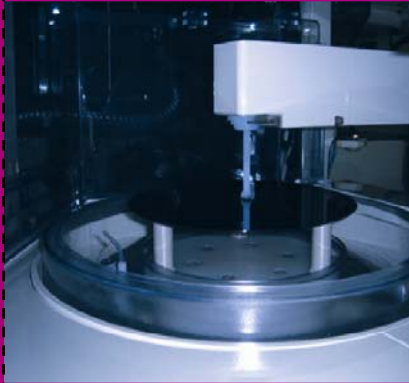


Automated VPD ICP-MS



Tool Metal Contamination

Improving Tool Design and Performance with Precision Wafer Surface Scan

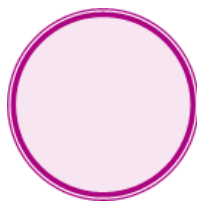
A major requirement for front end processing is low surface metal contamination prior to thermal processing and gate oxide growth. Alkali metals can cause MOSFET threshold voltage shifts, Al and Zn affect the oxidation rates of silicon, and Fe, Cr, and Cu can cause junction leakage currents and gate oxide integrity (GOI) degradation. In addition, metals can cause surface and interface micro-roughening and form silicides.

One of the most sensitive surface analytical techniques for metals is vapor phase decomposition inductively coupled plasma mass spectrometry (VPD ICP-MS). VPD ICP-MS is a 3 step process.

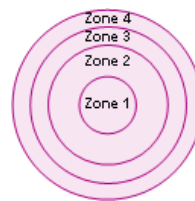
- Vapor phase decomposition
- Wafer surface impurity collection using a scanning droplet
- Scanning droplet metal analysis using ICP-MS

The automation of the vapor phase decomposition and scanning droplet collection has several advantages. Precision wafer scanning may be programmed to perform bevel-edge, radial and sector scans of the wafer surface.

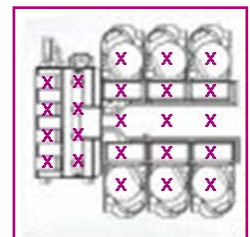
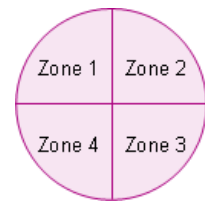
Bevel-Edge Scan



Radial Scan



Sector Scan

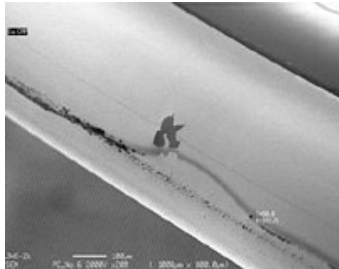


Key Applications for Tool Contamination Evaluation

Witness wafers are used to monitor in-tool metal contamination present as surface molecular contamination - molecular metals (SMC-MM) that lands on the wafer or from contact with wafer handler components.

Bevel-Edge Scan

The bevel and edge scans may be used to evaluate the wafer cleanliness from contact with wafer handlers, new or retrofitted systems, or with wafer carriers.



Wafer bevel showing defect

Edge-grip and ring seal handler.

- End-effector is designed to grasp wafers with a talon-like device that effectively grips the wafer without effecting contact of the wafer surface - front or backside

Wafer flip module

- Used for coatings, bakings, etches, rinses and inspection of wafer backside

Wafer edge defect

- Successive byproduct layers may peel or flake off from the edge of the during wafer transportation thereby contaminating other substrates in the wafer carrier

Sector Scan

The sector scans may be performed as quadrants or thinner slices of the wafer surface. In contrast to a total surface scan where “hot” spots are not identified the sector scans provides a “compass” direction of where the source may originate from.

Electrostatic chuck (ESC)

- These are ultra-flat, high-purity ceramic chucks that are three to five times stiffer than glass or metal alternatives. ESCs are composed of specialized materials making them challenging to clean.

Vacuum chuck

- Used for coatings, bakings, etches, rinses and inspection of wafer backside

Radial Scan

The radial scans provide localized information of surface metal contamination at specific radial distances from the center of the wafer.

Wafer chuck and heat/cool pedestal assembly

- Ring or pin contacts offers a significant decrease in the surface contact area on the wafer backside; lift pin may contaminate the wafer surface

Vacuum chuck

- Metal sources may arise from materials (new and cleaned) and new coatings used in the tool