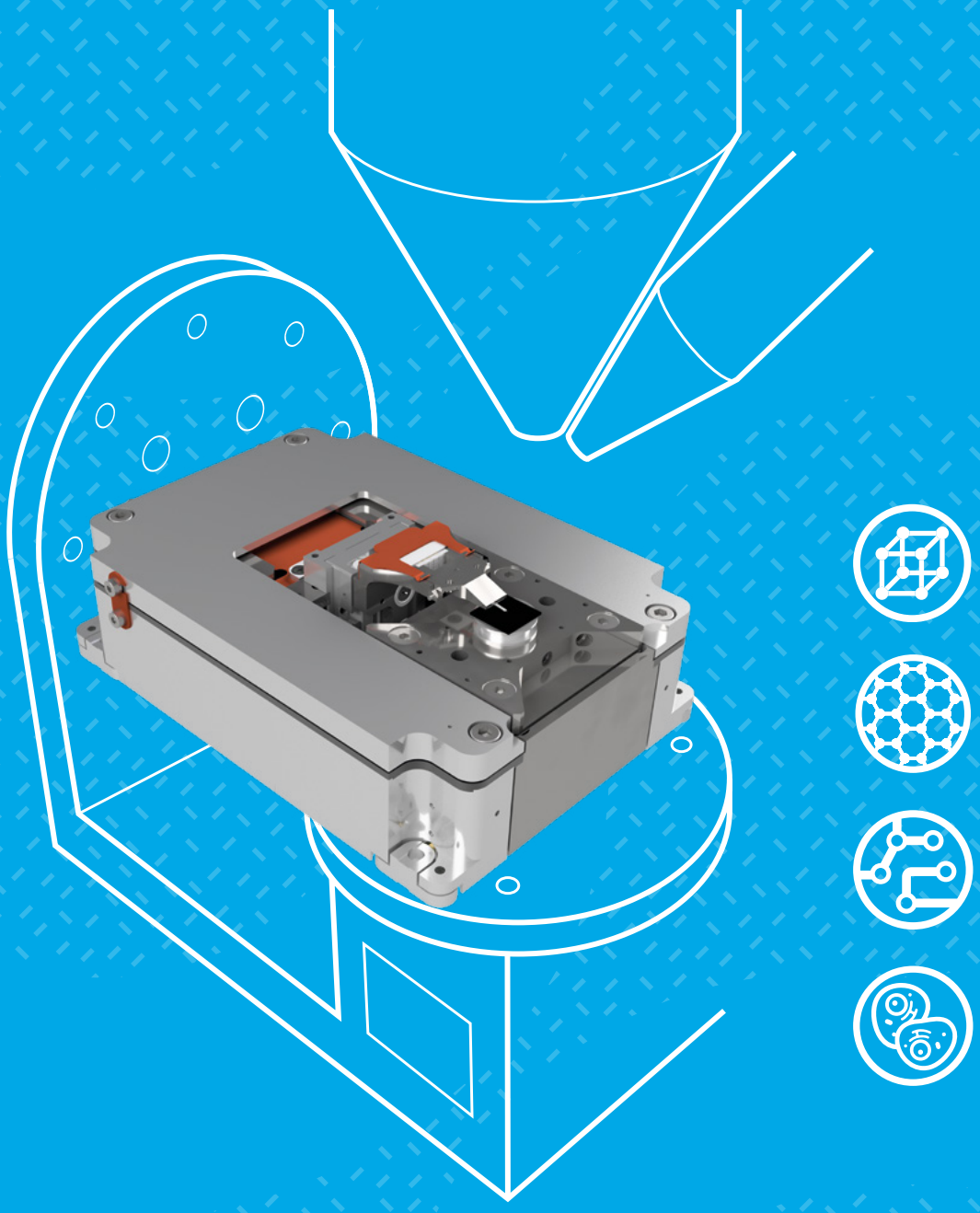
NenoVision

Next level of imaging



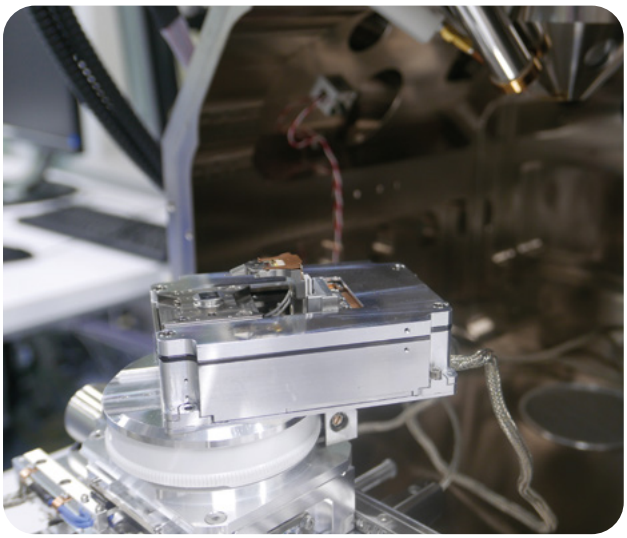
LiteScope

AFM-in-SEM for In-Situ Correlative Microscopy

LiteScope

We introduce the game-changing **Atomic Force Microscope (AFM)** for seamless integration into **Scanning Electron Microscope (SEM)**, which unlocks new possibilities for in-situ correlative microscopy.

- **In-situ multimodal & correlative analysis**
- **Optimized & time-efficient workflow**
- **Ultimate performance inside SEM**
- **Open-hardware design for easy customization**



Measurement modes

Mechanical properties

- Sub-nanometer topography
- Surface roughness
- Local elasticity
- Local hardness

Correlative analysis

- Correlative Probe and Electron Microscopy

Magnetic properties

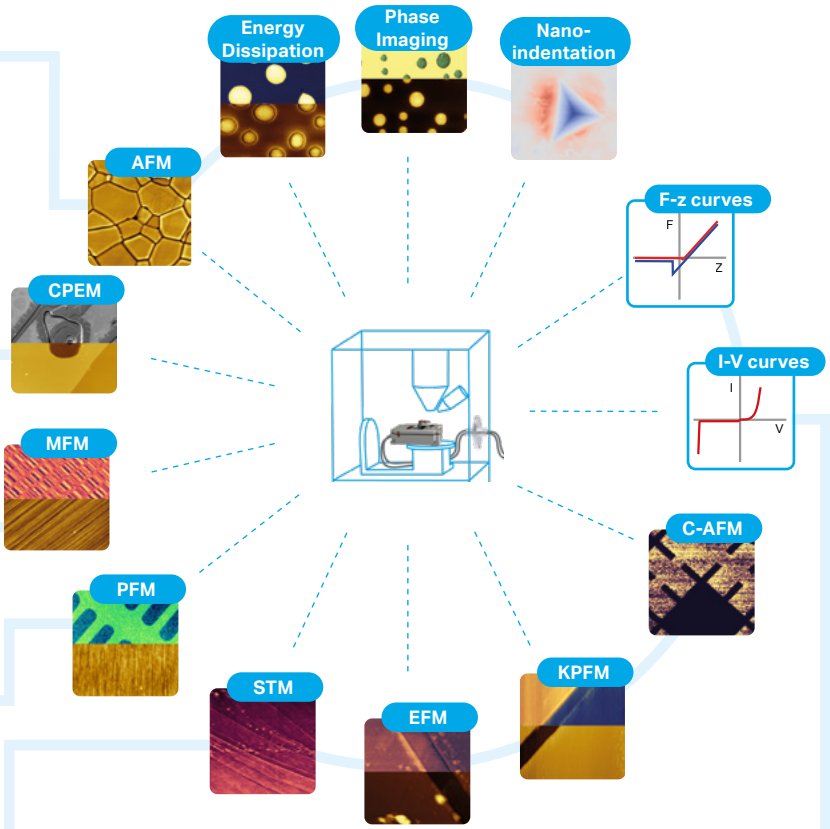
- Magnetic domain imaging

Electro-mechanical properties

- Piezoelectric domain imaging

Electrical properties

- Conductivity mapping
- Local surface potential mapping
- Local electrical properties



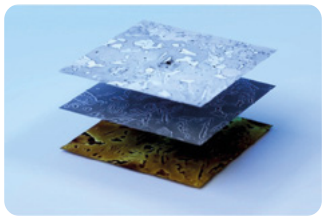
Spectroscopy

- I/V characteristics
- F/z characteristics

Why AFM-in-SEM?

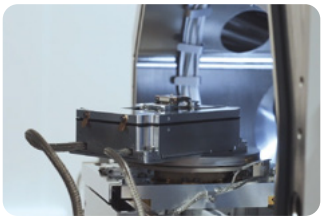
Scanning electron microscopy and **atomic force microscopy** are the two most used and **complementary techniques** for sample analysis in the sub-nanometer range. The integration of AFM into SEM **merges the strengths of both techniques**, resulting in extremely **time-efficient workflow** and enabling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

Key technology benefits



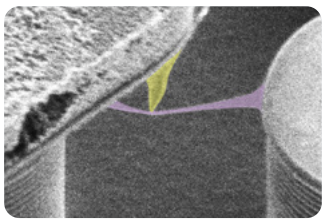
Correlative multimodal sample analysis

Cutting-edge CPEM technology allows **the simultaneous acquisition of AFM and SEM** data and **their seamless correlation**.



In-situ sample characterization

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



Precise localization of the region of interest

Extremely precise and time-saving approach **uses SEM to navigate the AFM tip** to the region of interest, enabling its fast & easy localization.

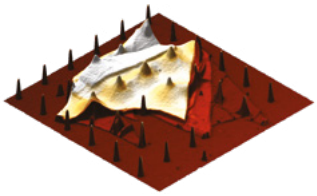
We merge the forces of AFM and SEM

AFM

- Precise 3D topography
- High resolution (to sub-nm)
- Mechanical properties
- Electrical properties
- Magnetic properties

3D topography

LiteScope



3D CPEM image

SEM

- Fast 2D imaging
- Viewfield range (mm–nm)
- Surface modification
- Elemental composition
- Crystal structures

2D image

Correlative Microscopy & CPEM+

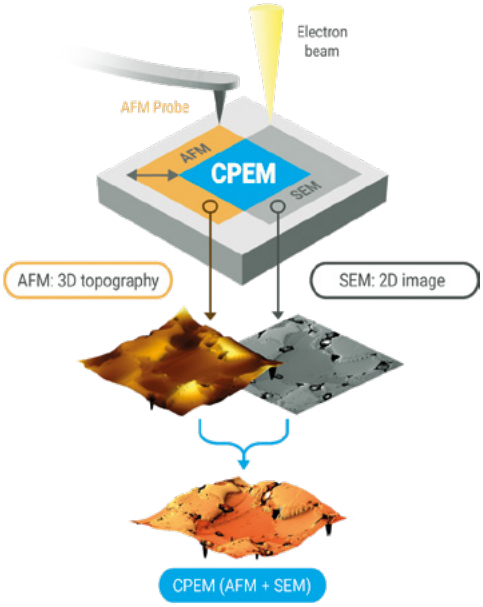
Correlative Probe and Electron Microscopy (CPEM) presents the revolutional technology for **in-situ correlative microscopy**. This hardware correlative technology enables **simultaneous acquisition of SEM and AFM data**, and their automated seamless correlation.

CPEM+ benefits

Simultaneous and correlated data acquisition
The multiple channels of AFM and SEM data are simultaneously acquired via NenoView software.

Unprecedented precision of image correlation
Direct hardware correlation technique of AFM and SEM ensures the unparalleled precision of correlation.

Ultimate and time-efficient workflow
Probe autotuning and AI-driven data processing & corrections arrange for a fast and smooth workflow compared to other correlative techniques.



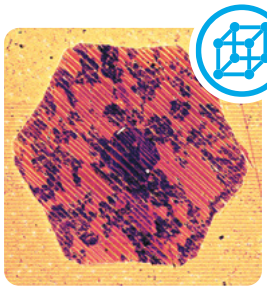
How does it work?

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 condition**s.

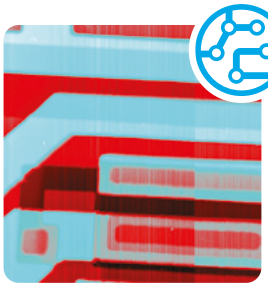
Application areas

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 industrial applications.



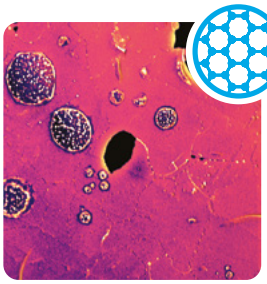
Material Science

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



Semiconductors

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



Nanostructures

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

Life Science

- Cell biology
- Marine biology
- Protein technology

Ultimate Performance in SEM

By utilizing a compact design and a state-of-the-art digital signal processing unit, we achieved an atomic resolution in the whole Z-axis range with a noise floor of up to 35pm inside the SEM.

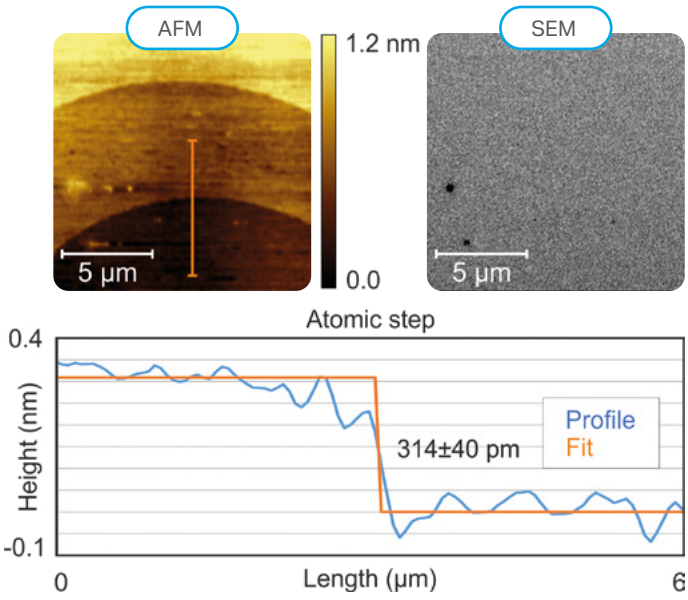
Reference sample

Sample: Si atomic terraces
Analysis: CPEM, simultaneously AFM and SEM

Measurement results

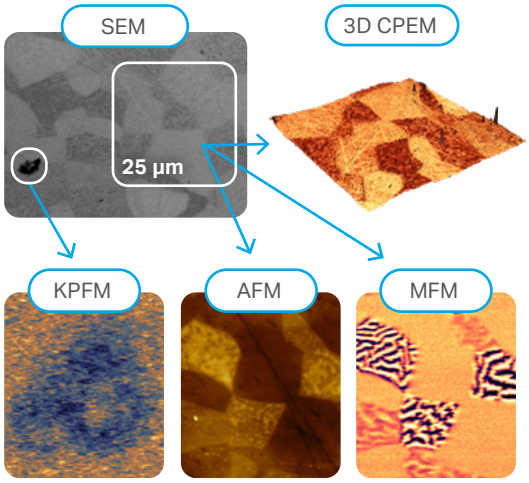
- Step height: 314 ± 40 pm
- RMS roughness of the terrace: 72 pm
- Noise floor up to 35 pm

CPEM measurement



LiteScope's unique applications

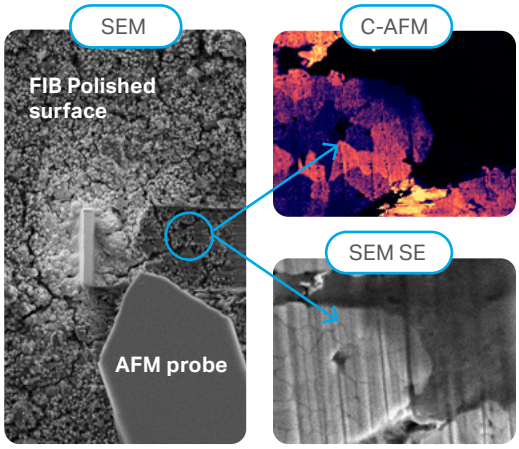
LiteScope's unique applications require the simultaneous use of SEM and AFM. This approach is essential or highly advantageous compared to using separate SEM and AFM instruments. It improves measurement feasibility and reduces overall costs.



Complex Analysis of steels and alloys

Complex analysis of duplex steel by AFM-in-SEM reveals surface topography (AFM), magnetic domain structure of ferrite grains (MFM), grain phase contrast (SEM), and impurities by surface potential (KPFM).

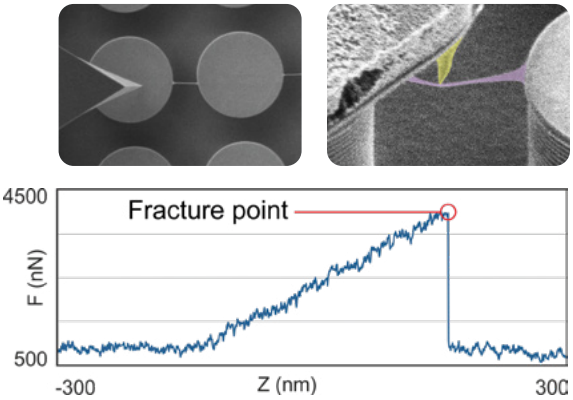
- Correlative multimodal analysis reveals complex properties
- Precise localization of ROI by SEM, comprehensive analysis by AFM



In-situ characterization of batteries

Air-sensitive cathode active material is analyzed In-situ by sample preparation (FIB, GIS) and characterization (SEM, AFM, C-AFM, CPEM) of the grain cross-sectioning directly inside the SEM chamber without any air exposure. Sample courtesy: Aleksandr Kondrakov, BELLA (DEU).

- Characterization of local conductivity (C-AFM) at the CAM cross-section
- In-situ preparation of sensitive CAM w/o air exposure



Advanced characterization of nanowires

Hanging spider silk nanowires were investigated for their unique mechanical properties by ultra-precise positioning of AFM tip on the hanging nanowires. Force-distance spectroscopy enabled the determination of both elastic and plastic deformation of nanowires. Sample Courtesy: Linnea Gustafsson, KTH (SWE).

- SEM: Precise targeting of AFM tip and life observation of nanowire deformation
- Analysis of properties as young modulus and tensile strength

NenoView software

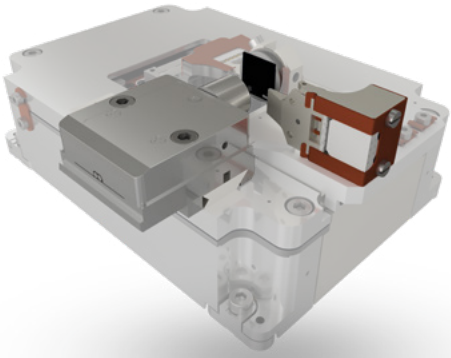
NenoView is user-friendly, web-based software, which **allows full control of measurements**, data acquisition, and data processing. Full support of CPEM+ technology **enables direct correlative microscopy** within our software.

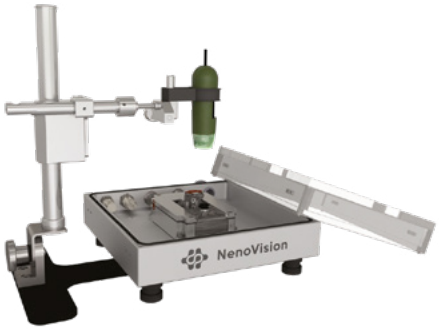
- Automatically **saves the setup and the data**
- Optimized workflow for individual measurements
- **Automated** probe tunning
- **AI-driven** image **correlations** and data processing.

Optional accessories

External nanoindentation module

Nanoindentation module 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.



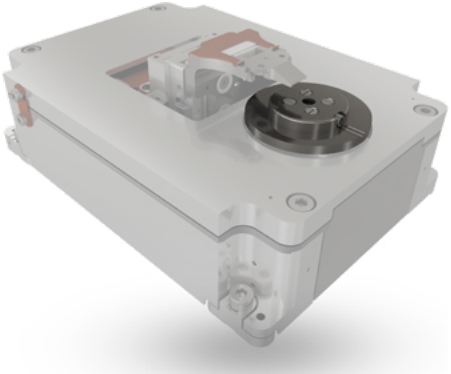


NenoCase and digital camera

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

Sample rotation module

The module is extremely **useful for FIB milling procedures followed by an AFM analysis**. It also allows simultaneous **mounting of several samples** into the SEM chamber and performing their AFM and SEM correlative measurements without opening the chamber.



NenoVision

Next level of imaging

LiteScope technical specification

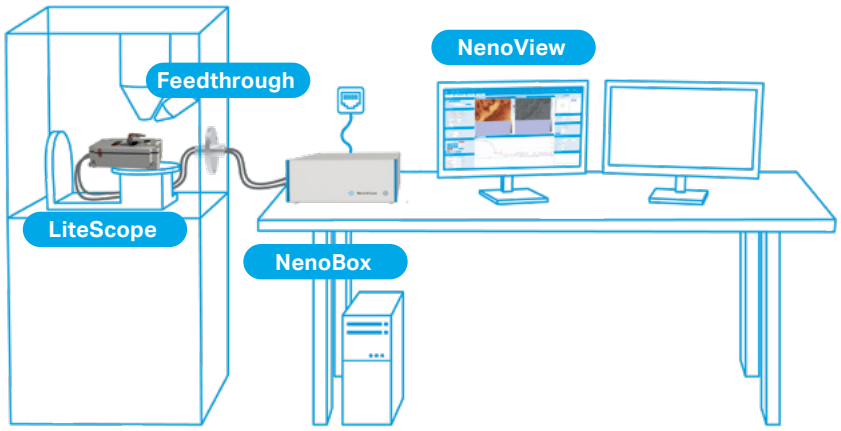
Dimensions XYZ	118 mm x 84 mm x 35.7-48.4 mm	**Scan range in open loop XYZ (±10%)**	100 µm x 100 µm x 20 µm
Total weight	460 g	**Scan range in closed loop XYZ**	80 µm x 80 µm x 16 µm
Vacuum working range	10^{5} Pa to 10^{-5} Pa	**Resolution XYZ up to**	0.2 nm x 0.2 nm x 0.04 nm
Operating temperature	+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

- **Mechanical:** AFM Topography, Energy dissipation, Phase imaging, Nanoindentation
- **Electrical:** C-AFM, KPFM, EFM, STM
- **Magnetic:** MFM
- **Electro-mechanical:** PFM
- **Spectroscopy:** F-z curves, I-V curves
- **Correlative:** CPEM

SEM compatibility

Thanks to its optimized design, AFM LiteScope is compatible with most SEM systems produced by Thermo Fisher Scientific, TESCAN, ZEISS, Hitachi, Jeol, and their accessories.



What do you get?

LiteScope package

- LiteScope – scan head
- NenoBox – control unit
- NenoView – control software
- Feedthroughs
- SEM adaptor
- Cabling
- Installation & Training
- Probes

2023/03

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.

Contact us!

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NenoVision