NenoVision

Litescope™

Scanning Probe Microscope designed for integration into the Scanning Electron Microscopes offering unique Correlative Probe and Electron Microscopy technique.

LiteScope™

LiteScope™ is a unique Scanning Probe Microscope (SPM). It is designed for easy integration into various Scanning Electron Microscopes (SEM). The combination of the complementary SPM and SEM techniques enables it to utilize the advantages of both. Complex sample analysis, including the characterization of surface topography, mechanical properties, electrical properties, chemical composition, magnetic properties and others, can be easily performed using LiteScope™ and its range of replaceable probes.

The design of LiteScope™ also enables it to be combined with other SEM accessories such as a Focused Ion Beam (FIB) or Gas Injection System (GIS) for the fabrication of nano / microstructures and surface modifications. In this combination, LiteScope™ offers quick and easy 3D inspection of the fabricated structures.

Furthermore, LiteScope™ opens up a completely new field of novel measurement techniques which enables correlative microscopy, so-called Correlative Probe and Electron Microscopy (CPEM). The CPEM technology is the first of its kind on the market. It enables both SPM and SEM measurements to be taken in the same place, at the same time, and using the same coordination system. Only CPEM technology brings you the full advantages of the correlative imaging of the SPM and SEM techniques.

Highlights

- **LiteScope™ improves the performance of the SEM**
- **Available as a plug-in for existing microscopes or as a new SEM**
- **Unique Correlative Probe and Electron Microscopy (CPEM) technology**
- **Complex surface characterization – topography, roughness, magnetic properties, conductivity, electrical properties**
- **Self-sensing probes without optical detection, no laser adjustments**
- LiteScope™ is easy to mount to / remove from the sample stage of the SEM
- Compatible with FIB, GIS, EDX and other accessories
- Operates in tilted positions (angle 0°–60°), WD min. 5 mm
- Retractable measuring head frees up space around the sample
- Commercially available probes, wide range of measuring modes
- Quick and easy replacement of probes and samples
- User friendly software, operation in web browser, easy remote access
- LiteScope™ also works as a stand-alone SPM

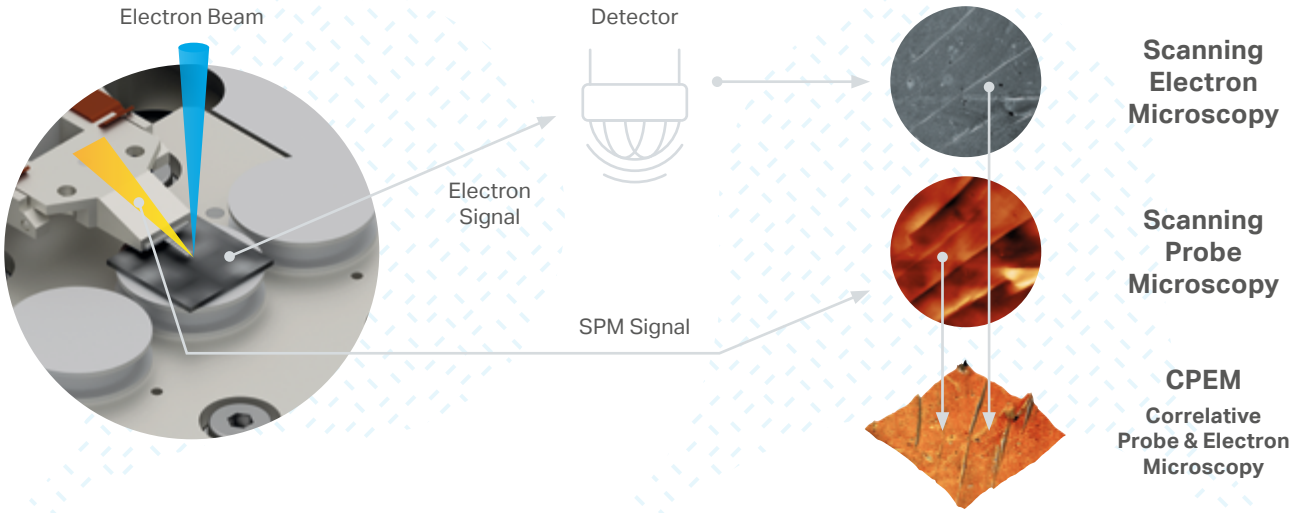
Something More...

Correlative Probe and Electron Microscopy – CPEM

LiteScope™ is a powerful enhancement to how existing SEM instruments work. However, there is more to it than that.

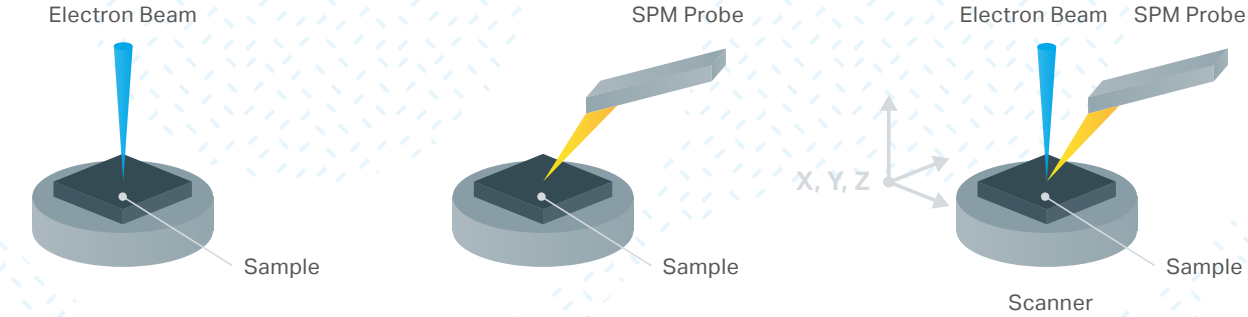
Correlative microscopy brings together the benefits of imaging the same object using two different techniques. The correlation of the data from the separate images provides more detailed information about the sample, which would otherwise be too complicated to analyse.

NenoVision has developed unique technology – Correlative Probe and Electron Microscopy (patent pending) – for application in correlative imaging. CPEM enables the determination of the surface characterization of a sample area by both SEM and SPM simultaneously and using the same coordination system.



CPEM technology enables correlative imaging of the standard SEM and SPM methods in a manner that has not been available until now.
CPEM synchronizes the scanned area, resolution and image distortion and correlates the acquired SPM and SEM images in real time.

Simultaneous scanning with known constant offset and identical resolution ensures that the analysis is performed on the same surface.
The resulting image can be directly viewed on-line using our NenoView software.



Scanning Electron Microscopy

Scanning Probe Microscopy

CPEM
Correlative Probe & Electron Microscopy

Technical Specifications

LiteScope™ is a fully operational SPM, which enables its users to acquire detailed characteristics of a sample on the nanoscale. It can be used as a stand-alone microscope or in combination with an electron beam, which is its biggest advantage. LiteScope™ is usually operated in a high vacuum, but may, on request, be adapted for use in ultra-high vacuums. LiteScope™ is attached to the sample stage of the SEM / FIB microscope, thereby making it possible to manipulate it according to user preference. LiteScope™ is able to measure in tilted positions, for example for simultaneous usage with the FIB technique. In such cases, the user will appreciate the docking option, whereby the whole SPM probe can be retracted and hidden in the body of LiteScope™.

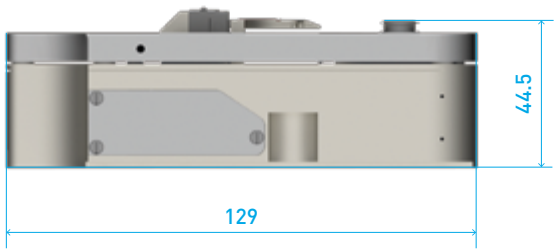
The mechanical design respects all essential construction requirements in terms of rigidity and appropriate resonance frequency. The result is a highly stable framework with very low levels of mechanical vibration, which produces extremely reliable results.

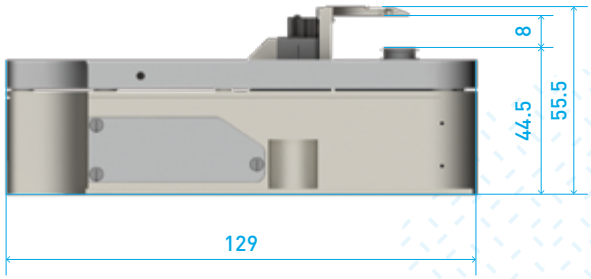
Design highlights

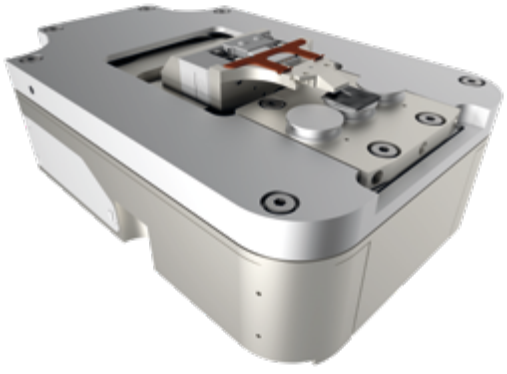
- Low profile and small size enables integration within SEM / FIB instruments
- Easy integration procedure – mounting on the SEM / FIB manipulator
- Universal probe holder suitable for several SPM methods and easy "Plug & Play" assembly
- Sample tilt up to 60°
- Optimized mechanical design with very low vibration levels (rigidity and appropriate resonance frequency), integrated preamplifier (to eliminate the signal distortion / noise as much as possible)

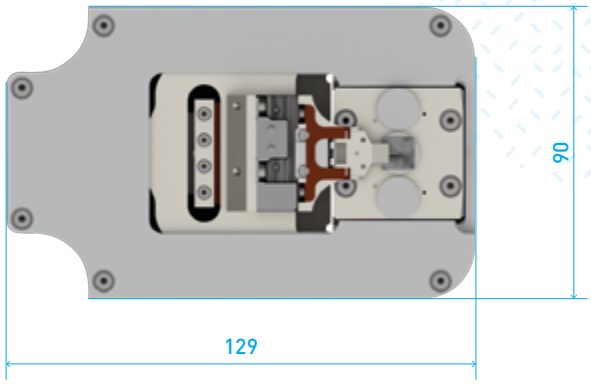
LiteScope™ Data

Total weight	650 g
Vacuum working range	10^{5} Pa to 10^{-5} Pa
Scan range X, Y, Z	100 µm × 100 µm × 100 µm
Maximum sample size	22 mm × 11 mm
Maximum sample height	8 mm
Resolution	up to 0.2 nm









All dimensions are in millimeters (mm).

Control Unit

All the electronics that drive LiteScope™ are integrated in one control unit.
This unit is a standard 19" rack mount which can easily be placed into a free slot of the SEM electronics or positioned freely according to your actual needs.

Features

- Maximum PLL frequency 75 kHz for dynamic measurements suitable for tuning fork based probes (on request – higher frequency, use of external PLL)
- 2×16 bit DAC per scan axis (scan range, offset) to achieve maximum resolution for the entire view field
- 5×16 bit auxiliary inputs for simultaneous measurement of user signals (±10 V)
- Option to use input channels in feedback-loop mixer
- Probe signal output / monitor
- External probe excitation
- All the necessary connections for using external Lock-in / PLL
- Ethernet connection to LAN / PC
- 110 VAC or 230 VAC operation, 200 W

NenoView Software

NenoView software is user friendly and gives you full control of the measurement set-up, data acquisition and data processing. NenoView automatically saves the measurement setup with the data; this feature is very helpful for later analyses.

Features

- Web based user interface
- Easy for new users, flexible for experts
- User accounts management
  - Personal user accounts
  - Individually configurable accounts – layout, parameters, complexity …
- Remote access to the user data, download of data from control PC to the local computer
- Remote experiment control via e. g. tablet, smartphone
- Integrated data post processing, analysis, export …

Imaging Modes and Probes

LiteScope™ provides and supports a wide range of SPM imaging modes and available probes. The most important technical design feature is the universal probe holder, which makes it very easy to install different probes on a "Plug & Play" basis.

The list of the methods and relevant probes supported by LiteScope™

	Akiyama Probe	Tuning Fork Based Probes	PRS / A*	Pt / Ir Wire
STM (Scanning Tunneling Microscopy)		●		●
AFM – Contact Mode			●	
AFM – Tapping Mode	●	●	●	
AFM – Conductive		●		
MFM (Magnetic Force Microscopy)		●		
KPFM (Kelvin Probe Force Microscopy)		●		
EFM (Electrostatic Force Microscopy)		●		
FMM (Force Modulation Mode)			●	
Local voltage measurement		●		●
Local current measurement		●		●

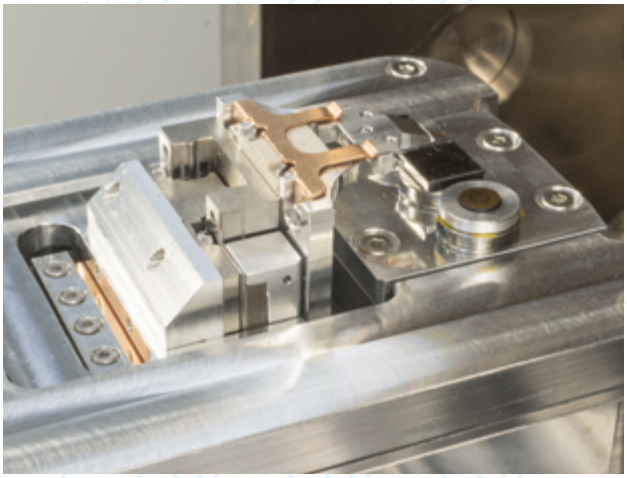
* **P**iezo-**R**esistive **S**ensing / **A**ctive (**PRSA)** probes

All the identified probes are commercially available. Custom made probes can be utilized with an appropriate probe holder, which can be designed on request.

SEM Integration

LiteScope™ is specifically designed to be integrated into SEM microscopes on a "Plug & Play" basis. LiteScope™ is simply attached to the sample stage of the electron microscope by four screws. The electrical cables are plugged into the prepared vacuum feedthrough.

LiteScope™ can be mounted or removed in less than 5 minutes. LiteScope™ can be easily integrated into the electron microscopes of different manufactures. We provide the appropriate adapters and feedthroughs, which can also be adjusted according to customer needs.



Application

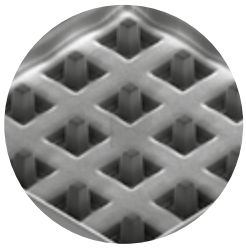
LiteScope™ has many applications ranging from basic academic research to failure analysis in industry. The main applications are related to analysis, in particular where conventional SEM does not provide sufficient information and additional 3D imaging is required using a SPM. The availability of other or complementary imaging modes broadens the application field even more.

The unique CPEM technology, with its correlative imaging, can be applied to highly demanding fields where imaging using conventional SEM may provide misleading information due to surface contamination related to the chemical contrast which interferes with the surface topography. CPEM is the ideal solution for the accurate analysis and interpretation of images in real time.

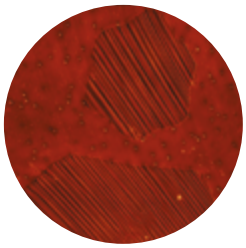
Basic research in the field of **material science and nanotechnology** requires detailed and full analysis of surfaces and nanostructures using different analytical methods. This is based on the need to fully understand the principles of the nanoscale range. LiteScope™ is the ideal tool for these scientific applications.

The immediate advantage is evident for technologies like FIB and GIS where the structures are formed directly in the SEM. The 3D analysis tool for the newly created structures is essential.

Furthermore, LiteScope™, equipped with CPEM and other imaging modes, enables the complex analysis of prepared structures and nano-devices.

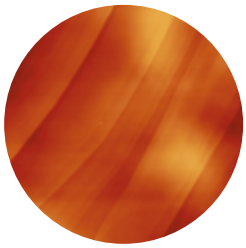


SEM image
Automated FIB preparation of pillars with well-defined shapes for applications such as atom probe or micro mechanical testing.
Source: FEI Company

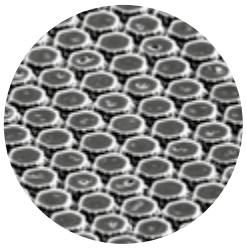


SPM image
Graphene single crystal grown on copper foil.
Source: NenoVision

SEM image
Logic Device – 65 nm technology.
Source: FEI Company



SPM image
Atomic steps on HOPG measured by dynamic AFM using Akiyama probe.
Source: NenoVision



SEM image
Hexagonal pattern etched in silicon during optical exposure of the photoresist.
Source: FEI Company

In **industrial quality control and R&D laboratories**, LiteScope™ helps to identify surface structures, topography, surface roughness, contamination, etc. These abilities are highly prized by industrial customers who need to verify the quality of a surface and therefore save on losses due to failure.

LiteScope™ can be applied to a broad range of industries, including those in the fields of **semiconductors, solar cells, memory devices, MEMS and NEMS**. These fields require nanoscale analysis more than any others. Nowadays, the requirements for complex analysis of nano-circuits and nano-devices are increasing. LiteScope™ fulfils those demands by extending the 3D imaging and multi-characterization of samples in real time.

2019/05

NenoVision was established in 2015 as a spin-off of the Central European Institute of Technology / Brno University of Technology in the Czech Republic. The company is located in Brno, which is a university city with a long and proud tradition in developing scientific instruments. Brno is also referred to as the "Mecca of electron microscopy" because of its historical involvement in the development and production of electron microscopes.

The company founders have more than 10 years' experience in developing Scanning Probe Microscopes designed for a wide range of applications and various environments. NenoVision continues to build on that tradition and expertise by bringing innovative Correlative Probe and Electron Microscopy technology to the market.

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NenoVision

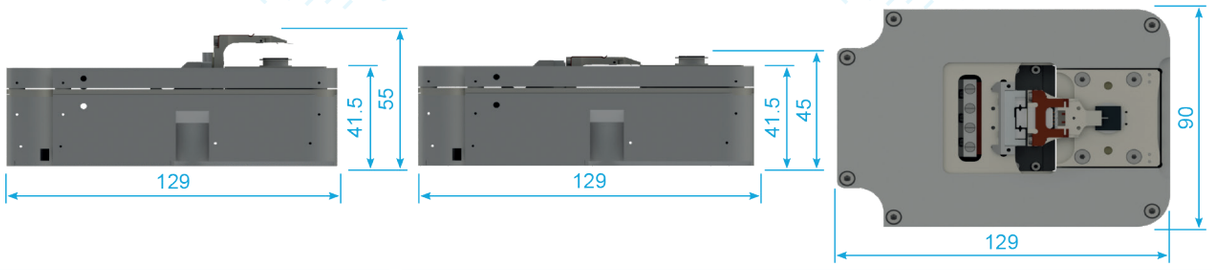
LiteScope™
Technical Specification

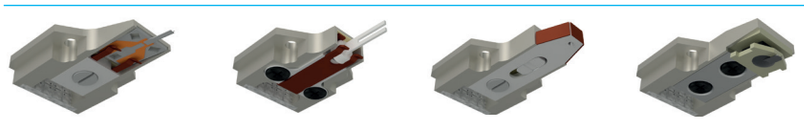
Environmental

Operating temperature	+15 °C to +25 °C
Operating pressure	10^{-5} Pa to 10^{5} Pa
Dry environment only	

Mechanical

Overall dimensions	129 mm × 90 mm × 45 – 55 mm



Weight	650 g
Maximal scanned sample area	22 mm × 11 mm × 8 mm
Coarse approach	True orthogonal positioning
	Calibrated, pre-stressed linear ball bearings
	Self-locking
	Minimum incremental motion 50 nm
	Speed >2 mm/s
	X travel range 24 mm, Y travel range 12 mm
	Z travel range 12 mm (Open Loop), 10 mm (Closed Loop)
Scanning unit	Based on multi-layer, low-voltage piezoelectric transducer
	Solid state flexure guide system
	Open Loop / Closed Loop
	XYZ-axis movement 100 µm (Open Loop), 80 µm (Closed Loop)
	Resolution 0.2 nm (Open Loop), 2 nm (Closed Loop)
Fast and easy probe exchange	Universal acceptor for different probes
	Four standard probe holders
	
Sample holder for standard SEM stubs (Ø12.7 mm with Ø3.2 mm and 4,6 mm long pin)	Two additional positions for SEM/FIB imaging/machining (not to be measured by AFM)

Operation and control system

Modes of operation	AFM – contact, AFM – tapping, C-AFM – on request
	EFM – on request, STM – on request, MFM – on request
Probes	Akiyama probe, Tuning-fork based probes, Piezoresistive probes, NenoProbes, etc.
Maximal frequency of PLL for dynamic measurements 75 kHz (Higher PLL frequency on request)	
2× 16 bit DAC per scan axis (scan range, offset) to reach maximal resolution everywhere within the view field	
User selectable piezo amplifier gain scan range (vs. resolution)	100 µm (< 2 nm)
	50 µm (< 1 nm)
	10 µm (< 0.2 nm)
	5 µm (< 0.2 nm)
5× 16 bit auxiliary inputs for simultaneous measurements of user signals (±10 V)	
Input channels could be used in feedback-loop	
Probe signal output / monitor	
External probe excitation	
All necessary connections for using external PLL	
Ethernet connection to the control PC	
110 VAC / 230 VAC operation, 200 W	

Software

Web based user interface	
Easy for new users, flexible for experts	
User accounts	Every user has an account
	Accounts individually configurable – layout, parameters, complexity,…
Remote access to the user data, download of data from control PC to the local workstation	
Remote experiment control via eg. tablet, smartphone	
Integrated data post-processing, analysis, export, etc.	

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