

Nova Elipson[®]

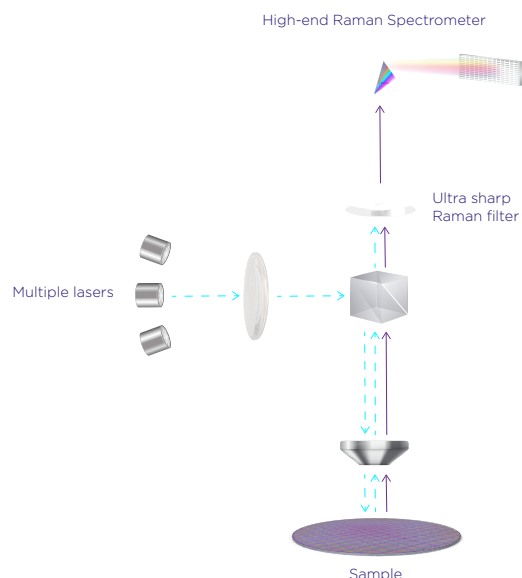
Advanced Raman Spectroscopy Capabilities in the Fab

Fully Automated Inline Raman Platform

Nova Elipson[®] is a high-end, standalone metrology system that measures material properties for the Memory and Logic market segments. The system leverages Raman Spectroscopy to analyze material properties such as composition, strain, crystallinity, and surface.

Advantages of Raman Spectroscopy

- **Non-Destructive** Leverages a fast, optical technique suitable for materials metrology
- **Small Spot Size** Combined with high speed for in-die analysis of 3D structures
- **A Single Platform** to characterize strain, crystallinity, phase, and composition



Highlights & Benefits

HVM Proven 300mm fully automated, recipe-driven solution, seamlessly integrated with the fab's YMS to continuously stream quantitative data for APC

Multiple Wavelength Source Enables adjustment of probing depth via selection of light source with adequate penetration, to optimize data acquisition

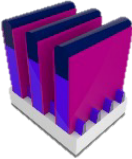
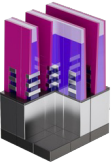
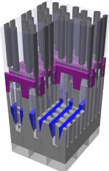
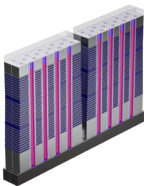
Full Advanced Polarization Control of the Raman spectrum, is used to selectively extract the signal of interest and filter unwanted data

Advanced Algorithmic Suite

User-friendly proprietary algorithmic suite to extract rich material characterization insights

Why Nova Elipson®?

Materials are one of today's key performance enhancement drivers for advanced nodes. New materials and alloys are constantly being introduced into the semiconductor industry. This complexity propels a need for extensive information flow to accurately characterize material properties. Nova Elipson® Raman Spectroscopy is a sophisticated in-line solution extracting real-time insights that had been previously available only in a laboratory environment

Device	Applications	Elipson® advantage
Planar / FinFET 	EPI metrology: Strain, %Ge, Doping Level, Defectivity	Measures On-Pattern & In-Die
	Channel Strain and Mobility Prediction	Early step detection Time-to-results
Gate All Around 	Nanosheet Strain and Mobility Prediction	Measures On-Pattern & In-Die
	SiGe Remaining Detection	Sensitivity Direct measurement
DRAM 	ACL Phase Detection Hardness prediction	Measures Pattern or Blanket
	Contact Poly-Si Crystallinity	Early fault detection Non-destructive
Flash 	ACL Phase detection Hardness Predictio	Measures Pattern or Blanket
	Channel-Hole Poly-Si Crystallinity Level and Grain Size	Non-destructive Time-2-Results

Nova Metrion®

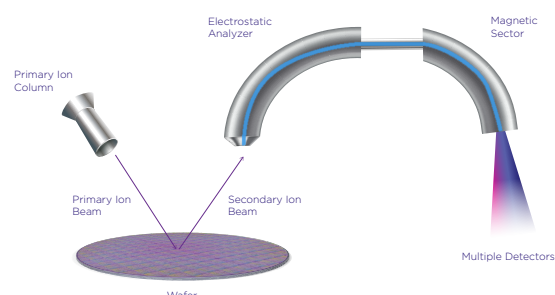
The first in-line SIMS for statistical process control (SPC) of compositional profiles



Meet Nova Metrion®

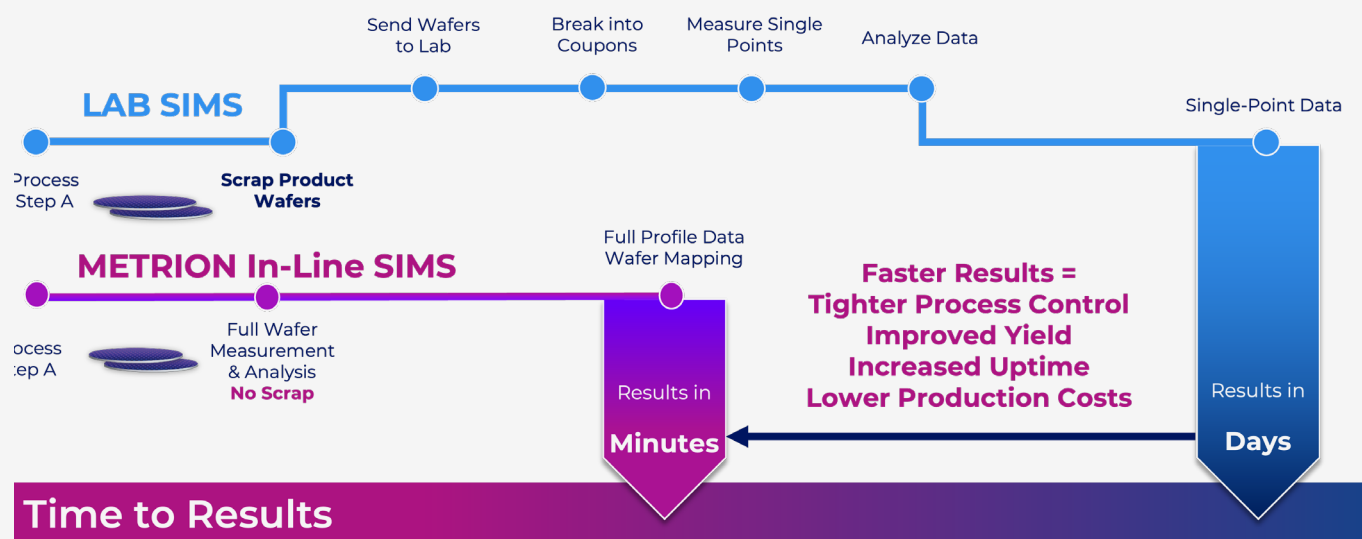
Metrion is a fully-automated SIMS platform validated for in-line production process control. Nova Metrion® takes repetitive measurements out of the lab and into the fab where time-sensitive information is critical for SPC.

- SIMS technology enabling quantitative compositional profiling tailored for the fab
- Fully-automated, recipe-driven, 300mm HVM-ready
- Designed for process control of complex film stacks for logic and memory
- Fast, reliable, and repeatable SIMS data
- Validated on various high-value use cases for logic and memory



Advantages of SIMS (Secondary Ion Mass Spectrometry)

- Built-in Film Analysis
- Contamination Free
- Whole Wafer Measurements
- Full Wafer Uniformity Maps
- Reduced Scrap and Enhanced Yield

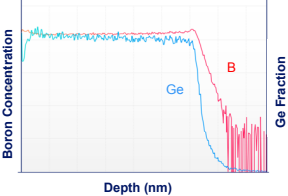
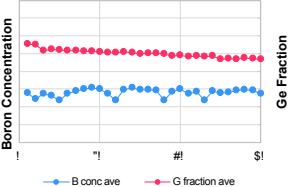
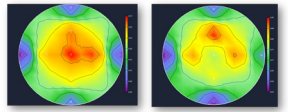
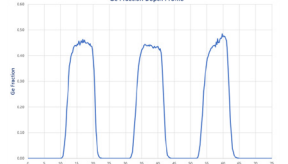
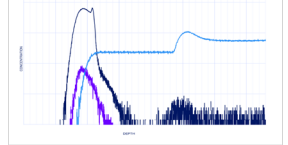
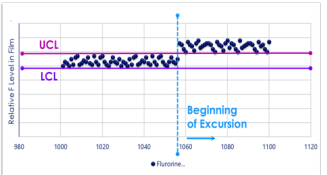


Why Nova Metrion®?

An innovative SIMS platform designed from the ground up, Nova Metrion® is the only **fab SIMS tool tailored for in-line**, enabling seamless integration within automated factory workflows. The system is engineered to deliver high-precision metrology results for process control of complex film stacks for both logic and memory devices.

Measuring the precise concentration of chemical species as a function of depth, Nova Metrion® generates compositional profiles that can be used to monitor and control various important properties, including dopant concentration, implant uniformity, and contamination levels.

Nova Metrion® Application Space

Dopant Concentration	<p>Small variations in dopant concentration impact device performance</p>	<p>In-line SIMS is critical for Epi performance:</p> <ul style="list-style-type: none"> • Epi chamber matching in the fab • Tighter process control • Increased uptime 	<p>Dopant Concentration Profile in SiGe</p>  <p>Automated Epitaxy SPC</p> 
Deposition Uniformity	<p>Variations in Nanosheet SiGe growth affect etch selectivity and impact device performance</p>	<p>In-line SIMS monitors Ge concentration to ensure uniform deposition on each individual nanosheet and across the wafer</p>	<p>In-Line Germanium Deposition Uniformity Across Wafer</p>  <p>SiGe Growth Uniformity Monitoring</p> 
Contamination Detection	<p>Chemical residues and contaminants like Cl and F in the metal lines kill devices</p>	<p>In-line SIMS quickly determines the presence, the concentration, and the location of contaminants in the entire film stack</p>	<p>Cl & F Concentration Depth Profile</p>  

Nova VeraFlex® IV

The Next Generation of Faster,
High-Precision In-Line XPS and XRF
Materials Metrology



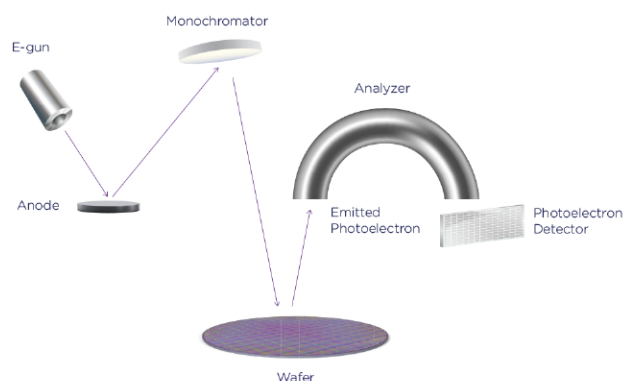
Meet Nova VeraFlex® IV

The Nova VeraFlex® has revolutionized inline materials metrology and is the industry standard for simultaneous XPS and XRF materials characterization.

- Substantial throughput improvement while maintaining precision performance
- Higher signal-to-noise performance revealing novel SPC process control capabilities
- Enhanced beam control compatible with next-generation pad requirements
- Recipe transfer and tool matching compatibility with legacy VeraFlex® models
- Supported by Nova Fit® Machine learning solutions to maximize system productivity

The Advantages of X-RAY Photoelectron Spectroscopy (XPS)

- Surface sensitive technique directly measuring thickness and composition without spectral reference models
- Ultra-thin film sensitivity to element and bonding state composition correlating to electrical device performance
- Combined XPS and XRF measurements deliver precise thickness and composition results for complex multilayer film stacks
- Simultaneous thickness and composition measurements without sensitivity to underlying film composition

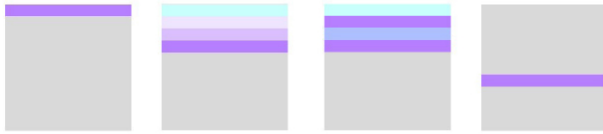


Why VeraFlex® IV

With next generation device performance requirements driving new integration challenges, VeraFlex® XPS is ideal for inline process control requiring advanced measurements for VNAND, DRAM, & Logic.

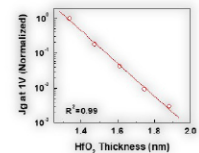
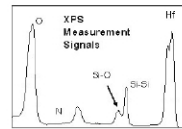
Direct Measurement

Precise Thickness and Composition Metrology



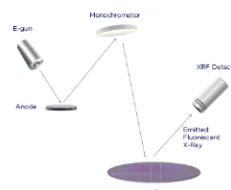
In-Line Control

Early correlation tracking to E-Test Performance



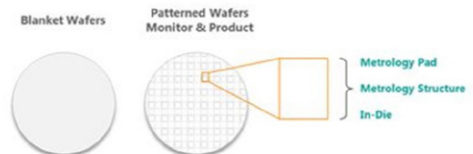
Simultaneous XPS and XRF

Simultaneously leverage both techniques at the same location



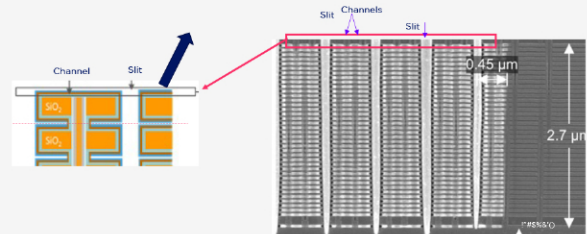
Precision where you need it

The Industries most precise In-line XPS



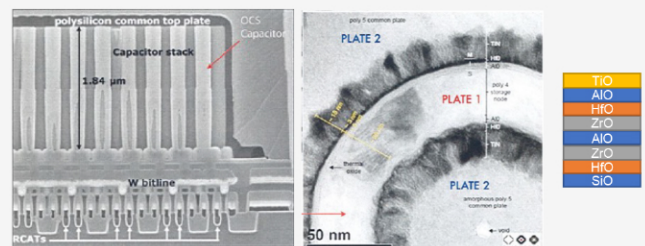
VNAND Use Case: In-die measurements

Sensitive to thin films and unaffected by the complexity of underlying stacks, XPS is ideal for in-die metrology of the memory cells.



DRAM Use Case: Complex High-K multi-stack thickness control

XPS is the only technology that can enable direct measurement of complex High-K dielectric structures.



Nanosheet Use Case: Thickness and Composition Control

Tool to tool matching and thin film sensitivity enable high-volume SPC control of ultra-thin High K Metal Gate structures.

