AN 363
TXRF and SURFACESIMS.XP
The Total Solution For Surface Contamination Measurements

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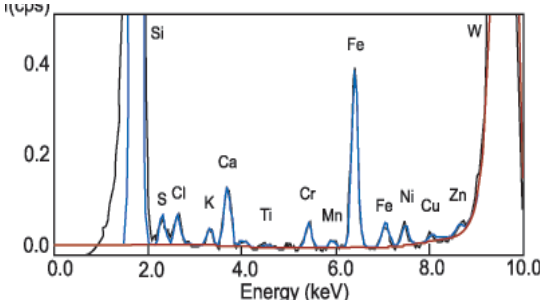
Discussion

Ultra-clean surfaces are critically important to successful processing of semiconductor devices. Device failure can often be attributed to surface contaminants such as transition metals and alkali atoms. In order to control contaminants, it is necessary to identify and quantify them. Utilizing both TXRF and SURFACESIMS.XP provides the total solution with the best value for surface contamination measurements on semiconductor surfaces.

Features of TXRF

- Survey technique; detection of elements from S to U.
- Non-destructive, automated analysis in a clean room environment.
- Whole wafers 100 - 300 mm. Smaller wafers to 50 mm may be mounted for analysis.
- Large analysis area (10 mm diameter) at a glancing angle below the critical angle.
- Detection limits ranging between 10^9-10^{10} atoms/cm^2 for most metals.
- Long term precision: <20% RSD.
- ASTM Method (F1526-95)
- Applicable substrates: Si, SiO_2, GaAs, others

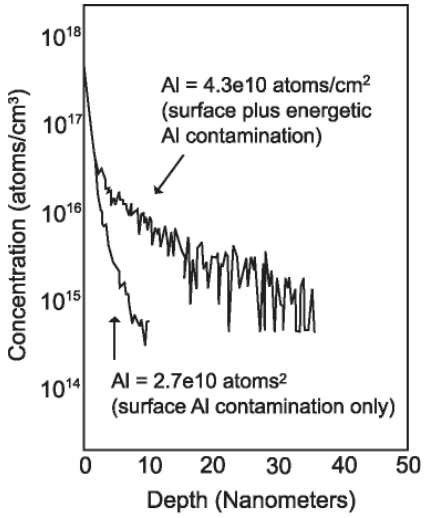
As a survey technique, TXRF provides high sensitivity multi-element surface contamination measurements at low cost.



TXRF spectrum of metallic impurities on Si wafer

Features of SURFACESIMS.XP

- Element-specific detection of all elements and isotopes, especially light elements (H-S) where TXRF has poor detection efficiency.
- ASTM methods (F1617-98) for Al, Na, K and Fe contamination on silicon and epi substrates.
- Measurement of near surface depth distributions, providing both surface and in depth detection of contamination.
- Small analysis areas (minimum 50x50 μm^2) - very useful for device applications and for navigating measurements between airborn particles.
- Detection limits ranging between 10^8-10^9 atoms/cm^2 for most metals.
- Long term precision: ~10% RSD.
- Applicable substrates: Si, SiO_2, SiC



SURFACESIMS.XP depth profiles of Aluminum in Si

SURFACESIMS.XP provides (1) areal densities of surface contaminants and (2) information about the near surface depth distribution of contaminants. This represents an important advantage over TXRF, VPD-AAS, and VPD-ICPMS.

TYPICAL DETECTION LIMITS OF SELECTED ELEMENTS (10^{10} ATOMS/CM^2) ON SILICON

Elements	TXRF	SURFACESIMS.XP	Elements	TXRF	SURFACESIMS.XP
Li	*	0.001	V	2	0.01
B	*	0.1	Cr	0.7	0.03
C	*	100	Mn	0.6	0.05
N	*	300	Fe	0.3	0.05
F	*	40	Ni	0.3	0.5
Na	*	0.01	Cu	0.3	0.3
Mg	*	0.05	Zn	0.8	0.5
Al	*	0.05	As	3	0.5
P	*	1	Mo	*	0.1
S	50	2	Rh	20	0.7
Cl	20	20	Sb	20	0.1
K	40	0.01	Sn	*	0.1
Ca	10	0.05	Ta	3	0.1
Ti	2	0.05	W	10	0.2

* These elements cannot be detected by TXRF or cannot be measured at practical levels. In some cases, spectral interferences prevent detection at low levels.

Reference

Correlation between SURFACESIMS and TXRF measurements of surface metal contamination on silicon, S. P. Smith, J. Metz and P. K. Chu, in Secondary Ion Mass Spectrometry (SIMS XI), edited by G. Gillen, R. Lareau, J. Bennett and F. Stevie. (John Wiley & Sons, Chichester, 1998) pp. 233-236.

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