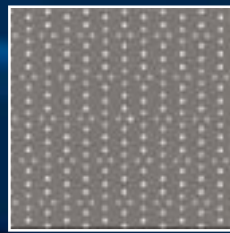
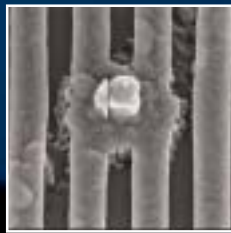




**Defect Analyzer Series**  
Advanced 200 mm and 300 mm DualBeam™  
Systems for In-fab Structural Diagnostics



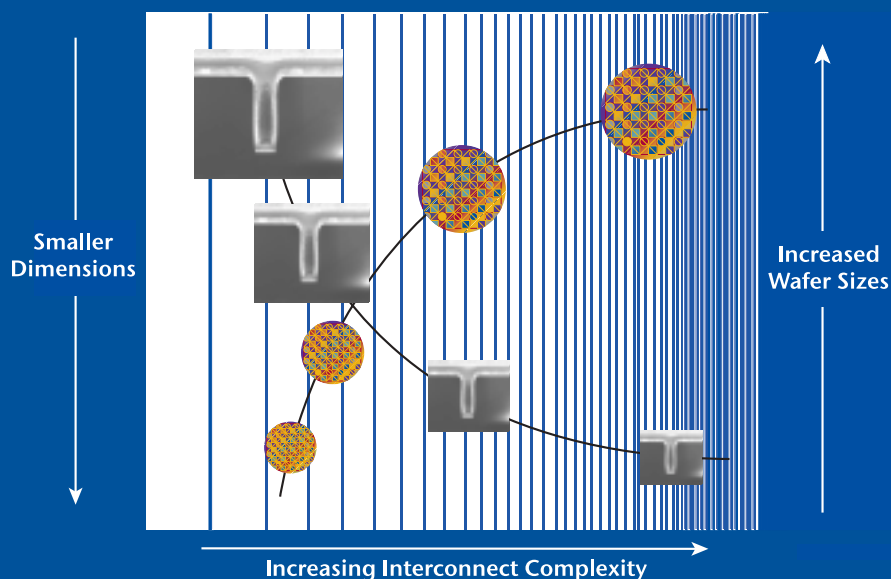
*Automated 3D analysis for faster yields and increased profit*



**Defect Analyzer Series: In-fab 3D structural analysis of advanced process defects. Automated, rapid analysis. Enhanced yields. Increased productivity.**

*FEI's DualBeam tools have become the preferred solution for semiconductor manufacturers needing to maintain yields while facing new challenges:*

- Increased wafer sizes
- Increasing device complexity
- Smaller dimensions
- More metal layers
- Increasing aspect ratios
- New materials



# The 3D solution for rapid, in-fab diagnostics

The Defect Analyzer Series provides process engineers with timely, accurate answers for determining the root cause of costly yield excursions. The result: better control over advanced processes, for enhanced yields, reduced time-to-market, and drastically reduced process development costs.

The ability to locate and visualize defects of all types — systematic, process margin, or particulate — and determine the root cause of a yield or process problem has exceeded the capabilities of optically-based tools and conventional scanning electron microscopes (SEMs). With more than eighty percent of today's defects occurring below the surface, 3D solutions as provided by the Defect Analyzer Series are vital to both finding and revealing hidden data.

The Defect Analyzer Series systems use a powerful combination of tool automation, SEM, focused ion beam milling, and beam gas chemistry technology, coupled with the most advanced 200 mm and 300 mm stages available, to help manage processes crossing the 0.18  $\mu\text{m}$  design nodes.

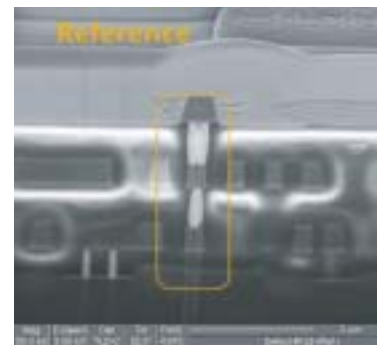
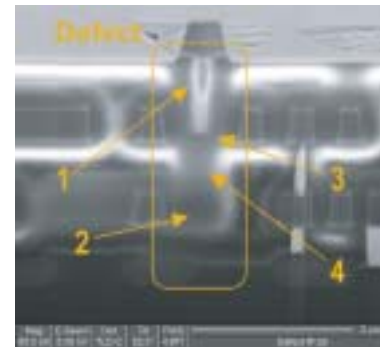
They are engineered to operate in the most demanding fab environments. These powerful DualBeam systems are based on the same fully integrated FIB/SEM technology that has made FEI the leading supplier of 3D analytical and metrology solutions for advanced semiconductor manufacturers.

## A competitive edge, through higher yields and reduced costs

Whether your fab is introducing new processes or in volume production mode, the Defect Analyzer Series can significantly improve your fab's performance by capturing high acuity images that facilitate rapid root cause analysis. In short, FEI's Defect Analyzer Series will:

- Speed time to data
- Enhance yields
- Increase productivity
- Save you money

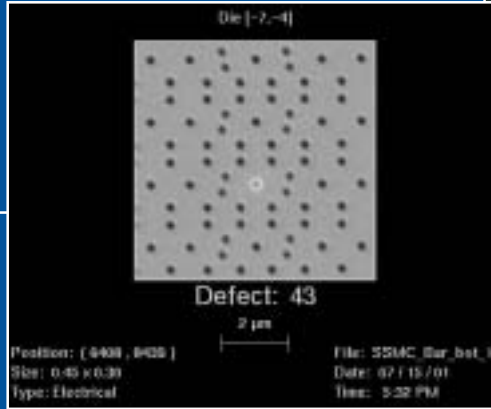
It is easy to understand why manufacturers are choosing 3D solutions for their fabs. Look at the facts. Consider the options. Get a competitive edge. The Defect Analyzer Series.



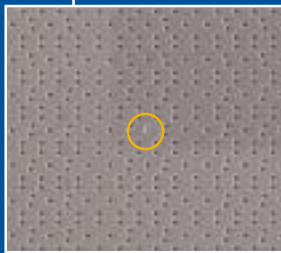
The DualBeam cross-sectional image of the defect reveals multiple problems including: (1) poor etch/fill, (2) missing metal 1, (3) missing metal 2, and (4) missing a metal via.

# Defect analysis using DualBeam Auto Slice and View

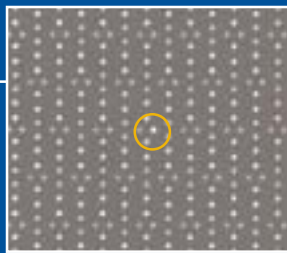
The defect is located using voltage contrast on the KLA eS20 system.



KLA eS20

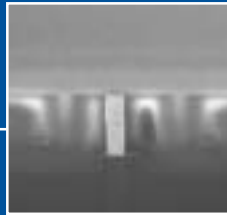


Electron beam image



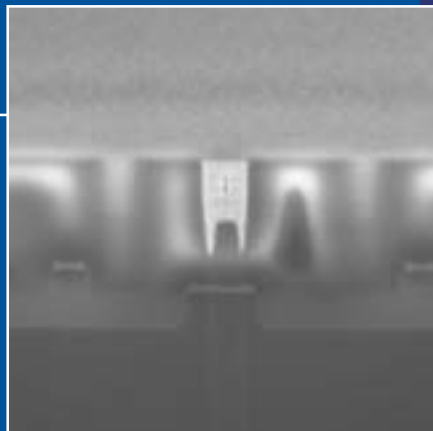
Ion beam image

FEI's Defect Analyzer relocates the defect using voltage contrast.



"Slice and view" provides 3D cross-sectional defect images.

High resolution images are forwarded to the yield management system to determine the cause of the defect and the corrective action needed.



# Higher yields in less time for increased profit

Whether you are ramping up a new, advanced process, or running at full capacity, the 3D advantage of DualBeam defect analysis will improve efficiency and significantly improve yields.

## Faster, less costly process ramps

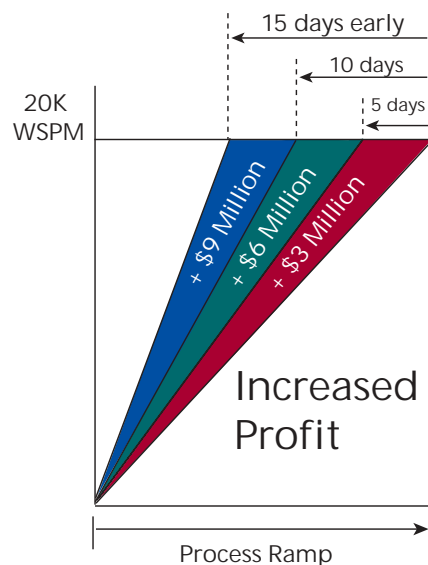
Given the growing number of structures that can no longer be fully evaluated from a top-down (2D) view, the 3D capabilities of the Defect Analyzer lets a user quickly identify the need to modify process parameters. A task that once required external lab analysis can now be accomplished in-fab, saving the time previously lost to manual cleaving and polishing procedures.

Additionally, the costly time delays of hit-or-miss mechanical cross-sectioning of defects can be eliminated. Users can now keep full lots of wafers intact through the use of in-fab, site-specific cross-sectioning and defect analysis. Significantly more process parameters can be evaluated and optimized in a single pass. The result: silicon savings of up to \$14 million during a typical ramp period.

## Better yields, higher margins for volume production

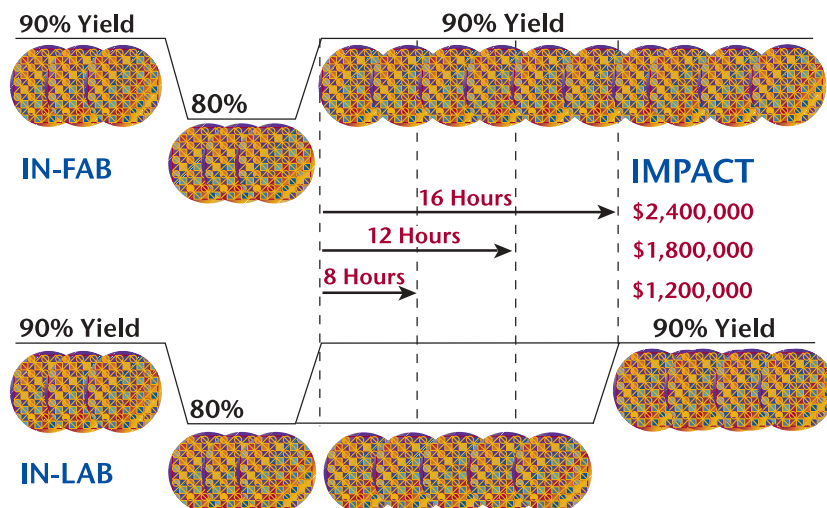
In fabs running at capacity, a delay in the time to solution for a single yield excursion can typically cost \$150,000 per hour for a 10 percent yield loss. This represents a \$2.4 million loss of turnover per occurrence. User Analysis has shown that using a DualBeam in the fab for root cause analysis can typically result in an overall time savings of 16 hours. An important savings that translates into better operating margins for your business.

## Faster ramp increases profits



*With proven savings of both time and money, the Defect Analyzer systems are a critical solution for both controlling costs in the fab ramp-up phase, and maintaining profit margins in a volume production environment.*

## Benefit of deploying a Defect Analyzer system in the fab

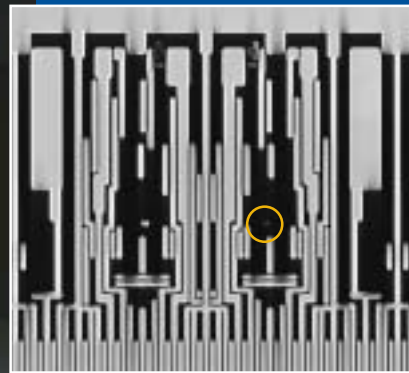
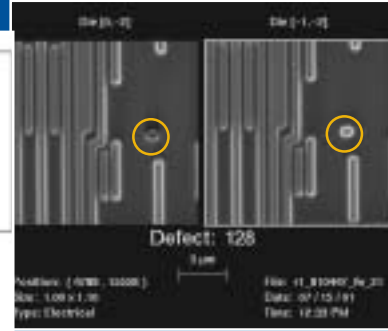
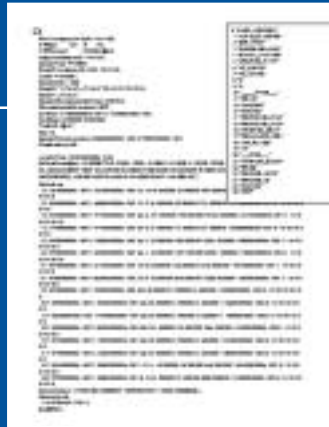


\* Assumption in cost models:

- 64M DRAM at current market price 300 mm wafers
- 10 months ramp to full production of 20,000 WSPM (wafer starts per month)
- Linear “events” over the 10 month period where the Dualbeam tool provided the pivotal answer
- Profit before tax of 10%
- Single yield excursion of only 10%
- Impact given is difference between in “good chips” produced when locating a FEI DualBeam in-fab rather than in the laboratory
- Model available in spreadsheet upon request.

# Ultra high resolution TEM analysis of defects using AutoTEM sample preparation

SEM-based defect detection tool provides a list of identified defects.

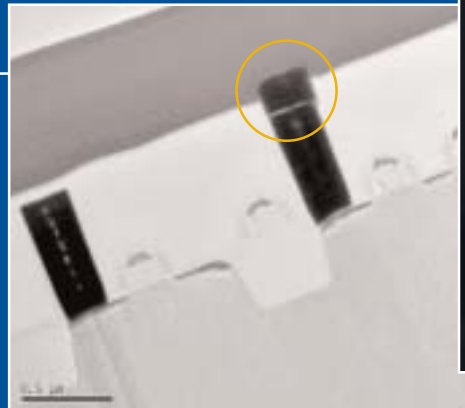


The Defect Analyzer revisits the defect sites to determine whether more data is required to provide root-cause analysis.



Defects requiring ultra high resolution analysis are automatically created with AutoTEM™ sample preparation.

Ultra high resolution TEM images are forwarded to the yield management system to determine the cause of the defect and the corrective action needed. In this case, an oxide formation was found in the TEM image that could not be imaged using SEM.



# Increased productivity through automation

Automation of tasks that are repetitive and where the operator has little or no added value allows lab and fab managers to concentrate resources on the real issue—*what to change to improve process yield*. FEI has engineered the operation of the Defect Analyzer for maximum ease of use and productivity.

## Programmed recipes provide for retained learning and sharing of optimum conditions

The Defect Analyzer tool lets the operator easily record instrument conditions to create pre-programmed recipes for the automation of repetitive tasks. Flexible software allows for easy user customization. Recipes can be made process-layer-specific and shared between tools.

## Automated job sequences ensure consistency and minimize operator “on-tool” time

Consistent data collection methods are key to developing yield management strategies that work.

Automating the collection of critical defect information guarantees consistency from user to user and from shift to shift. Pre-programmed sequences for repetitive milling and imaging processes can mean the difference between an operator spending just 30 minutes to set up a job, or having to spend an entire 8 hour shift in front of the tool.

## Job creation can be done off-line to pre-schedule shift operations

With off-line job creation, supervisors and yield managers can focus on the strategies for determining root cause analysis, and more effectively communicate with the tool's operator what defect information needs to be gathered off-line.

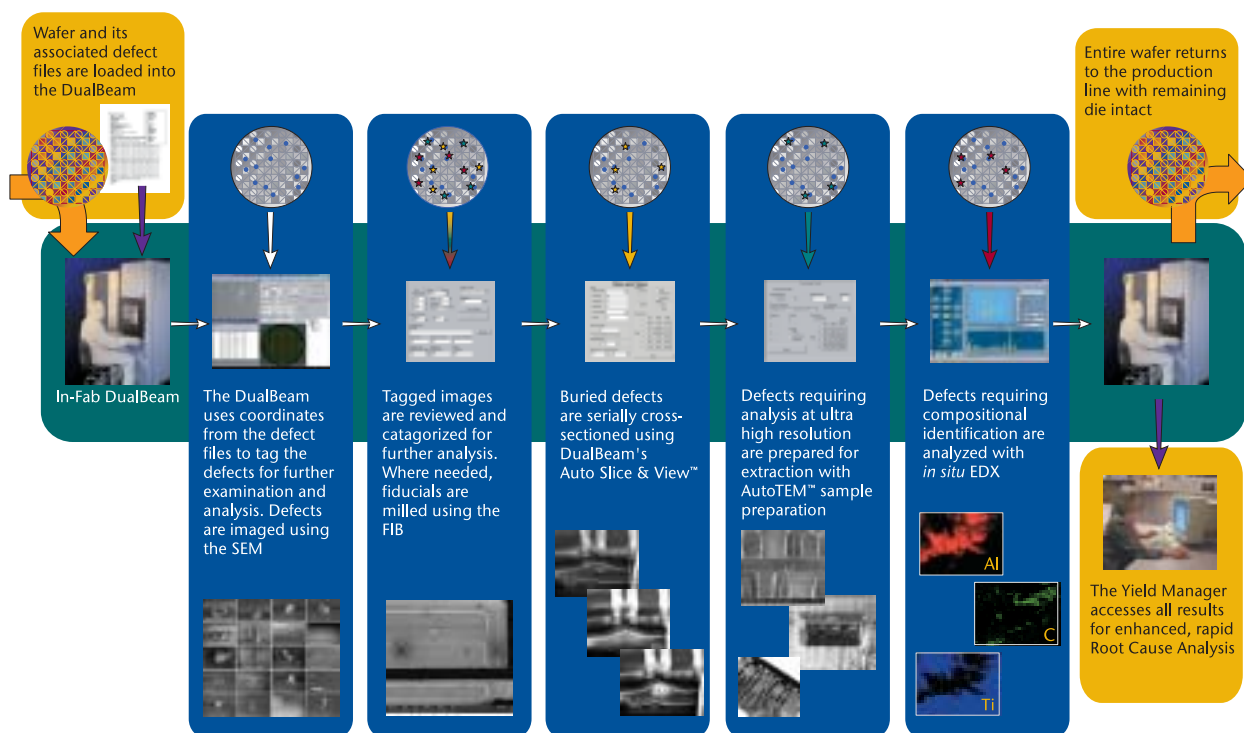
Job creation can also maximize tool usage by providing better predictions of the time needed to complete the required analysis.

## Tool parameter automation reduces operator fatigue and facilitates throughput

Tool parameter optimization is needed only during the job creation phase and can be recreated at each subsequent site by the job sequencer. This leads to better uniformity of results and less user fatigue.

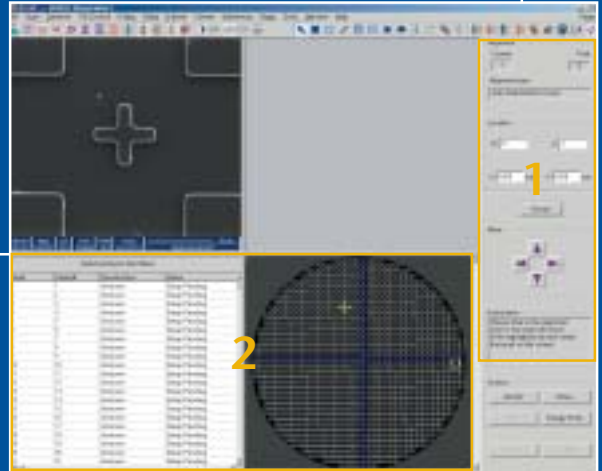
## Data can be shared with off-line analysis tools, while on-board storage provides a real time monitor of the current yield opportunity

Most data analysis tools are supported through the Defect Analyzer software option for exporting critical data. When using Defect Explorer™, images can be recalled by process, product, lot, or defect time.



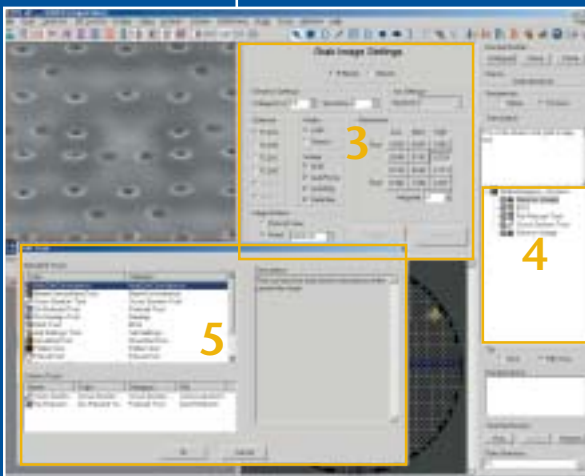
# Easily programmed tool automation enables fast and consistent answers

(1) The wafer alignment wizard makes it easy to set up an automated wafer alignment that can be used for subsequent wafers of the same type.



(2) Integrated defect file navigation and pick list display provides all the information you need in one screen.

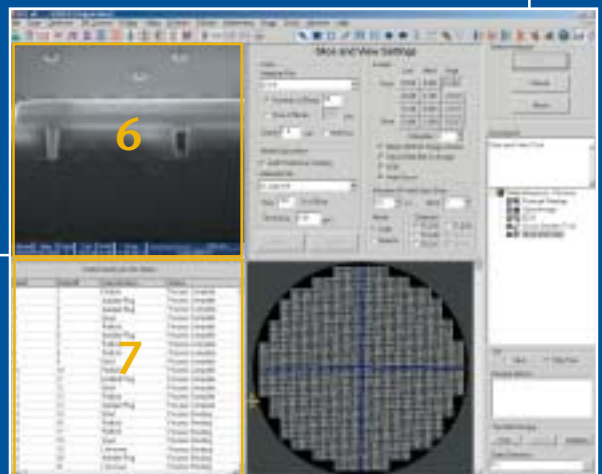
(3) Imaging parameters can be customized to provide the optimal image for your analysis.



(4) The defined process sequence is displayed for easy visualization and modification.

(5) A job sequence is created using the large library of automated tool operations.

(6) Automated wafer alignment, sample preparation and imaging provide answers quickly and reliably. Here the root cause of a voltage contrast defect is revealed to be an incomplete fill.



(7) Defect classification can be updated and transferred to your yield management software.

# Industry-leading technologies, for high performance

The unique geometry of the FEI DualBeam concept provides the basis for a high throughput, automated tool.

## Automated processes, for increased efficiency

The DualBeam system is coupled with fully automatic compensation for wafer warp. In the past, a skilled operator had to manually bring the often-warped wafer surface to the eucentric height of the stage. FEI has automated that process by adding a closed loop control of stage "Z" through the use of a capacitance probe.

The coincident point of the beams is also the target for all gas chemistry injection systems. Gases needed for the enhanced processing of the wafer during FIB operations are automatically directed to this point for the most efficient, high speed creation of cross sections.

Where elemental analysis of the defect is required, the EDX detector is also optimally focused to the coincident point of the beams.

## Unmatched Stage Performance

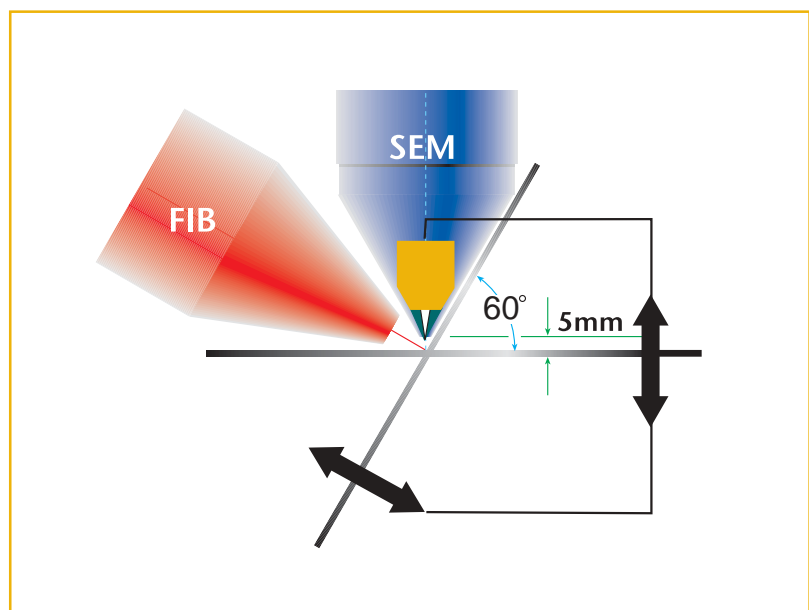
One of the key enabling technologies in FEI DualBeam systems is the high performance stage. It moves rapidly and smoothly to targeted locations on the wafer. Once there, it fixes on the target with no further shifts, allowing the beams to continue the defect examination.

The revolutionary stage in Defect Analyzer tools has a blazing 100 mm/sec top speed, coupled with an accuracy unmatched by any other stage in the world. When a Defect Analyzer stage arrives at the target location it normally displays less than 10 nm/minute drift. Alignments are faster,

navigation overheads become irrelevant to throughput, and the tool can be used for the most demanding application of Bit Fail mapping. Even with the cell sizes of today's advanced DRAM, users arrive at the target cell in the array an unsurpassed 85 percent of the time. When identifying sub-half micron particles, the beam stays fixed throughout the analysis period without relative movement.

FEI's high performance stage features five full axes. This allows tilting between the SEM top down position and the high-tilt FIB position, without losing the smallest features from the field of view. Defects where the topography is difficult to interpret can be completely rotated and tilted up to 60 degrees while staying in the (5000X) field of view, anywhere on the wafer.

FIB and SEM work together at a single point to monitor 3D structures. This third dimension enables a comprehensive view of a process problem and possible culprits.

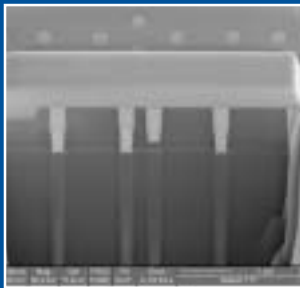


# Performance Enhancing Beam Gas Chemistry

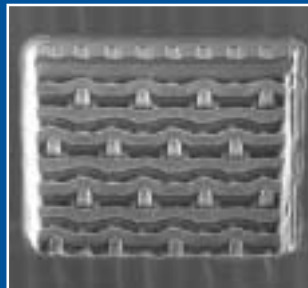
The Defect Analyzer Series is equipped with a fully integrated beam gas delivery system that provides enhanced performance for all phases of FIB cross-sectioning. Self-contained in a double isolation system, with no external plumbing, it features automated needle insertion delivery for the lowest installation cost and highest reliability and performance. These process gases interact with the ion beam to provide reproducible, high quality and readily interpretable cross sections quickly and reliably. A wide range of gases optimized to your process is available. Typically the automatic creation of a quality cross section for defect analysis includes the following enhanced steps:

- Protecting the face from artifacts
- Fast material removal
- Selective surface etch to reveal significant detail

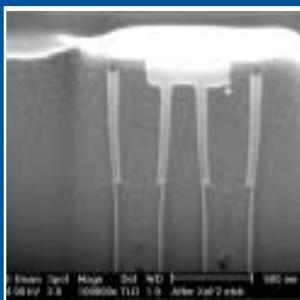
*Integrated beam gas delivery system features a wide range of gases optimized to your process*



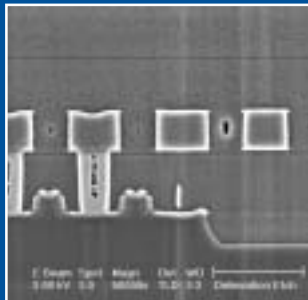
Platinum protective



Selective milling for deprocessing



Xenon DiFluoride



Oxide Delineation



FEI World Headquarters, Oregon, USA



FEI, Massachusetts, USA



FEI, Eindhoven, The Netherlands

# Global resources to support your FAB investment

FEI company is The Structural Process Management Company™ serving semiconductor, data storage, and analytical lab and life science markets. Our technology base represents more than 50 years of advanced engineering for FIB, SEM, TEM and DualBeam solutions. We have more than 1,600 employees around the world working for the success of our customers. With FEI, you can invest in your Defect Analyzer DualBeam system with confidence.

## Global service and applications support

FEI service and application support is organized from three regions: North America, Europe (including Latin America), and Asia Pacific (including Australia). Our application support laboratories welcome you for demonstrations, training and application support in Hillsboro, Oregon; Peabody, Massachusetts; Eindhoven, The Netherlands; Singapore; and Tokyo.

## Remote diagnostics and software upgrades

FEI's service engineers are able to perform remote diagnostics to improve time to repair and the overall efficiency of your system. Software upgrades can also be made available as part of service agreements and downloaded remotely.

## Visit FEI's website

To learn more about FEI, its products, and advanced Structural Process Management solutions for semiconductor processing visit FEI's website at [www.feicompany.com](http://www.feicompany.com).

FEI customer support is never far away with 24/7 Technical Assistance Centers and experienced service crews in 41 countries.



SEM  
TEM  
DualBeam  
SNP  
FIB



Ongoing training gives FEI engineers hands-on experience in system assembly and diagnosis. Each year more than 500 service engineers attend advanced courses at training centers in the USA and The Netherlands.

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