Failure Analysis of PCBAs

Failure analysis of PCBAs can be made more timely and cost effective through awareness of some "do's and "don'ts …

Do's

- Provide all available background information including previous test failures, touch-up operations, replaced components, failure symptoms, environmental variables, and failure history of other related PCBAs
- Provide documentation including assembly drawing, electrical schematic, PCB drawing, and parts list
- Carefully handle the PCBA to avoid introducing damage or contamination that might obscure the failure cause

Don'ts

- Don't reflow solder joints on suspect components. This will mask solder joint failures and potentially damage the PCB
- Don't use mechanical or electrical probe pressure to attempt to heal electrically open solder joints or PCB vias, as this will obscure the root cause of the open circuit condition

Analysis Approach

The approach used to analyze failed PCBAs will depend on the nature of the failure symptoms. However, the general approach is as follows,

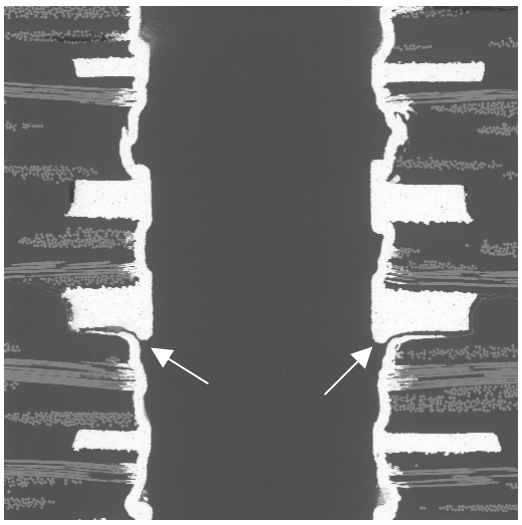
- Review all available documentation
- Examine the assembly under a stereomicroscope and document any anomalies (e.g. suspect solder joints, mechanical damage, discoloration, suspected contamination or corrosion, etc.)
- Electrically isolate and/or verify the failure
- PWB related failures generally require cross-section preparation to reveal the failure site and root cause
- Component related failures require either decapsulation or cross-section preparation to reveal the failure site and root cause
- Contamination and corrosion related failures often can be characterized without sectioning or decapsulation
- SEM/EDS examination is performed to document the failure site and resolve root cause. High resolution images are used to identify the failure mechanism and elemental analysis can reveal chemical or material related factors
- Generate a compressive report including all relevant background information, analysis results, and conclusions

Common Causes of PCBA Failures

PTH via opens

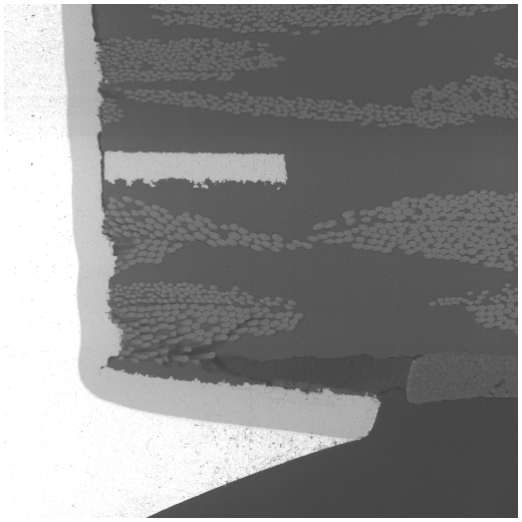
The example below shows an open PTH-via that was related to a PCB quality issue.

Poor drilled hole quality, nail-heading, and thin electroplated copper all contributed to this failure.



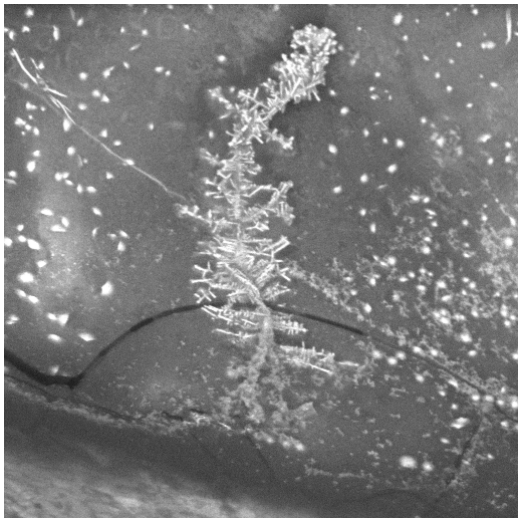
Inner layer separation

This example shows a failed inner layer connection to a PTH solder joint. The failure was related to poor inner layer strength caused by lack of etchback treatment during PCB fabrication.



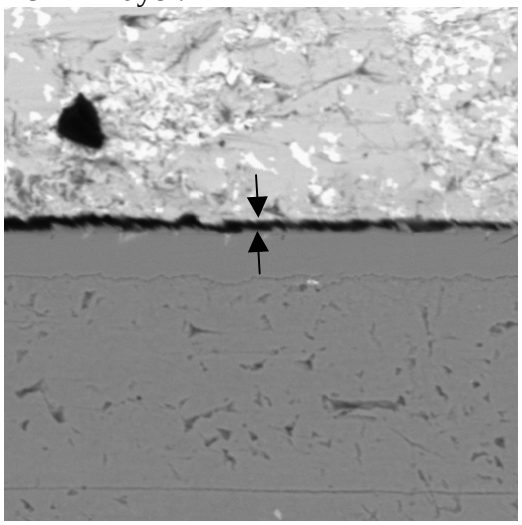
Electromigration

This Pb-dendrite grew between two QFP leads. Residual chloride from an OA flux, condensed moisture, and voltage bias created the conditions for this electromigration failure.



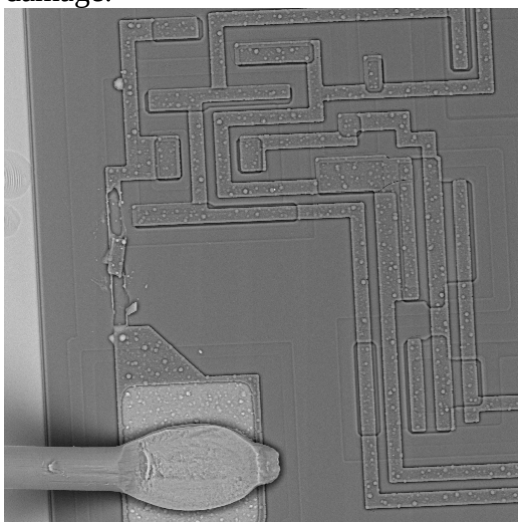
Black Pad Syndrome

This BGA solder joint failed at the interface between the Sn-Ni IMC layer and a P-rich EN layer.



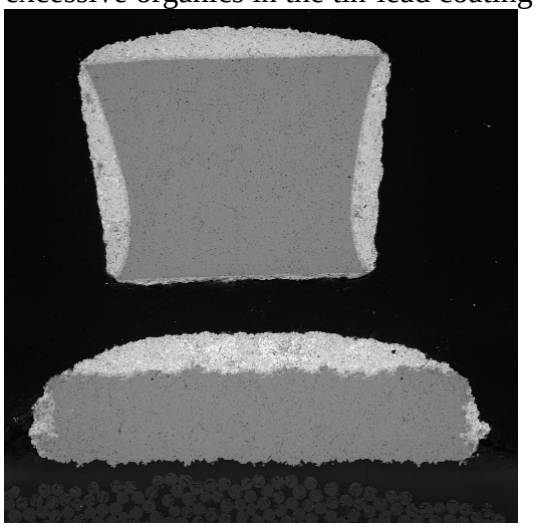
Electrical Overstress and ESD

This example shows a fused metal run on the input of an IC. Energy and pulse width of the event that caused this failure can be estimated from the location and type of damage.



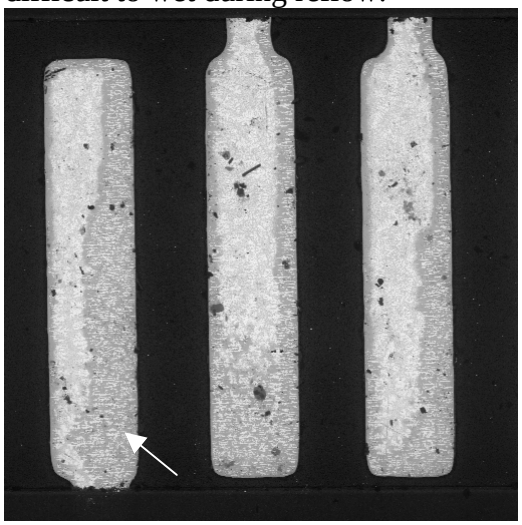
Component Solderability

This example shows a dewetted QFP lead. The solderability issue was attributed to excessive organics in the tin-lead coating on the QFP leads.



Exposed IMC on HASL PWBs

Poor quality HASL finishes on PWBs can cause severe solderability problems during reflow soldering operation. Exposed copper-tin IMC oxidizes and becomes very difficult to wet during reflow.



Conclusions

SEM Lab, Inc. supports failure analysis of PCBAs. Contact Dr. Ed Hare at (425) 335-4400 or email at ehare@sem-lab.com for more information.