

WAFER SUBSURFACE TRACE METAL ANALYSIS

BY AUTOMATED BULK SILICON ETCH (BSE) ICP-MS

Front end surface engineering is a complex set of processing that entails, epitaxy, SiGe or SOI film depositions followed by the growth of gate dielectrics and subsequent ultra-shallow implants to obtain the desired electrical properties. Inadvertent, trace metal impurities incorporated during oxidation, implant and epitaxial growth can change the electrical property of the bulk material of the substrates leading to device degradation. Trace metals resident on the surface of a wafer cannot be assumed to be better or worse than the bulk of the material, unless examined.

Automated Bulk Silicon Etch (BSE) uses advanced chemistries to characterize the sub-surface trace metals on silicon wafers. Wafer surface is etched to customer specified depths and metal impurities in the etched silicon layer are collected for analysis by Inductively Coupled Plasma Mass Spectroscopy.

This versatile BSE technique allows etching of films from 250Å to 2.0µm depths.



APPLICATION:

- Implanted wafers
- Epitaxial Silicon
- Bare silicon

ADVANTAGES:

- Customized etch depths
- Etching accuracy better than $\pm 10\%$
- Superior method detection limits (MDLs)
- Good spike recoveries 75-125% for most elements
- Ability to analyze all wafer sizes
- 40 plus elements
- Full wafer surface etching with localized scanning capability
- Cost effective

TABLE 1. AUTO BSE ICP-MS METHOD DETECTION LIMITS AND SPIKE RECOVERIES BASED ON 300mm WAFER

Element	MDL	Spike Recovery	Element	MDL	Spike Recovery
Aluminum	0.05	114%	Lead	0.001	104%
Antimony	0.002	103%	Lithium	0.02	96%
Arsenic	0.01	121%	Magnesium	0.1	99%
Barium	0.002	71%	Manganese	0.05	100%
Beryllium	0.05	97%	Molybdenum	0.003	96%
Bismuth	0.0001	82%	Nickel	0.02	84%
Boron	10	NA	Potassium	0.05	97%
Cadmium	0.001	102%	Sodium	0.05	93%
Calcium	0.1	99%	Strontium	0.001	87%
Chromium	0.2	90%	Tin	0.1	84%
Cobalt	0.01	98%	Titanium	0.1	109%
Copper	0.01	79%	Tungsten	0.0008	112%
Gallium	0.001	104%	Vanadium	0.002	96%
Germanium	0.01	114%	Zinc	0.05	102%
Iron	0.05	103%	Zirconium	0.001	91%

Surface Concentration ($\times 10^{10}$ atoms/cm²)