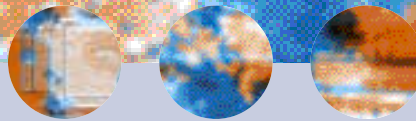


# TOTAL SOLUTIONS FOR THE SEMICONDUCTOR INDUSTRY

# CSMA



In today's semiconductor industry the most important targets for device fabrication are:

- Yield improvement
- Higher performance
- Higher throughput
- Improved device reliability

Modern surface analysis techniques have a significant and continuing role to play in helping device engineers to achieve these goals. The case studies described below show how CSMA's experts have solved a range of problems in the industry, with major benefits to our clients.



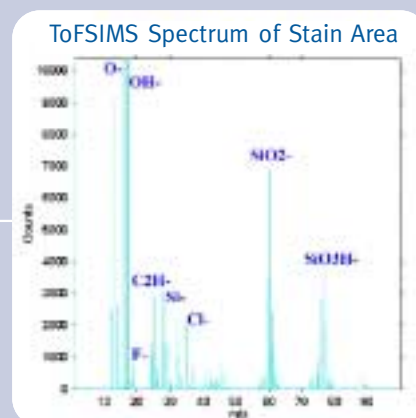
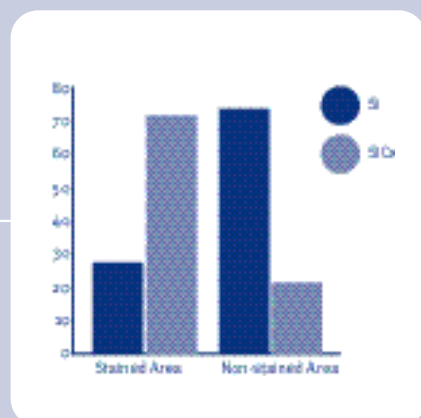
## CASE STUDY ONE

### Surface Staining on Device Wafers

This case study relates to the characterisation of a green surface stain, present on the reverse side of a failed device wafer using ToFSIMS and XPS.

- ToFSIMS spectra of stain and non-stain areas show the presence of silicon oxide, organic residues, sodium, aluminium, fluorine and chlorine.
- The relative levels of contaminants are similar on both areas.
- XPS analysis revealed similar levels of C, N and Al in both stain and non-stain areas.
- High resolution XPS of the Si2p spectral region (see below left) shows significantly higher levels of silicon oxide in the stain area.

Time of Flight SIMS and XPS combine to reveal higher levels of silicon oxide in the stain region. Identification of a faulty process step led to removal of the problem with subsequent yield improvement.





## Corrosion of Device Wafers

Corrosion of semiconductor devices during fabrication or after packaging and shipment can lead to serious yield loss or long term product failure. In this case study, corrosion has occurred on bond pad regions and surrounding line features after wafer storage. Optical microscopy and DSIMS analysis have been used to identify the nature and cause of corrosion.

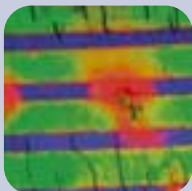
- Optical microscopy examination at CSMA revealed a concentration of corrosion sites and staining around the wafer edge.
- SIMS mass spectral analysis revealed the presence of ionic residues including sodium, potassium, fluorine and chlorine in corroded / stained areas.
- SIMS imaging of contaminant distributions shows high localised concentrations of ionic residues in and around corrosion sites.



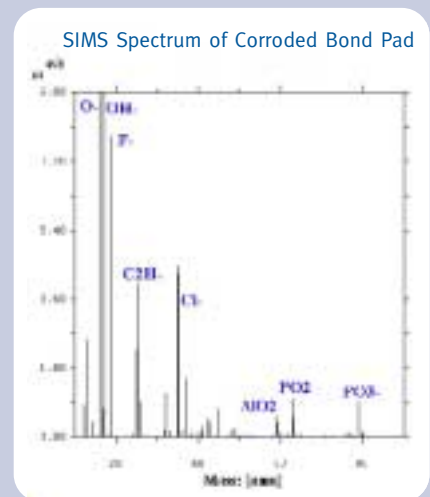
Optical micrograph of a corroded bond pad region



SIMS image overlay of the distribution of chlorine residues ( $\text{Cl}^-$  is red) on the bond pad and line features ( $\text{O}^-$  is blue)



SIMS image overlay showing titanium oxide corrosion product (red) on aluminium (green) and silicon lines (blue).



SIMS mass spectral and imaging analysis shows ionic residues remaining in wafer edge areas after insufficient washing. The resulting corrosion of titanium silicide leads to titanium oxide formation and ultimately wafer rejection. An improved washing / drying procedure would lead to significant improvement in wafer rejection.

CSMA provides a complete surface analysis service to industry to accommodate every level of demand:

- rapid turnaround analysis (24 hours)
- problem solving and failure analysis
- litigation and expert witnesses
- training courses
- reverse engineering and competitor analysis
- materials and product development
- patent registration / infringement

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