ANALYSIS OF TRACE METALS ON WAFER EDGE AND BEVEL

BY AUTOMATED VPD ICP-MS

Wafer edge exclusion zone is a major source of contamination as it comes in contact with processing equipment. Transition to copper interconnects, low-k dielectrics as well as decreasing gate lengths in semiconductor manufacturing have resulted in bigger yield hits due to presence of trace metal impurities on wafer bevel and edge.

Vapor Phase Decomposition (VPD) and Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) is the most utilized technique for analyzing trace metal contamination on wafer surfaces owing to its superior sensitivity and capability to analyze low to high Z elements.

ChemTrace® offers this technique for one-sided bevel or entire bevel edge analysis using an Automated VPD ICP-MS with excellent method detection limits (MDL's) and spike recoveries, see Tables 1 and 2. Using this technique, the scanning precision for 2mm scan is controlled to ±0.1mm from both front and back of the wafer.

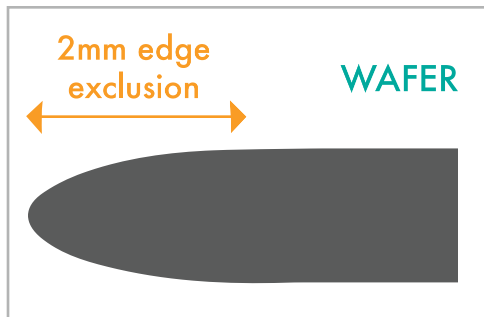

TABLE 1. BEVEL EDGE TRACE METAL METHOD DETECTION LIMITS OR 300mm WAFERS

One Sided Bevel				Entire Bevel Edge			
Element	MDL	Element	MDL	Element	MDL	Element	MDL
Al	0.1	Pb	0.001	Al	0.1	Pb	0.001
Sb	0.003	Li	0.1	Sb	0.002	Li	0.05
As	0.04	Mg	0.2	As	0.02	Mg	0.2
Ba	0.002	Mn	0.04	Ba	0.001	Mn	0.04
Be	0.3	Mo	0.01	Be	0.2	Mo	0.01
Bi	0.0002	Ni	0.08	Bi	0.0001	Ni	0.04
B	1.0	K	0.1	B	2.0	K	0.1
Cd	0.01	Na	0.3	Cd	0.01	Na	0.1
Ca	0.2	Sr	0.006	Ca	0.1	Sr	0.001
Cr	0.4	Sn	0.01	Cr	0.2	Sn	0.01
Co	0.1	Ti	0.05	Co	0.1	Ti	0.05
Cu	0.02	W	0.002	Cu	0.01	W	0.001
Ga	0.008	V	0.01	Ga	0.004	V	0.01
Ge	0.04	Zn	0.07	Ge	0.03	Zn	0.04
Fe	0.04	Zr	0.005	Fe	0.04	Zr	0.002

Surface Concentration ($x10^{10}$ atoms/cm^2)

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TABLE 2. SPIKE RECOVERY % FROM BEVEL EDGE SCAN

Element	One Side Bevel	Full Bevel	Element	One Side Bevel	Full Bevel
Al	101%	104%	Pb	96%	83%
Sb	96%	80%	Li	102%	87%
As	55%	54%	Mg	115%	94%
Ba	91%	76%	Mn	100%	85%
Be	105%	85%	Mo	107%	88%
Bi	81%	65%	Ni	112%	91%
B	35%	39%	K	104%	92%
Cd	92%	81%	Na	104%	95%
Ca	102%	108%	Sr	98%	85%
Cr	102%	85%	Sn	107%	90%
Co	101%	86%	Ti	115%	107%
Cu	79%	65%	W	93%	80%
Ga	102%	83%	V	99%	85%
Ge	84%	70%	Zn	103%	84%
Fe	107%	98%	Zr	97%	79%

ADVANTAGES:

- High degree of scanning repeatability
- Scanning accuracy to 2.0 ± 0.1mm
- Wafer sizes of 200-450mm
- Excellent Method Detection Limits
- 40 plus elements in one scan
- Fully quantitative
- Good spike recoveries (75-125%) for most elements

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