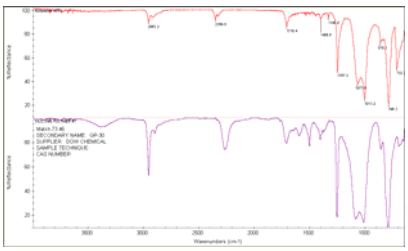
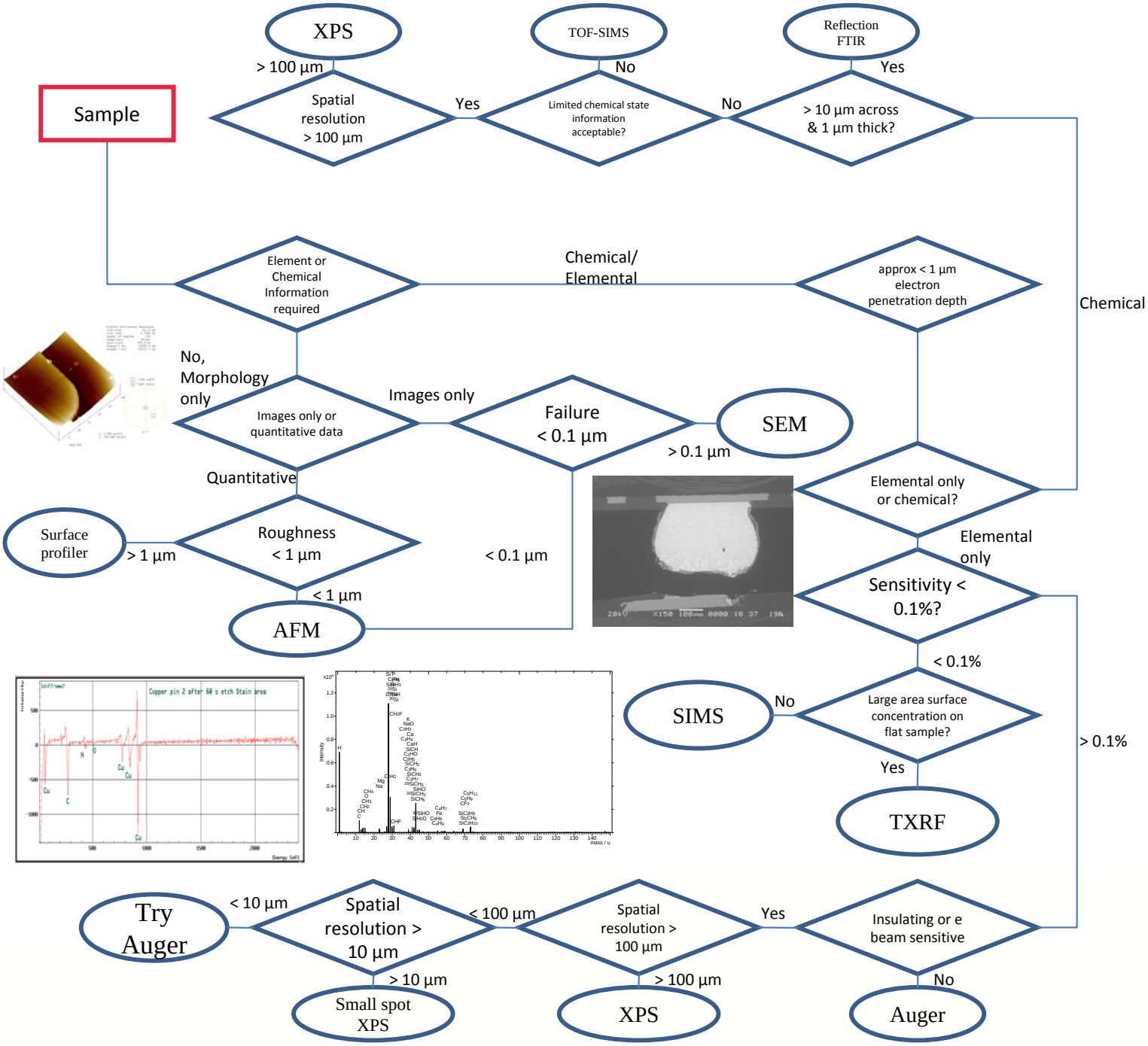
Failure Analysis



The Analysis Maze



Having Problems?

We are your solutions to your problems!

Failure Analysis

Over 30 years experiences in analytical services, SETSCO SERVICES provides a comprehensive range of analytical capabilities and experience staffs to support the engineering and construction industries.

With frequent exposure to real case analysis works, increases our understanding in the failure.

Our KNOWLEDGE may be the ANSWER to your problem!

We PLEDGED to provide:

- Customer Satisfaction
- Use latest and state of art techniques
- Fast, Reliable and Accurate Failure Analysis Services

The key to successful analysis to determine the root cause of failure is a methodology designed to extract maximum information with minimum destruction of the device at a realistic cost. The particular procedure will depend on the nature of the device and the mode of failure.
Typically the procedure will start with electrical characterisation to verify the mode of failure followed by non-destructive investigations such as optical microscopy, X-ay imaging or scanning acoustic microscopy. Only then, will destructive analysis such as chemical decapsulation or mechanical cross-sectioning followed by SEM/EDX or FIB be considered. Setsco will work hand-in-hand with the customer to ensure common understanding on the issue.

SETSCO SERVICES PTE LTD
18, Teban Gardens Crescent
Singapore 608925
T (65) 6566 7777
F (65) 6566 7718
www.setsco.com
marketing@setsco.com

Biological & Chemical Technology Division

For any enquiries, please contact:

Ms. Yen Nee Ooi DID: 6895 2282 HP: 9029 3894 Ooiyn@setsco.com

Failure Analysis

Surface Analysis

Surfaces are where materials meet and interact with the world, therefore it is usually the first impact to external attack. The techniques available to analyse surface are SEM/EDX, AES, XPS, AFM, TOF-SIMS etc.

SEM/EDX

Scanning Electron Microscopy/Energy Dispersive X-ray analysis (SEM/EDX) is not a near surface analysis technique, as it provides information from the top micrometre or so of the surface rather than the top few nanometres. It is usually used for pre-examination to determine the type of surface technique to apply.

Auger Electron Spectroscopy (AES) provides elemental analysis of the top few nanometres with sub-micrometre lateral spatial resolution. It is ideal for conducting samples such as leadframes, electroplated components and semiconductor devices. AES can provide elemental maps and depth profiles.

Auger

X-ray photoelectron spectroscopy (XPS) provides similar elemental information to AES but with additional chemical information, eg it can differentiate between Cr(VI) and Cr (III). XPS is suitable for non-conducting samples but lacks the spatial resolution of Auger.

AFM

Atomic Force Microscopy (AFM) provides nanometre resolution surface images. It is widely used in the semiconductor, display and hard disc industries to measure surface texture and roughness of deposited layers.

Time of Flight Secondary Ion Mass Spectrometry (TOF-SIMS) is particularly suitable for analysing very thin surface layers of organic compounds. TOF-SIMS can provide maps and depth profiles of specific atomic and molecular mass numbers.

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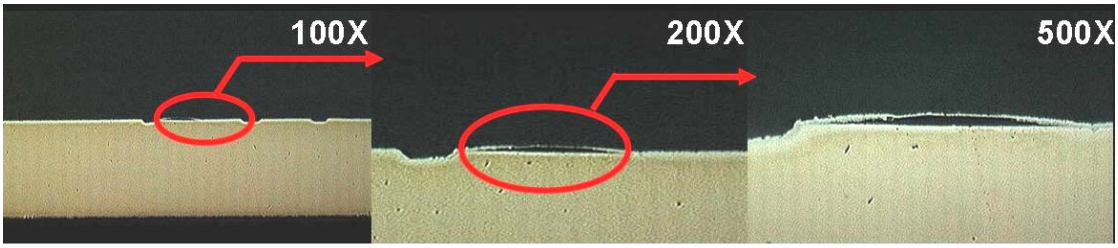
Failure Analysis

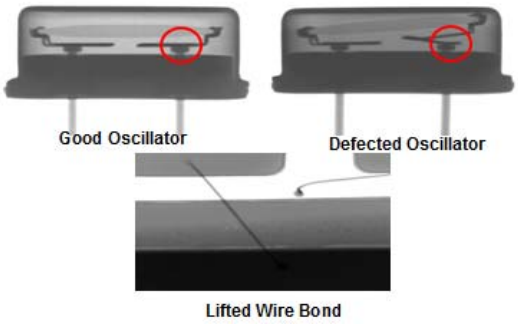
Non-Destructive Testing

Destructive means irreversible. In doing Failure Analysis, evidences are very important, every bits and pieces of the results are critical, sometime there is only one unit of the failed sample therefore usually the analysis process will begin with non-destructive work, so as to conserve the sample for any other analysis if necessary. The techniques available for non-destructive tests are Optical micrscopy, X-ray scanning and SAM.

Optical Microscopy at our lab is coupled with digital imaging and analysis. We perform dimension, annotation, archiving and standardized inspections on components, circuit boards, solder, microstructure morphologies, contamination, defects, and anomalies of electronic materials at 50x to 1000x magnification.

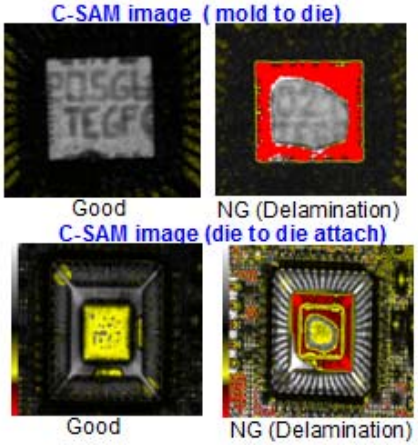


Optical Images@ different Magnification



X-RAY scanning is a quick, non-destructive analysis technique to look at the internal structure of the sample, usually use to inspect solders joint quality and the large scale structure of devices. Setsco is able to conduct the Dage x-ray inspection system, convectional film type and portable x-ray for on-side inspections.

Scanning Acoustic Microscopy (SAM) is a quick, non-destructive analysis technique that uses ultrasound waves to detect changes in acoustic impedances in integrated circuits (ICs) and other similar materials. Pulses of different frequencies are used to penetrate various materials to examine sample interiors for voids or delamination. SETSCO performs C-mode SAM (or C-SAM), with both reflective and through-scan capability.



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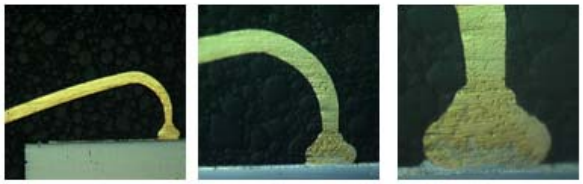
Failure Analysis

Destructive & Mechanical Testing

Non-Destructive may give a clue to the failure mode, however destructive test will be carried out for concrete evidence of the failure. Destructive and mechanical tests includes cross-section, FIB, TEM, decapsulation, hardness, tensile, solderability, Wire Pull Test and Ball Shear Test.

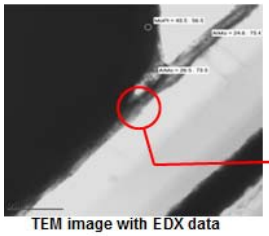
- **Mechanical Cross-Sectioning** is a method use to surface the internal structure of a sample. It involves careful selection, preconditioning, mounting in acrylic or epoxy resin materials to low deformation planar grinding using silicon-carbide papers and fine polishing.



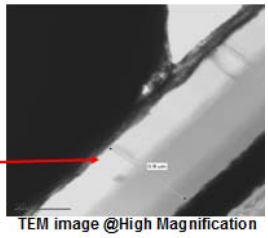
Inter Metallic Compound (IMC) Study

- **Focused Ion Beam (FIB)** is an important tool for savery precise cross sections or TEM preparation or to perform circuit modification.

- **Transmission Electron Microscopy (TEM)** is related techniques that use an electron beam to image a sample. High energy electrons, incident on an ultra-thin samples allow for image resolutions that are on the order of 1 - 2 Angstroms. Identification of nm sized defects on integrated circuits, including embedded particles and residues at the bottom of vias can be obtained using TEM.

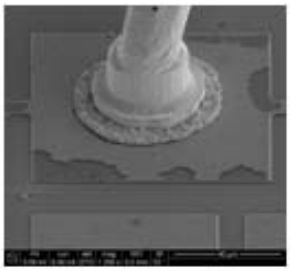


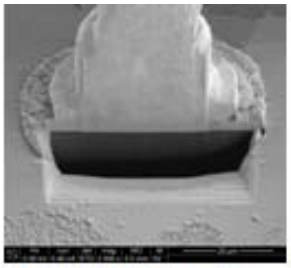
TEM image with EDX data

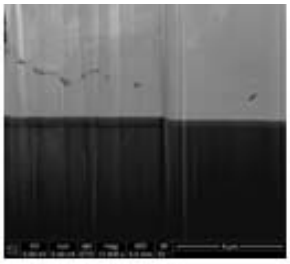


TEM image @High Magnification

- **Decapsulation** is the process whereby, materials are removed by chemical means or laser to exposed the internal structure.







FIB for Wire bond failure

- **Hardness** and **tensile** are the properties of the materials to resist to pemanent shape change and the magnitude of the pulling force exerted by a wire on another object respectively.

- **Solderability Test** measures whether a soldered joint can be made to the material, the inability to solder may be caused by contamination of work surface or solder paste.

- **Wire Pull Test and Ball Shear Test** are performed with Dage 5000 Bondtester, the purpose of the test is to verify the integrity of the wire bonds and solder balls formed by the wire bonders, a weak bonding strength will lead to an early failure of the product.

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Failure Analysis

Polymer and Organic Material Characterisation

Polymers and organic compounds are part and parcel of our daily life. They are linked up from various hydrocarbons chains, the properties of the compounds can have a huge impact on device performance yield and reliability. Setsco helps to characterise the compounds by DSC, TGA, FTIR, GCMS, Melt Fow Index and etc.

- **Differential Scanning Calorimetry (DSC)** is applied to determine glass transition temperature (Tg), phase changes, degree of cure and other thermal properties of polymers.

- **Thermogravimetric analysis (TGA)** is use to determine absorbed moisture, and residual solvent/volatile residues and polymer degradation temperatures.

- **Fourier Transform Infrared (FTIR) spectrometry and Gas Chromatography – Mass Spectrometry (GCMS)** is for analysing unknown organic compounds such as adhesives, coatings, lubricants, fluxes etc. Depending on the requirement, the technique can be used in several modes. For example FTIR can characterise microscopic droplets only 10 µm across or very thin coatings by attenuated total reflectance.

- **Melt Flow Index** to determine the flow of the thermoplastic polymer based on ASTM D1238 and ISO 1133.

Electrical Testing

The failure of an item is usually 1st detected when it failed an electrical test or functional test, therefore electrical testing is usually use as a mean to locate the area of fault. With our experience electrical engineer, Setsco will work with the customer to customise and conduct the electrical testing accordingly.

Chemical Testing & Others

The basic building block of matter is an atom, chemistry is the study of atoms (Chemical elements). Setsco have a range of chemical testing to suit your needs!

(Find out more on Setsco's chemical testing capability on our Chemical Testing Brochures.)

CONTACT US TODAY!!!

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