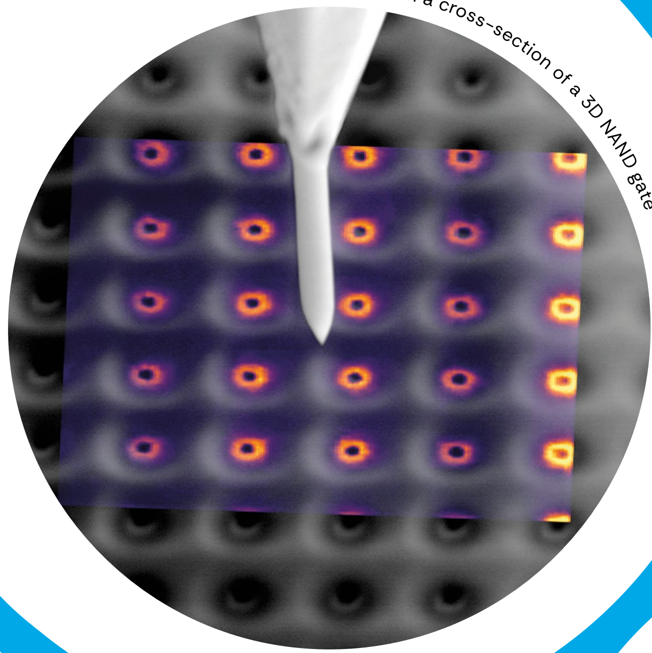
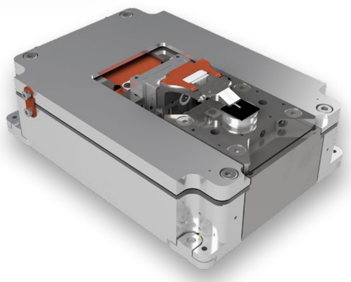
NenoVision



Semiconductor Failure Analysis using AFM-in-SEM LiteScope™

application note



Key added values

- Site-Specific Electrical Characterization of specific vias & interconnections.
- Merging sample preparation and analyses together by AFM-in-FIB/SEM.
- Reducing time and cost per analysis and speeding up the failure diagnostics.

Application areas

- NAND flash memory
- SRAM & logic circuits
- Transistors (FinFET, CMOS, ...)
- Thin films

NenoVision

Semiconductor Failure Analysis using AFM-in-SEM LiteScope

Semiconductors are the foundation of modern electronics, enabling everything from computing to data storage. As device dimensions shrink and become more complex, precise failure analysis is critical.

Failure Analysis with AFM-in-SEM LiteScope integrated directly into the **FIB/SEM environment**, enables in-situ, site-specific electrical and topographical characterization of semiconductor components at the nanoscale level. It delivers precise **conductivity mapping** and **dopant profiling** without compromising sample integrity.

Key benefits and features

+ **Site-specific failure analysis: Providing high-resolution conductivity & dopant mapping while using SEM for precise localization.**

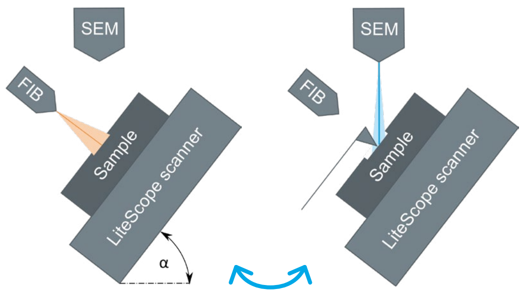
+ **Seamless in-vacuum workflow: Fully compatible with existing FA tools and workflows, preventing surface oxidation and contamination.**

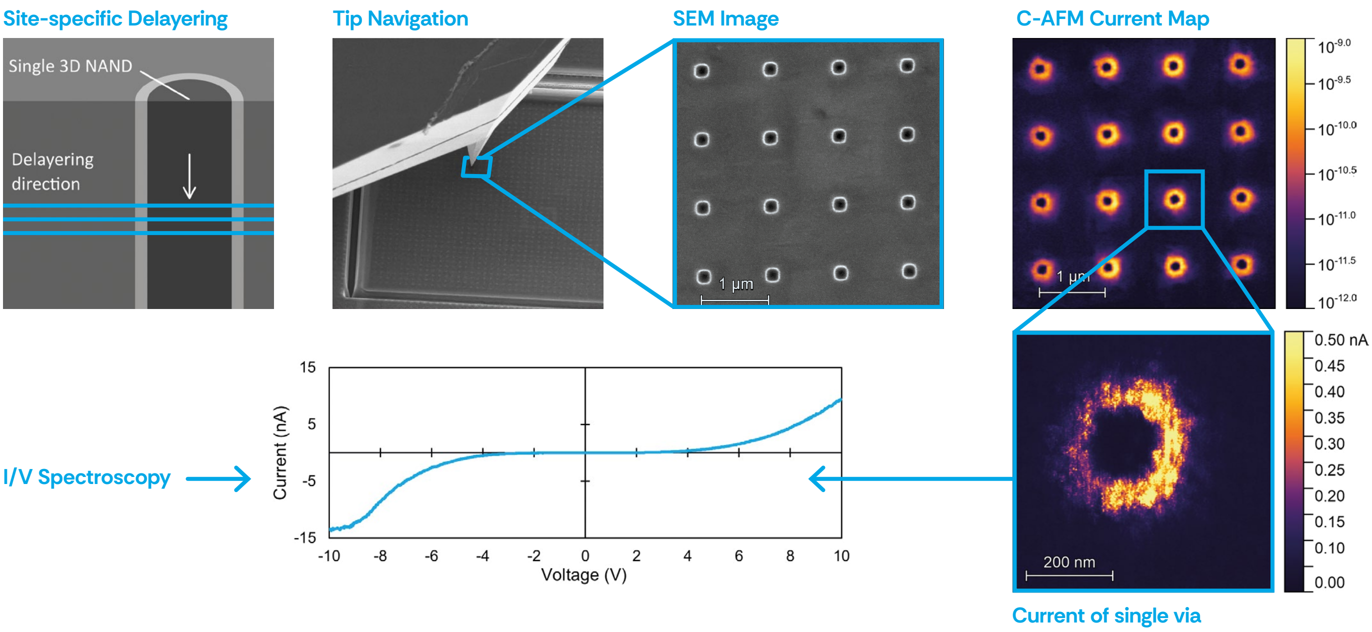
+ **Probe protection & optimized access: Docking station preserves AFM tip during FIB milling, while sample rotation optimizes angle for accessing even complex geometries.**

+ **Time-Saving & Cost Efficient: Integrated solution reduces measurement time per sample and accelerates R&D.**

In-situ electrical failure analysis of NAND structures

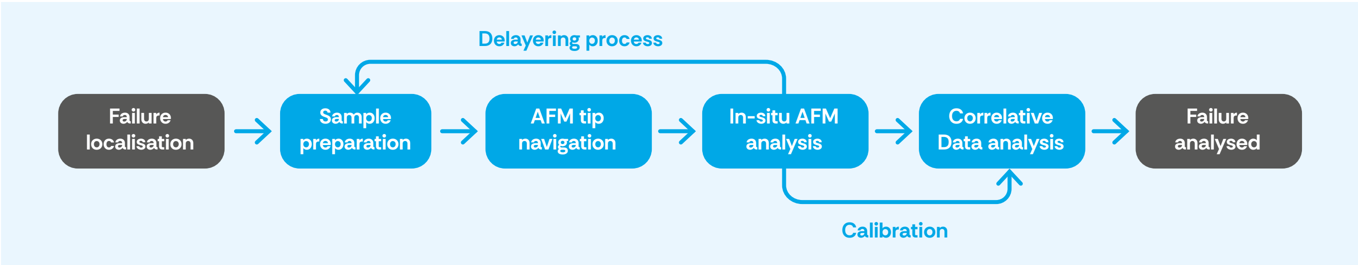
Using AFM-in-FIB/SEM, specific vias in a NAND structure were identified, **sequentially delayered** using the **PFIB**, and **electrically analyzed** via Conductive AFM mapping **(C-AFM)** and **I/V Spectroscopy**. This approach provides real-time monitoring of the delayering process, ensuring accurate via targeting and revealing **electrical failures of the nodes at different depths**.





Failure analysis workflow with AFM-in-FIB/SEM

Failure analysis with AFM-in-FIB/SEM begins with site-specific sample preparation using FIB to expose to the defect area. The AFM tip is then navigated to the region of interest for high-resolution electrical characterization, such as C-AFM or SSRM. Results are correlated (calibrated if needed) with SEM techniques for a comprehensive failure understanding.



Delayering Process: The in-situ approach enables sequential PFIB delayering, followed by localized conductivity analysis at each step, allowing precise access to individual layers at different depths.

Calibration: For quantitative dopant profiling, calibration starts with reference resistance measurements on a sample with known dopant concentrations. The measured resistance is then correlated with dopant levels to generate a calibration curve for accurate dopant quantification.

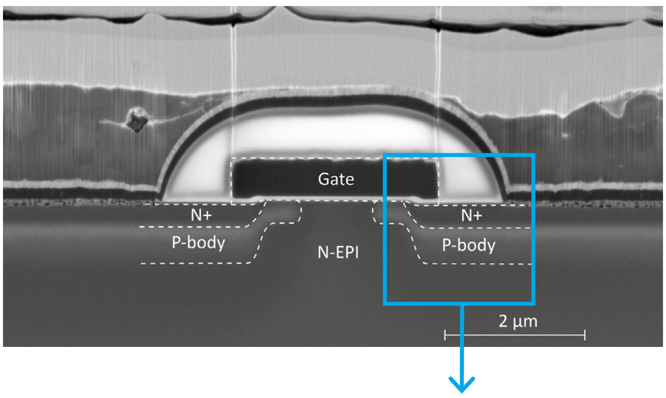
Site-Specific Dopant Concentration Analysis of MOSFET Transistor

We analyzed **dopant concentration** in semiconductor devices using **Scanning Spreading Resistance Microscopy (SSRM)** combined with SEM for high-resolution, site-specific electrical characterization.

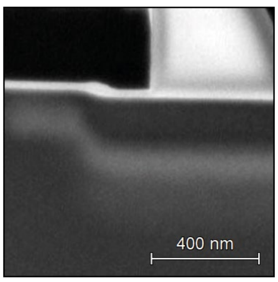
In-situ SEM-SSRM measurements provide an efficient workflow for dopant concentration mapping with nanoscale precision. By correlating SEM imaging with local electrical properties, we can identify **variations in doping levels** critical for **device performance and reliability**.

For **SiC MOSFET transistors**, this approach enables **direct characterization of doped layers and junctions** analysing precise shape, size, and depth of the structures, which has a crucial impact on its functionality and performance, ensuring **proper conductivity and minimizing losses**.

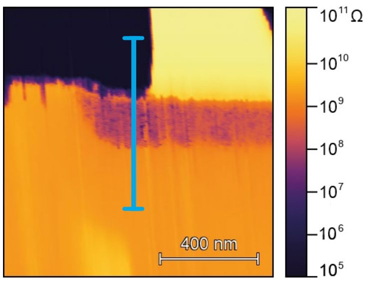
SEM overview



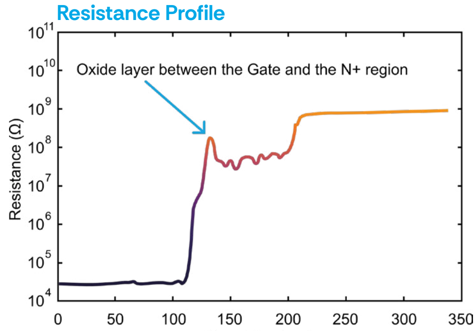
SEM Image



In-Situ dopant profiling



Resistance Profile



NenoVision

LiteScope solution for Semiconductor Failure Analysis

Our groundbreaking **AFM-in-SEM solution** enables in-situ, site-specific, high-resolution electrical property mapping of complex semiconductor devices, while allowing faster and more accurate failure localization at the interconnect level. This approach helps identify failure mechanisms more effectively, which can lead to enhanced device performance, greater reliability, and increased manufacturing yield.

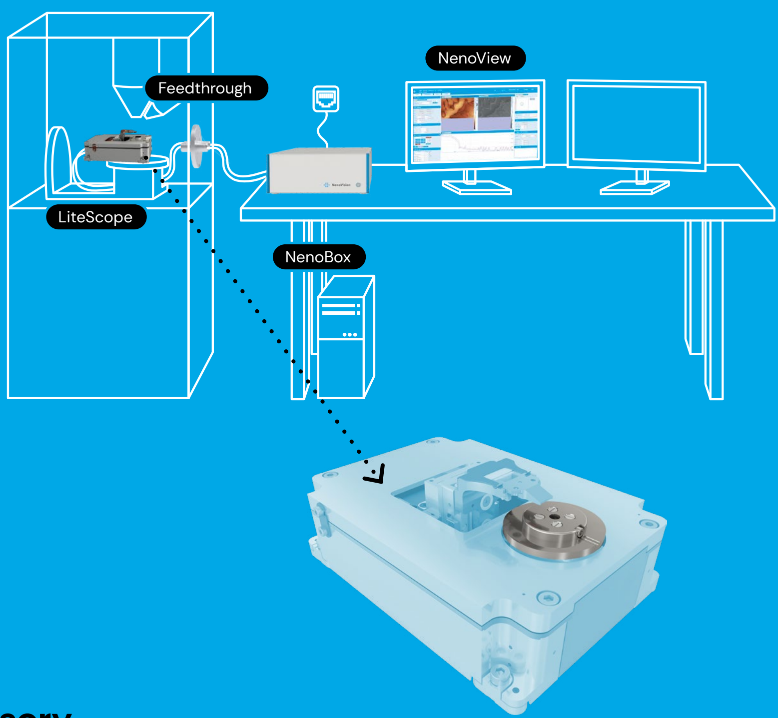
- ✓ **Innovative in-situ correlative failure analysis approach**
- ✓ **Time to result significantly reduced**
- ✓ **Site-specific vias or transistors**

LiteScope Setup →

NenoVision combines tradition and expertise with unique solutions in nanoscale using AFM-in-SEM microscopy.

Failure Analysis techniques from SEM (EBIC, EBAC, ...) and AFM (C-AFM, SSRM, ...) enhance defect detection and accelerate the failure diagnostics.

Setup is compatible with SEM systems produced by Thermo Fisher Scientific, TESCAN, ZEISS, Hitachi, Jeol, and their accessories.



Sample Rotation Module Accessory

Sample Rotation Module Enables precise rotation of the sample within the SEM chamber for optimal positioning between SEM/FIB applications and electrical AFM analysis.

More accessories, including the Sample Transfer Module and Load-Lock Mechanism are available on our website.

Ready to optimize your semiconductor failure analysis?

Let's discuss your own application!

NenoVision s.r.o.
Purkyňova 649 / 127
612 00 Brno, Czech Republic
info@nenovision.com
NenoVision