IMINA TECHNOLOGIES

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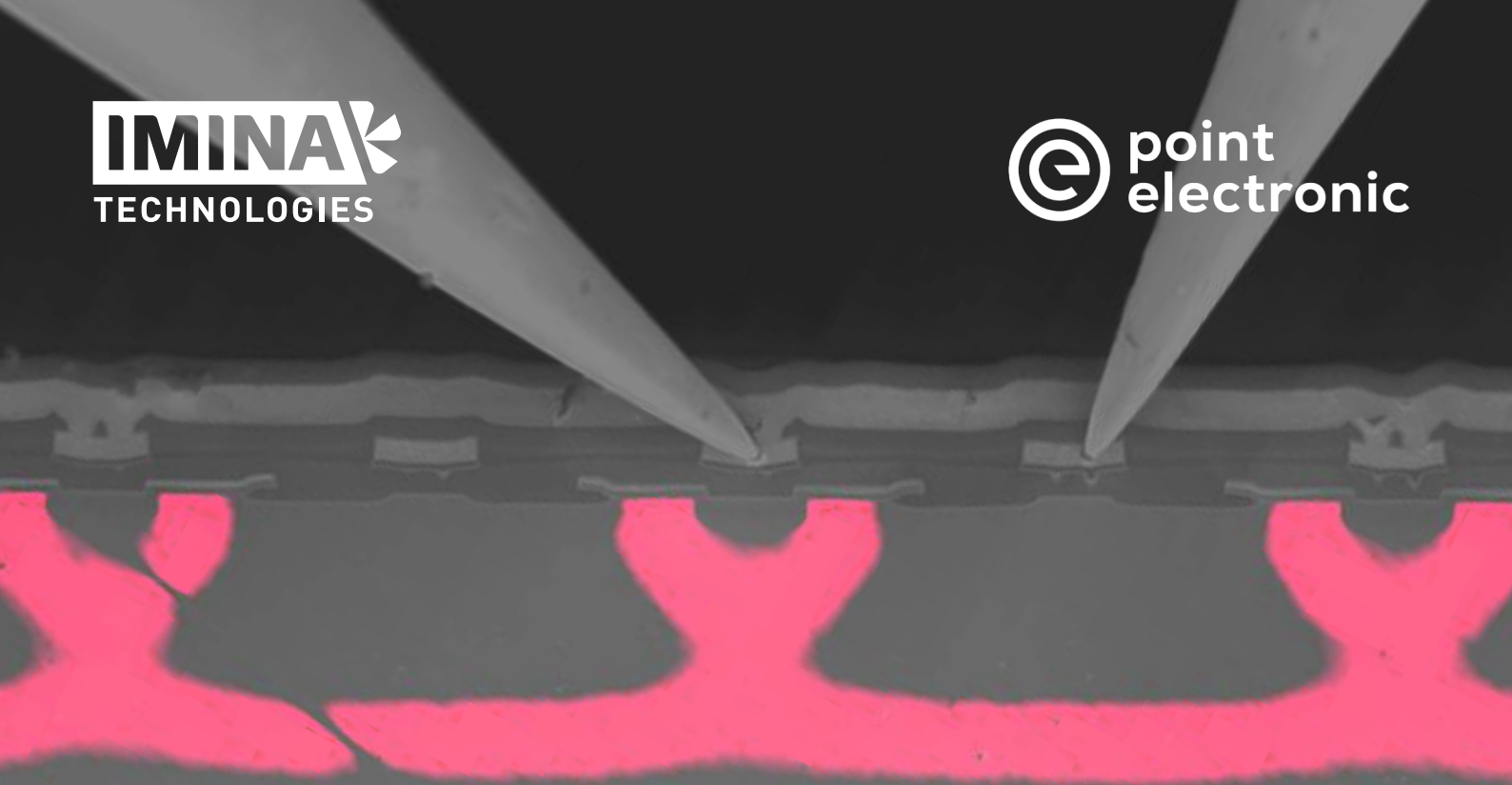


SEM nanoprobing and electrical failure analysis

Setting new standards in localizing and understanding device failures

User-friendly, streamlined workflow

— Intuitive step-by-step operator assistance and a short learning curve
— Unified software to control the entire workflow from setup to reporting

Efficient, robust and safe probing

— Fully encoded sample stage for quick navigation around the sample and semi-automated measurements
— NANO+ technology for faster and safer landing due to extended range of vertical scanning piezo motion

Ready for advanced technology nodes

— Highly stable nanoprobers for reliable electrical contact during measurements
— Flexible positioning with sub-nm precision over cm motion range

Designed to provide your facility with unique advantages

›› **Live multi-channel imaging and color coding for intuitive visualization of the signal from each probe**
›› **In-situ pre-amplifiers increase signal-to-noise ratio and help detecting low-impedance defects**
›› **Quantitative measurements enable image comparison and subtracting signals to uncover hidden contrast (image math)**
›› **Automated routing of contacts to GND, SMU or EFA hardware for highest flexibility and ease of use**
›› **Sample biasing and current compensation**

Advanced workflow to accelerate your nanoprobing and electrical failure analysis

What we offer

An advanced Electrical Failure Analysis (EFA) system fully integrated into a nanoprobing solution, suitable for any Scanning Electron Microscope (SEM), Focused Ion Beam (FIB) and Dual Beam microscopes.

Built for advanced nanoprobing and EFA

Visualize and analyze electrical properties and failures across the broad range of devices, components, and materials, including the most advanced technology nodes that demand low-kV and short working distance or immersion mode operation.

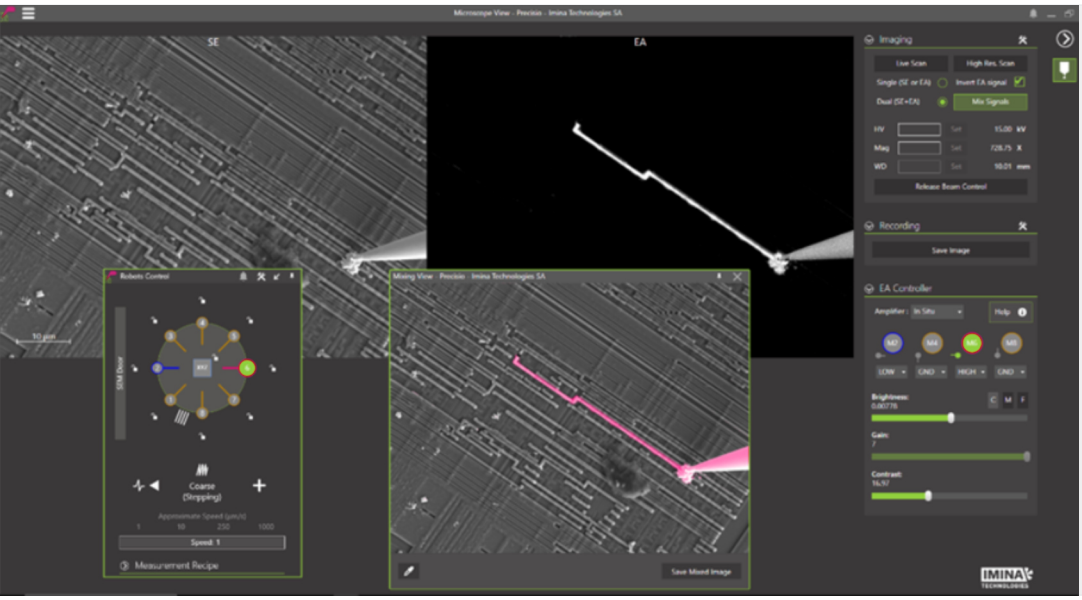
Workflow that saves your time

The entire workflow is fully integrated and streamlined. Precisio™ software integrates SEM imaging and SMU control, probe cleaning, measurement setup and recipes, built-in reporting and image processing. The package also includes MicroDIPS software for advanced image post-processing.

Easy to learn, ready to use

We minimized the learning curve so you can quickly and effectively incorporate nanoprobing and EFA in your workflow.

You also get comprehensive documentation as well as post-installation training and online coaching tailored to your tasks.



Precisio™

Unified user-friendly software suite to control the entire nanoprobing workflow and to streamline failure analysis, from setup to reporting.

Versatile tool for many tasks

- Electrical characterization
- Root cause analysis
- Precise location for lamella extraction
- Localization of shorts, opens or defects in dielectric
- Hardware security, reverse engineering

Flexible use across various samples

- Semiconductor integrated circuits
- Packaged devices, cross-sections
- Individual semiconductor components (p-n junctions, transistors, capacitors)
- Battery materials
- Nanowires, solar cells, etc.

What you measure

Electrical characterization

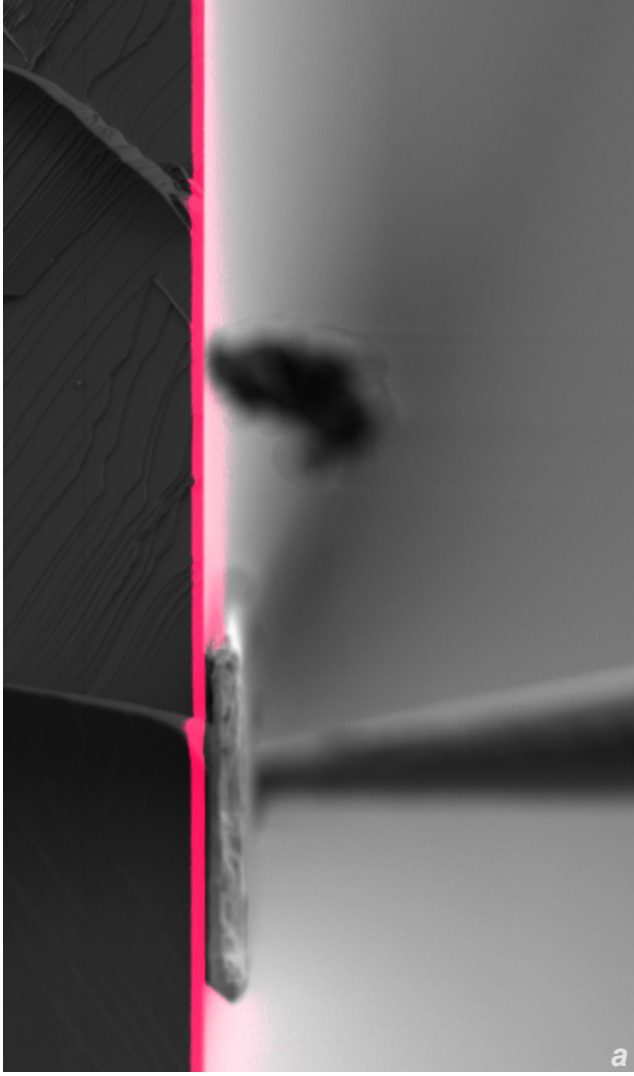
— IV measurements
— Leakage current
— Conductance / Resistance
— Capacitance / CV measurements

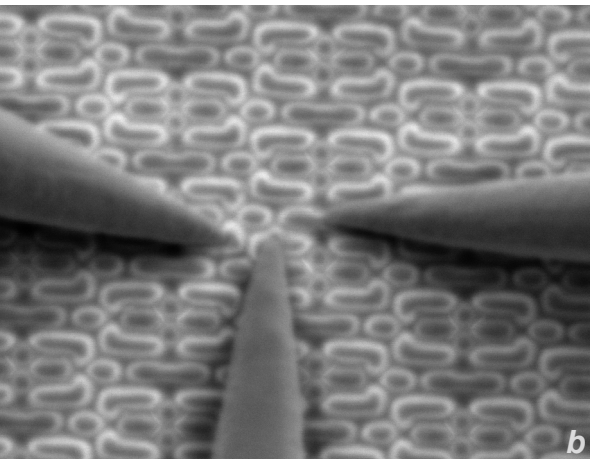
Electron beam collection techniques

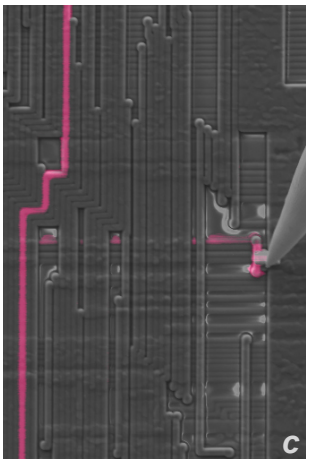
— Electron Beam Induced Current (EBIC)
— Electron Beam Absorbed Current (EBAC) and Resistive Contrast Imaging (RCI)
— Electron Beam Induced Resistance Change (EBIRCh)

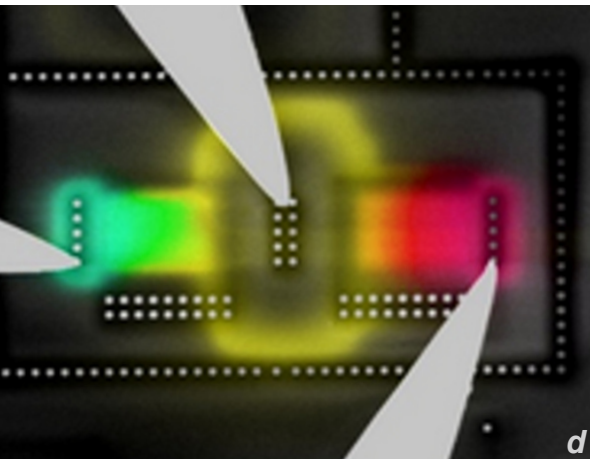
Enabling technologies

— Multi-channel acquisition for probe-specific signal color-coding and advanced post-processing
— Quantitative current measurements and image math
— Low-current, low-impedance defect detection
— Lock-in techniques
— Correlation with sample topography if you have a Back-Scattered Electron (BSE) detector









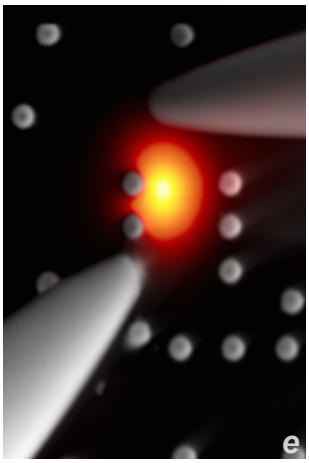


Figure a
Quantitative EBIC on a GaAs solar cell cross-section used to measure the diffusion length of minority charge carriers and depletion region width.

Figure b
Nanoprobing: probes in contact with gate, source and drain of the 5 nm technology node NMOS device to collect IV curves.

Figure c
Standard one-probe EBAC highlights a network on a chip.

Figure d
Multichannel EBIC reveals internal fields in a double transistor with a common source, each color corresponding to the signal collected with each probe.

Figure e
Live color mixing of secondary electrons and Lock-In EBIRCH signal to intuitively localize a low-resistance defect with a high signal-to-noise ratio.

More details about these measurements and other examples available on our website.
www.imina.ch/applications

System specifications

Our turnkey solution is compatible with most SEMs, FIBs, and Dual Beams. The ø125 mm stage accommodates up to eight nanoprobers and features shielded electrical connections that ensure a high signal-to-noise ratio. An active sample holder allows for sample biasing, and a fully encoded substage enables independent XYZ movement with nanometer precision for easier sample navigation and semi-automated measurements.

The nanoprobers feature NANO+ technology which enables an exceptional fine/scanning vertical motion range of ~15 µm at the probe tip for faster, safer, and more controlled probe landing.

Four direct nanoprobing channels and four switchable EFA channels with additional high-sensitivity in-situ signal pre-amplification, industry-leading imaging and electrical analysis controllers, as well as the EFA edition of Precisio™ software complete the setup.

Precisio™ software suite streamlines and unifies the experiment workflow with its intuitive user interface, pre-set options and automatic signal routing for straightforward switching between nanoprobing and EFA techniques (EBIC, EBAC/RCI, EBIRCh). Precisio™ enables live mixing of secondary electron images with EFA signals and includes measurement library for immediate results comparison, as well as reporting capabilities.

Nanoprobers

Positioning resolution
- Stepping/coarse: 60 nm (X, Y), 120 nm (Z)
- Scanning/fine: 0.02 nm (X, Y), 0.1 nm (Z)

Motion range
- Stepping/coarse: 20 mm (X, Y), ± 180° (R), 41° (Z)
- Scanning/fine: 250 x 440 nm (X, Y), 15 µm (Z probe tip)

XYZ Sample substage

Position resolution
- Stepping/coarse: <100 nm (X, Y)
- Scanning/fine: <0.01 nm (X, Y), 300 µm (Z)

Motion range
- Stepping/coarse: 5 mm (X, Y)
- Scanning/fine: 300 nm (X, Y), 300 µm (Z)
- Sensor resolution: 20 nm (X, Y), 10 nm (Z)

Electrical probing (4x direct channels)

Voltage range ± 100 V
(High voltage option available upon request)
Max. current 100 mA
Leakage current <100 fA/V
Resistance ca. 3.5 Ω from probe tip to flange connectors

EFA controller

Ex-situ pre-amplifier
- 10^3 to 10^{10} V/A variable gain
- 0.5 MHz bandwidth at 10^9 V/A

Internal sources
- -10 to 10 V, 16-bit bias voltage
- -10 to 10 µA, 16-bit compensation current

EFA imaging - Signal processing

1x Ex-situ pre-amplified, switchable among the 8 probes by software
- Gain 1 to 3'600
- Input offset -0.5 to 0.5 V
- 1 µs minimum dwell

4x In-situ pre-amplified
- Gain 1 to 1'800
- Input offset -1 to 1 V
- 200 ns minimum dwell time

4x Detector signals
- 10 ns minimum dwell time

Site requirements

Equipment and facilities requirements may vary depending of the system and its options.
Contact us for a complete evaluation of the requirements.

You can also request comprehensive nanoprobing and EFA services performed on the latest version of our setup by our experts at Imina Technologies head quarters in Switzerland. Contact us to learn more or request a quotation.

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