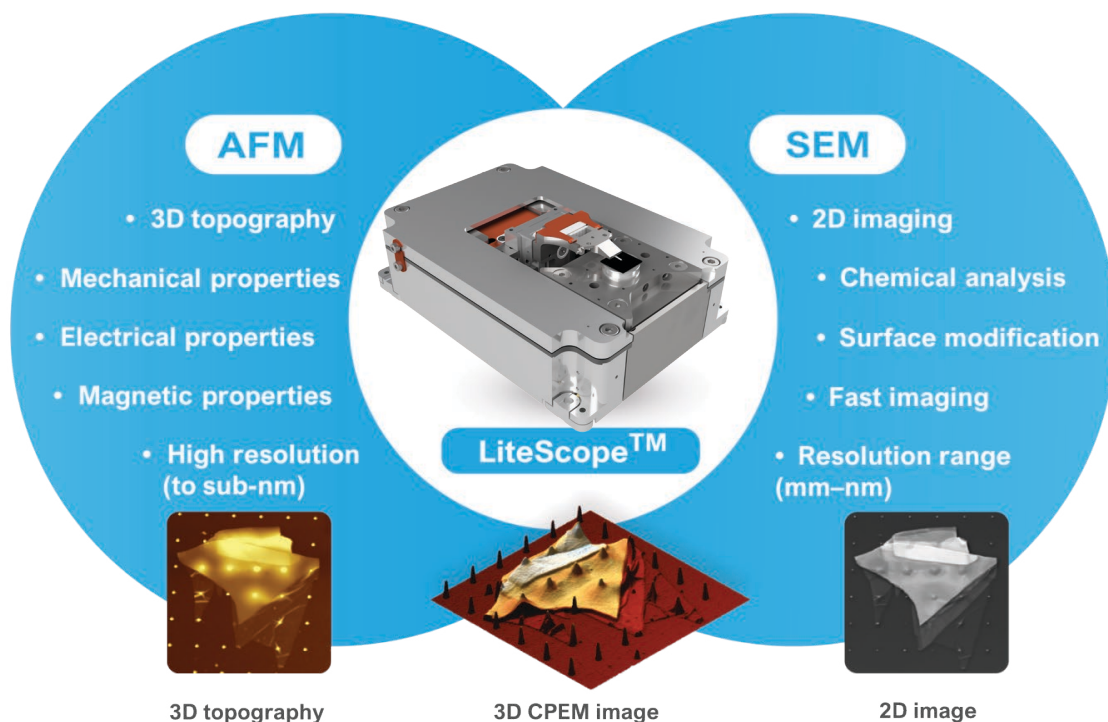
At NenoVision, we wanted to address the growing need for complex, time-efficient analysis and characterization of structures at the nanoscale, which is possible only by advanced correlative imaging and automation across various instruments. That's why we seamlessly merged Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM) into one tool, designed to be extremely versatile while combining the capabilities of both techniques. Additionally, our cutting-edge correlative imaging of AFM and SEM data sets our product apart from the competition, making NenoVision's unique Atomic Force Microscope, LiteScope™, the most advanced AFM in SEM on the market.



## Get the best of both techniques at the same time

Scanning electron microscopy and atomic force microscopy are the two most used, and, in fact, complementary techniques, for sample analysis in the (sub)nanometer range. The integration of AFM into SEM merges the strengths of both techniques, resulting in extremely time-efficient workflow and enables complex sample analysis that was difficult or readily impossible by conventional, separate AFM and SEM instrumentation:

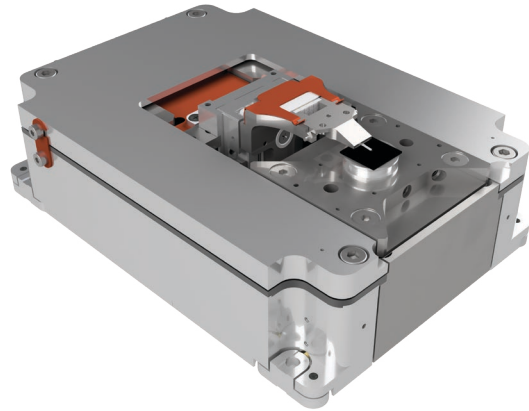
- Fast and precise – AFM navigation to the region of interest by SEM
- Two in one – complex sample characterization and advanced data correlation
- In-situ conditions - crucial for sensitive samples and novel analyses



## LiteScope

LiteScope is a compact Atomic Force Microscope designed for integration into a variety of Scanning Electron Microscopes.

- Fast, plug and play integration into SEMs
- Compatible with FIB, GIS, EDX and other standard SEM accessories
- Highly customizable
- Can be used as a stand-alone AFM as well



### Key benefits

#### Enhancement of SEM capabilities

- AFM in SEM enhances the capabilities of both techniques, enabling complex sample analysis

#### Fast & easy localization of region of interest

- SEM helps to quickly localize the region of interest and to precisely navigate the AFM tip

#### Extension of 2D SEM image into 3D

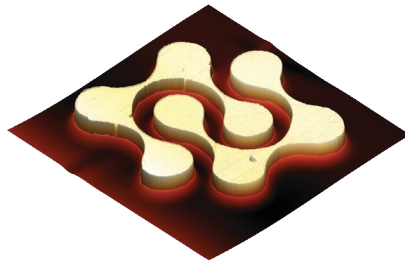
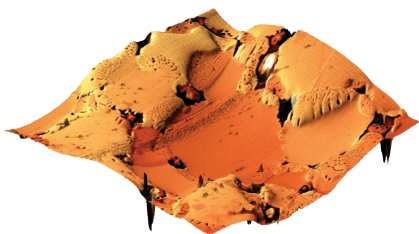
- SEM material contrast is enhanced by the information about sub-nanometer 3D topography and roughness

#### Ultimate precision of correlative imaging

- Unique Correlative Probe and Electron Microscopy (CPEM) technology enables simultaneous acquisition and correlation of the chosen SEM and AFM channels

#### No risk of sample contamination

- In-situ conditions inside the SEM ensure sample analysis at the same time, in the same place and under the same conditions



### Measurement modes

#### Material imaging

- topography and surface roughness (contact and tapping modes)

#### Mechanical properties

- elastic properties (contact and tapping modes), local stiffness and modulus

#### Electrical properties

- conductivity mapping (including insulated areas), surface potential mapping, spectroscopy, piezoelectric domain imaging

#### Magnetic properties

- magnetic domain imaging

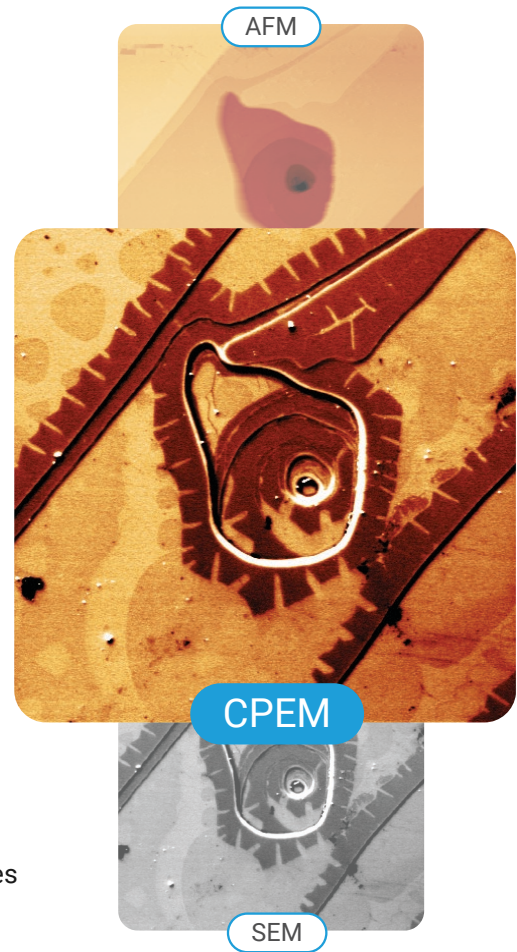
# Correlative Probe and Electron Microscopy

## Next level of imaging

Correlative Probe and Electron Microscopy (CPEM) is a unique technique, which was introduced and patented by NenoVision. It represents a hardware correlative technology, enabling simultaneous acquisition of SEM and AFM data, and their seamless correlation into one 3D image.

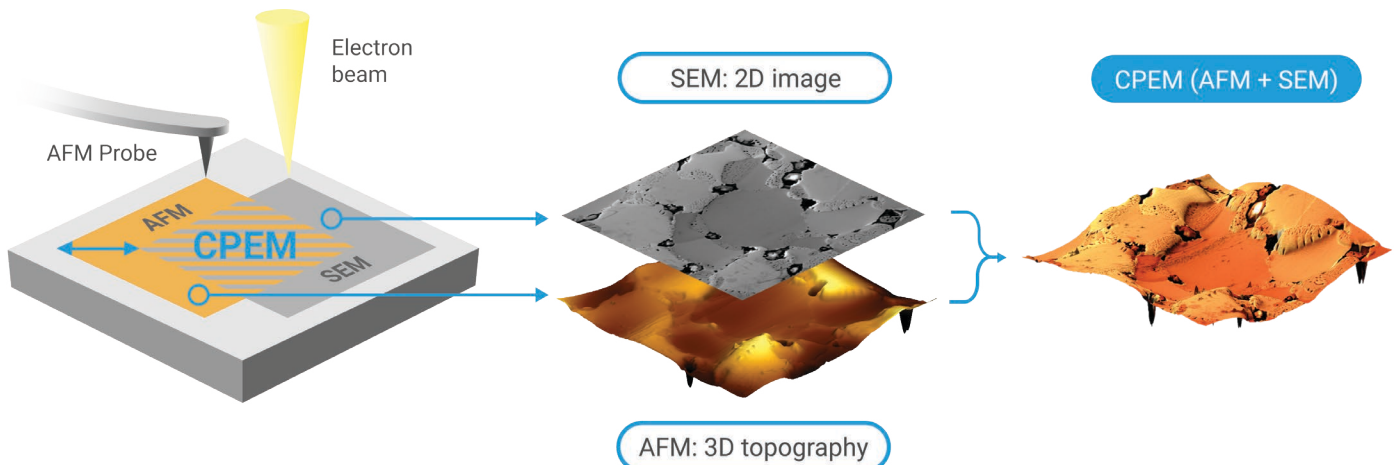
## Advantages

- Simultaneous acquisition of AFM and SEM data
- Absolute correlative precision
- Multimodal correlation of multiple AFM and SEM images
- In-situ conditions - same time, same place, same conditions
- Extremely time efficient with respect to other correlative techniques



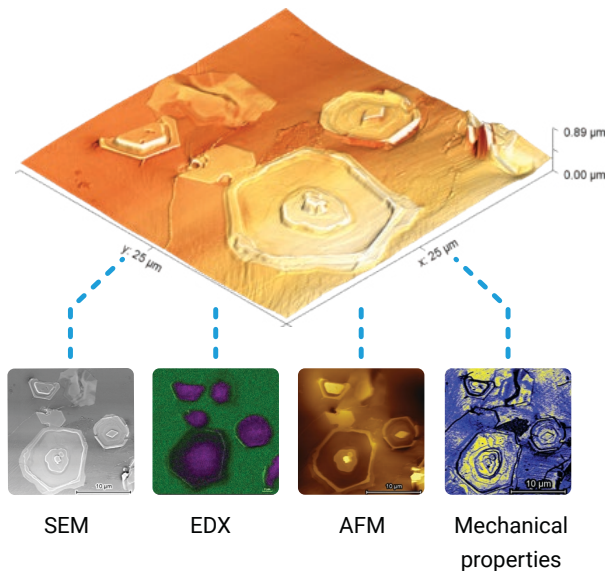
## How does it work?

On the sample, the electron beam points close to the AFM tip with a constant offset. They both remain static, while the sample is scanned with the LiteScope's piezo scanner. This way, data from both microscopes can be acquired at the same time, in the same place, and under the same conditions.



# LiteScope's unique applications

LiteScope's unique applications represent measurements, where the simultaneous utilization of SEM and AFM is either completely indispensable or vastly superior to the use of conventional, separate SEM and AFM instruments in terms of measurement feasibility or its overall cost.



## Complex analysis of 2D materials

### Analysis of molybdenum carbide

Complex correlative imaging of an identical spot on the Mo<sub>2</sub>C sample includes topography, EDX, conductivity and mechanical properties.

- CPEM: precise correlation of chosen AFM and SEM data
- SEM-EDX: fast nanostructure localization and elemental analysis
- AFM: topography, conductivity, mechanical properties

## In-situ analysis of sensitive samples

### Magnetic nanopatterning

In-situ AFM in SEM was necessary to selectively change (FIB-SEM) and immediately characterize magnetic properties of metastable FeNi thin films.

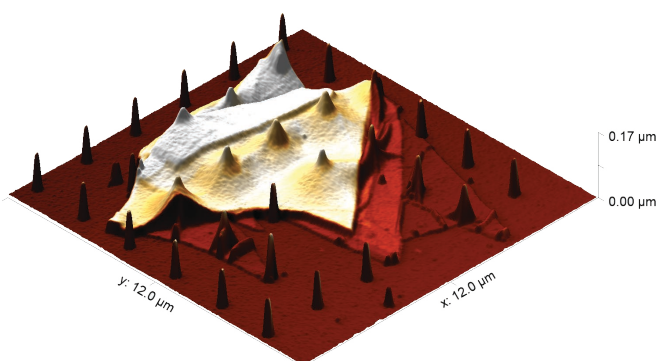
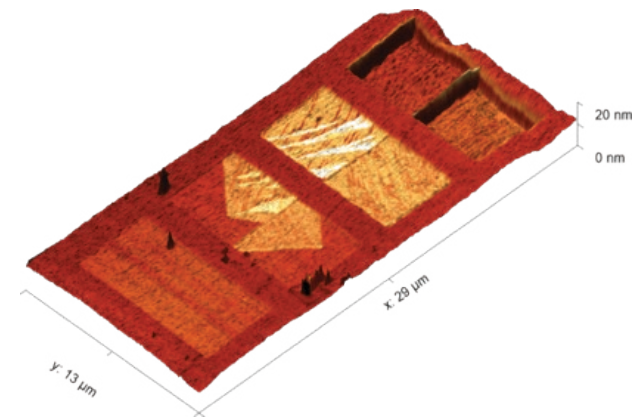
- In-situ conditions - FIB induced transformation of a sensitive sample had to be characterized by AFM and SEM in in-situ conditions.
- Immediate and precise ROI identification – small structural change at the FIB induced interface had to be analyzed by AFM.

## Fast & easy localization of region of interest

### WSe<sub>2</sub> flakes on silicon nanopillars

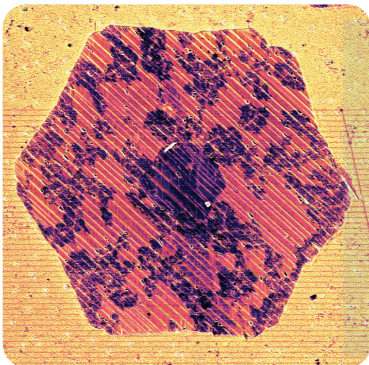
A certain shape of a WSe<sub>2</sub> flake monolayer over nanopillars creates a single-photon emitter.

- Fast ROI localization by SEM
- Difficult sample for AFM - combination of 1D and 2D materials
- CPEM: correlation of topography with monolayer resolution (AFM) and material contrast (SEM)



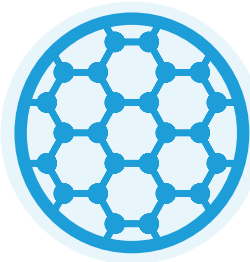
## Application areas

LiteScope offers users unprecedented possibilities in sample analysis and advanced 3D correlative imaging with unparalleled accuracy of image alignment. The versatility of LiteScope proves its applicability in a variety of fields such as Material Science, Nanotechnology, Semiconductors, Solar cell development, Life Science and other areas of research as well as industry applications.



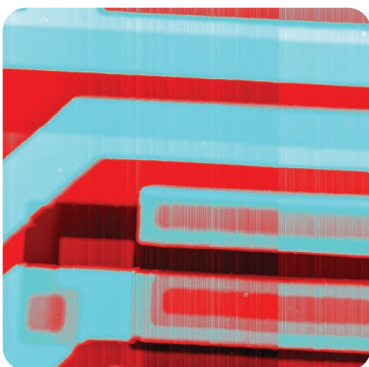
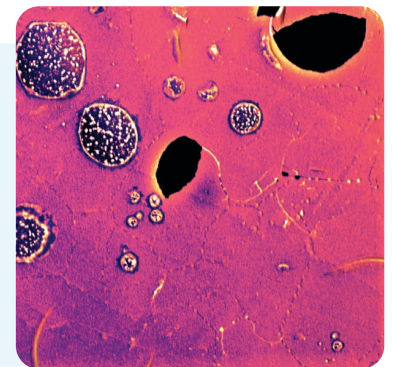
### Material Science

- 1D / 2D materials
- Steel & metal alloys
- Batteries
- Ceramics
- Polymers & Composites



### Nanostructures

- Modified surfaces FIB/GIS
- Quantum dots
- Nanostructured films
- Nano-patterning
- Nanowires



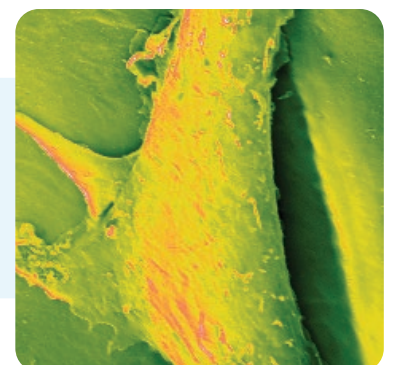
### Semiconductors

- Integrated circuits
- Solar cells
- MEMS / NEMS
- Failure analyses
- Dopant visualization
- Current leakage localization



### Life Science

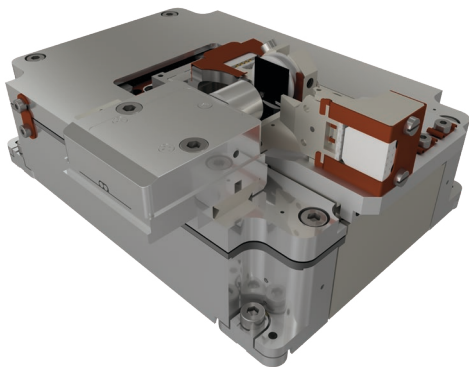
- Cell biology
- Marine biology
- Protein technology



## Optional accessories

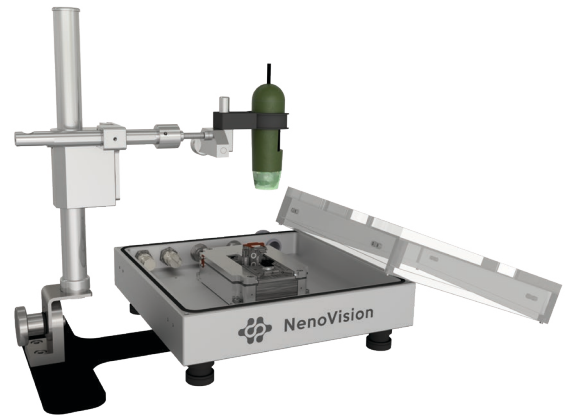
### External nanoindenter module

Nanoindenter enables micromechanical experiments to be performed while observing the specimen with superb SEM magnification and analyzing the indented specimen with sub-nanometer resolution using LiteScope.



### NenoCase and digital camera

Use LiteScope as a stand-alone AFM in ambient conditions or under different atmospheres and navigate the AFM probe precisely with our digital camera.

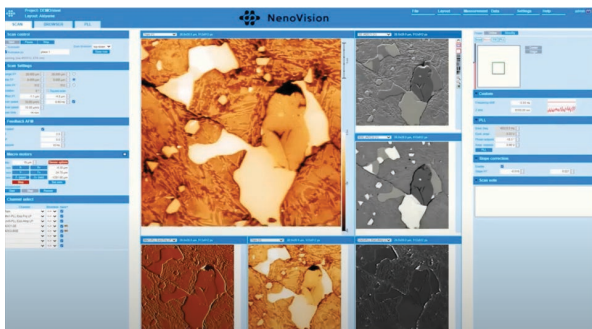


## Variety of AFM probes

LiteScope is not limited by the use of proprietary AFM probes but supports a broad variety of self-sensing probes from other manufacturers through custom probe holders. An AFM probe can be easily inserted into the appropriate probe holder and then attached to LiteScope's universal holder acceptor – no screws or tools required.

## NenoView software

NenoView is user-friendly, web-based software, which allows full control of measurements, data acquisition and data processing. NenoView supports CPEM technology and enables utilization of correlative imaging directly and internally.



In NenoView software, SEM and AFM channels can be selected, viewed, and recorded at the same time.

- Easy for new users, flexible for experts
- Automatically saves the setup and the data
- Integrated data processing, analysis and export features
- Remote experiment control and access to the user data

## LiteScope technical specification

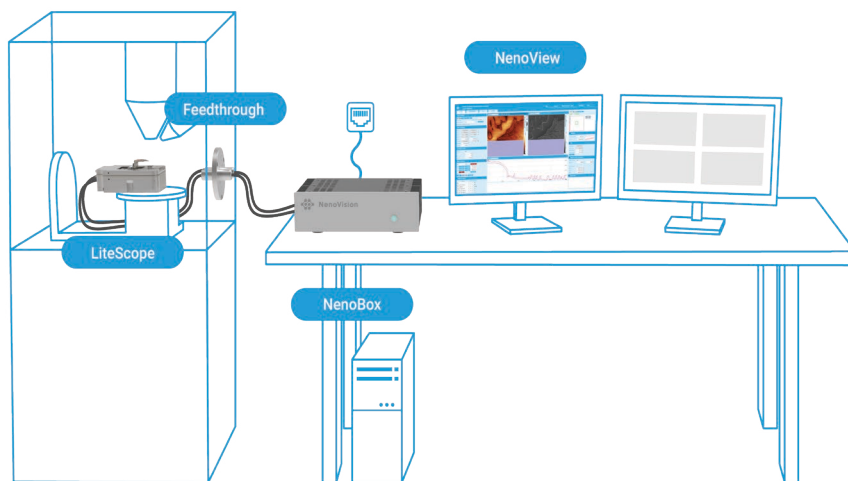
Dimensions XYZ	118 mm x 84 mm x 37.5-48.4 mm	Scan range in open loop XYZ ( $\pm 10\%$ )	100 $\mu\text{m}$ x 100 $\mu\text{m}$ x 20 $\mu\text{m}$
Total weight	460 g	Scan range in closed loop XYZ	80 $\mu\text{m}$ x 80 $\mu\text{m}$ x 16 $\mu\text{m}$
Vacuum working range	10 <sup>5</sup> Pa to 10 <sup>-5</sup> Pa	Resolution XYZ up to	0.2 nm x 0.2 nm x 0.04 nm
Operating temperature	+10 °C to +35 °C	Maximum sample height	8 mm
Maximal scanned sample area XYZ	21 mm x 11 mm x 8 mm	Maximum sample weight	100 g

### Measurement modes

Imaging modes:	Topography and surface roughness
Mechanical modes:	Energy dissipation (tapping mode), FMM (contact mode), F-z curves, nanoindentation
Electrical modes:	C-AFM, C-CPEM, KPFM, PFM, I-V spectroscopy, STM
Magnetic modes:	MFM

## SEM compatibility

Thanks to its small dimensions and light weight, AFM LiteScope is compatible with the majority of SEM systems produced by Thermo Fisher Scientific, TESCAN, ZEISS, Hitachi, and Jeol.



## What do you get?

### LiteScope package

- LiteScope – scan head
- NenoBox – control unit
- NenoView – control software
- Feedthroughs
- SEM adaptor
- Cabling

NenoVision combines tradition and expertise with unique solutions in nanoscale microscopy and correlative imaging using proprietary Correlative Probe and Electron Microscopy (CPEM) technology. Our company is located in Brno, Czechia - the center of electron microscopy with a long tradition in the development of scientific instruments.

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