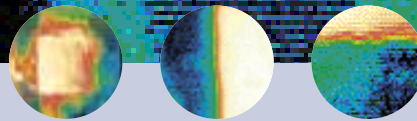


# TOTAL SOLUTIONS FOR THE ELECTRONICS INDUSTRY — CHIPS

# CSMA



One of the main tasks of the failure analysis engineer in the semiconductor industry is to find rapidly the cause of device failures so that necessary remedial actions can be implemented in the production line. Available in-house analytical equipment, however, is not always suitable or specific enough to fully characterise defective components where high spatial resolution, low detection limits and molecular information are required to solve the problem.

CSMA's surface analysis techniques such as XPS (X-ray Photoelectron Spectroscopy), ToFSIMS (Time-of-Flight Secondary Ion Mass Spectrometry) and DSIMS (Dynamic Secondary Ion Mass Spectrometry) readily provide this information as illustrated in the case studies below.

## BENEFITS TO CUSTOMER

- Cost effective - causes of failure can often be identified in less than a day
- Rapid information for reduced downtime and improved yields
- Recommendations for improvement of processes/product
- Assessment of competitors' products - reverse engineering

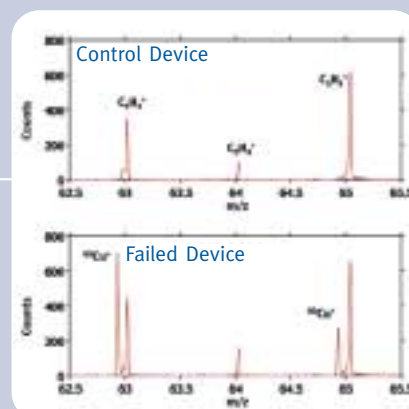
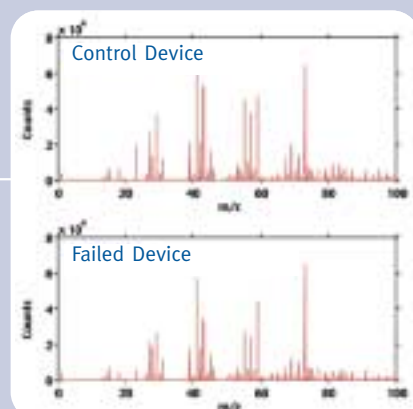


## CASE STUDY ONE

### Analysis of Die Surfaces for Determination of Failure

The device manufacturer experienced failure of devices where parts of the pins were no longer functional. Optical microscopy revealed cracks in the top surface passivation layer for the failed devices. One explanation was that ionic contaminants, possibly present on the outermost surface, migrated through these cracks and caused breakdown in the device. Comparative analysis of the surface of good and failed devices was carried out using ToF-SIMS to determine the presence, or otherwise, of ionic material to identify the possible cause of failure.

ToF-SIMS spectra indicated that the surface of control and failed devices were relatively similar with the detection, in both cases, of low levels of ionic contaminants and also organic residues. Although the migration of ionic contaminants through the crack was one possibility for failure of the devices, an alternative possibility was also discovered. Careful examination of the high mass resolution data showed an unexpected presence of copper on the surface of the failed devices.





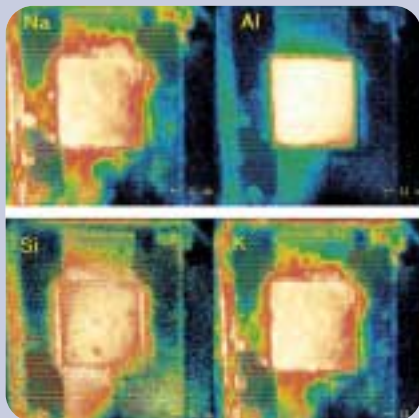
## Analysis of Bond Pad Areas on Devices

Device samples, demounted from their packaging, were submitted for analysis following moisture induced stress testing. Failed devices showed areas of contamination or corrosion product on and adjacent to bond pad areas, around the perimeter of the device, which were characterised by SIMS imaging. Equivalent areas of control devices were also analysed for comparison purposes.

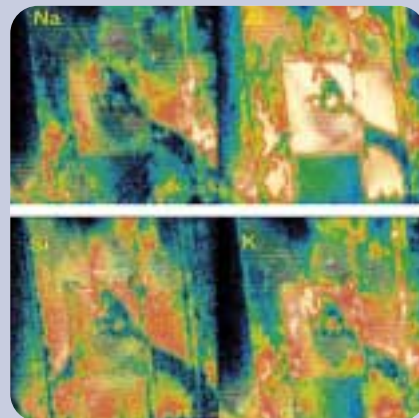
Mass spectral analysis and SIMS imaging (see selected images below) showed, for the failed device, the presence of aluminium and silicon oxides on and around the bond pad regions. With evidence from the chemical images (in particular Al) which matched the optically observed dendritic structures around the bond pads, these species were strongly suspected to correspond to corrosion products. In addition, antimony, sodium, potassium, chromium and iron residues were also found to be associated with the oxide-rich areas and were believed to have participated in the corrosion process.

For the control device, analyses also revealed evidence for the early stages of corrosion in bond pad areas.

The corrosion mechanism was interpreted as the result of the presence of two dissimilar metals (e.g. Al, Sb, Cr or Fe), electrolytes (Na, K, Ca and probably Cl) and moisture. The occurrence and concentration of the corrosion product around the perimeter of the device suggested that moisture ingress had occurred through the packaging.



Control Device



Failed Device

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

For further information contact our Head Office at:  
CSMA Ltd, Queens Road, Penkhull, Stoke-on-Trent,  
Staffordshire ST4 7LQ United Kingdom

Tel: +44 (0)1782 764440

Email: [enquiries@csma.ltd.uk](mailto:enquiries@csma.ltd.uk)

Fax: +44 (0)1782 412331

Web site: [www.csma.ltd.uk](http://www.csma.ltd.uk)

