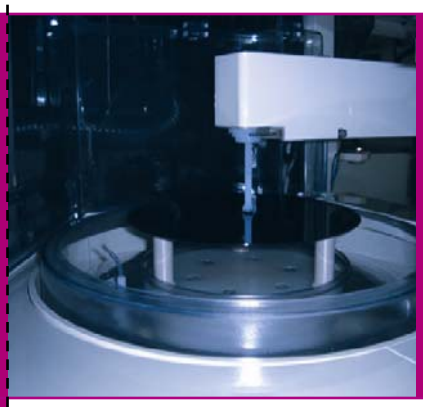
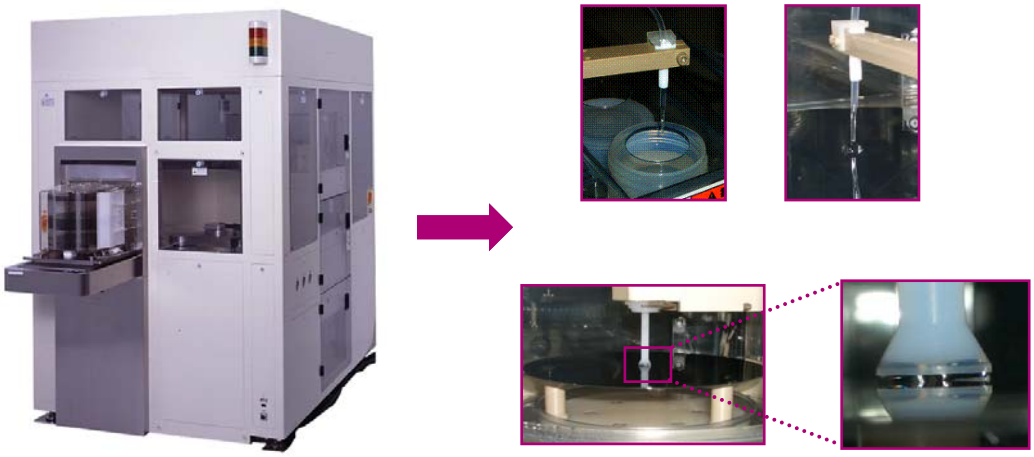
Automated VPD ICP-MS



Wafer Metal Contamination

Meeting the Requirement for Advanced IC Devices

The silicon wafer manufacturing industry produces defect-free wafer substrates with tightly controlled mechanical, electrical and material specifications. In addition, they produce engineered substrates such as strained silicon, SOI, specific multiple layer epi structures and graded layers. For front end processing (FEP) wafer cleanliness and surface preparation are prerequisites for high yield device production. The requirement for surface metal concentration on starting wafers is about $1x10^{10}$ atoms/cm^2 and is expected to be $1\text{-}5x10^9$ atoms/cm^2 for advanced technology nodes.



The automated vapor phase decomposition tool (shown above) when coupled to an inductively coupled plasma mass spectrometry (VPD ICP-MS) is a very surface sensitive analytical technique capable of:

- Low detection sensitivity; $5x10^6$ - $1x10^{10}$ atoms/cm^2 on 300mm wafers
- Whole wafer analysis; without breaking the wafer
- Elemental survey; over 60 elements in one analysis
- Total wafer surface; including bevel edge
- Localized surface analysis; bevel edge only, radial scan and sector scan

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Applications

In addition to supporting silicon wafer manufacturing VPD ICP-MS is frequently used as a witness wafer to verify metal cleanliness during processes and in the environment. Typical applications include:

- Ion implantation
- Thermal annealing furnace
- Cleanroom, FOUP, cleanhoods and MENV (mini-environment)
- Contact experiments with cleanroom gloves and packaging materials

VPD ICP-MS Process

Vapor Phase Decomposition (VPD)

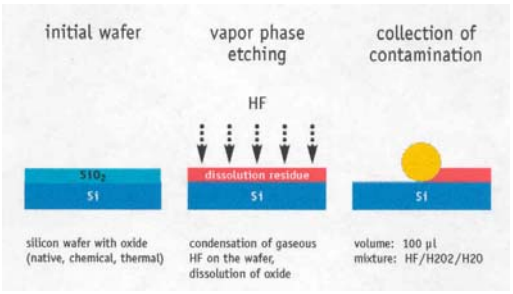
- The wafer is exposed to moist HF vapor that dissolves all oxides on the wafer surface

Drop Scan Collection

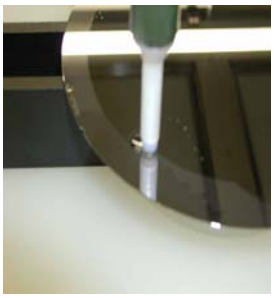
- The wafer is scanned with a controlled droplet of dilute high-purity acid
- The acid droplet collects all contaminants from the HF decomposed surface oxide
- The droplet can scan front and backside of wafers

Collection Droplet Analysis

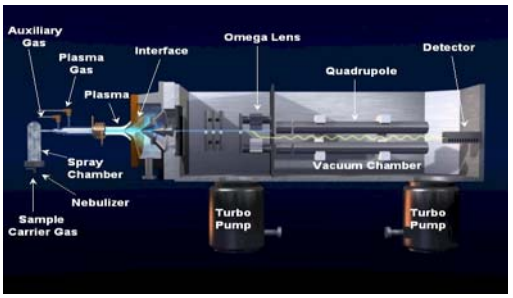
- The droplet is then analyzed for elemental contamination by ICP-MS



Vapor phase decomposition (VPD)



Drop scan collection



Droplet analysis by ICP-MS

Common Elements Monitored

Any element may be optimized for detection sensitivity using a customized collection droplet recipe. Recovery experiments are routinely performed to ensure element recovery is between 75% and 125%.

11 element list: Al, Ca, Cr, Cu, Fe, K, Mg, Na, Ni, Ti and Zn

- Mobile metals such as Na and K
- Metals that dissolve in silicon or form silicides such as Ni, Cu and Cr
- Major gate oxide-integrity (GOI) killers such as Ca
- Metals such as Fe may fall into both classes above

30 extended list: This list may be customized to meet your requirements. Elements may include the following and include any additional elements except for Au, Ag and Pt that require aqua regia as the collection solution.

- Ca, K, Na, Al, Fe, Cr, Cu, Ni, Zn, Li, Be, Mg, V, Mn, Co, Ga, Sr, Zr, Mo, Cd, Sn, Sb, Ba, Ti, Rb, In, Ce, Th, Y and U

Localized Surface Scan

Our automated VPD system can be programmed to perform precision scan patterns on the wafer surface such as bevel edge, radial and sector scans. The bevel edge scan is made in accordance to SEMI M1-1105 edge profile requirement.