Why Electronics Failure Analysis?

PART A

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Failure mechanisms in today's electronics can be the result of complex components and assemblies, harsher lifecycle environments and ever changing material sets. Failures most commonly occur near the beginning and near the ending of the lifetime of the hardware. Whenever they occur, failures can cause costly downtime and delays, product recalls and reputational damage.

Effective failure analysis is critical to product reliability. Without identifying the root causes of failure, true corrective action cannot be implemented and the risk of the problem arising again, increases. Anyone involved in any aspect of electronics failure analysis needs a clear understanding of the failure mechanisms of electronic products as well as familiarity with the tools and techniques used to determine the root causes of failures.

STI Electronics, Inc. Analytical Lab, specializes in failure analysis and material analysis of electronic assemblies, printed circuit boards (PCBs) and electronic components in all stages of the assembly process, for various applications. We use a combination of a wide variety of equipment, appropriate techniques based on the failure information (both destructive and non-destructive) and our accumulated expertise to diagnose the root cause and help resolve customer issues.

In this particular newsletter we will discuss some examples that would apply to the analysis of electronic components. Failure analysis of electronic components would include integrated circuits (ICs), memory chips, transistors, diodes, capacitors, resistors, light emitting diodes (LEDs), power modules and others.

The following analysis example involved evaluation of an IC component that was not functioning correctly and would fail in-circuit testing at the customer site. Figure 1, illustrates part of the writing on the outside of the component, while Figure 2 reveals a SEM (Scanning Electron Microscope) image of the corresponding writing on the die itself, after having been exposed through chemical decapsulation

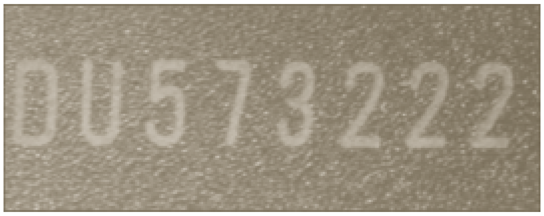

Figure 1: Writing on outside of component

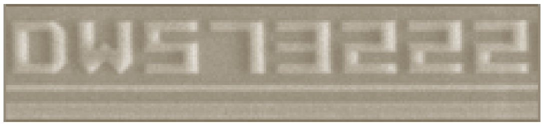

Figure 2: Corresponding writing on the exposed die surface

When comparing the writing in both images, a clear distinction can be observed. The "U" description on the outside of the part corresponds to a 2.5V VDDQ range max power supply support, while the "W" on the die surface supports a 1.8V VDDQ power supply. The external writing on the part in this particular case does not correspond to the max power supply the internal die can support, which could obviously lead to functionality issues of the component.

The following example is a typical EOS evaluation performed on an IC. Figures 3 and 4 below shows some significant EOS damage on the die surface / wire-bond connections:

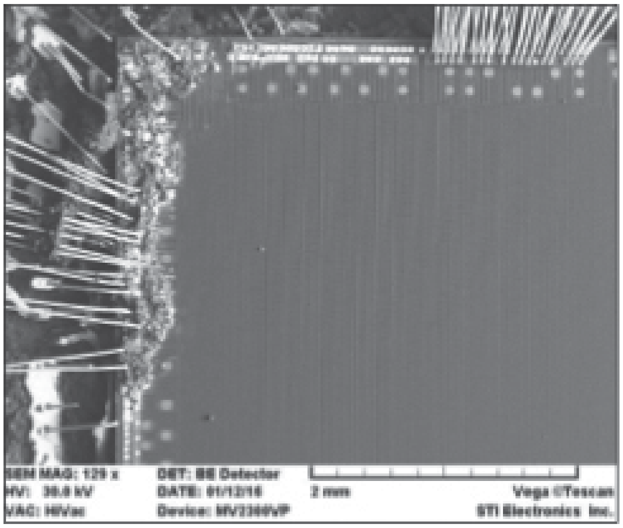

Figure 3: Affected corner of the die

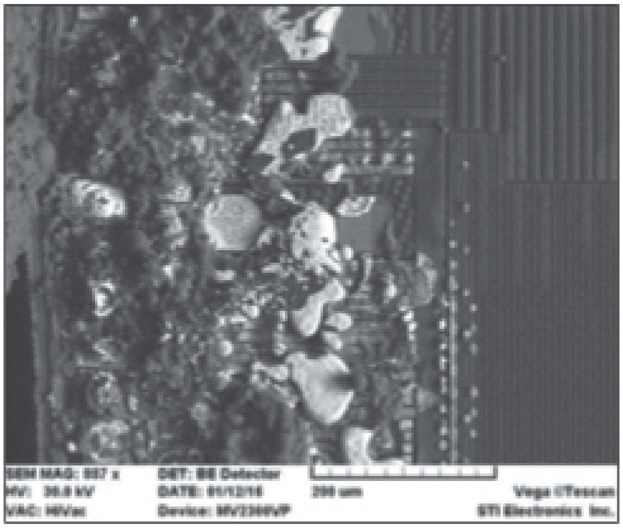

Figure 4: Close-up significant EOS damage

The last example is a micro-sectional SEM evaluation showing a capacitor component with a large fracture through the internal metallization:

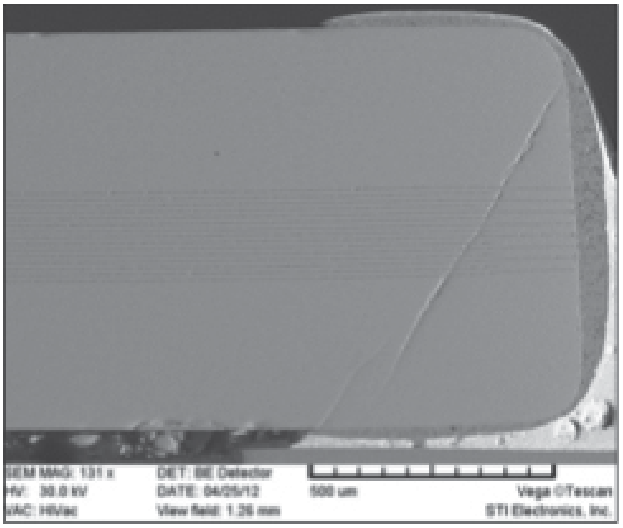

Figure 5: Overall view fractured capacitor

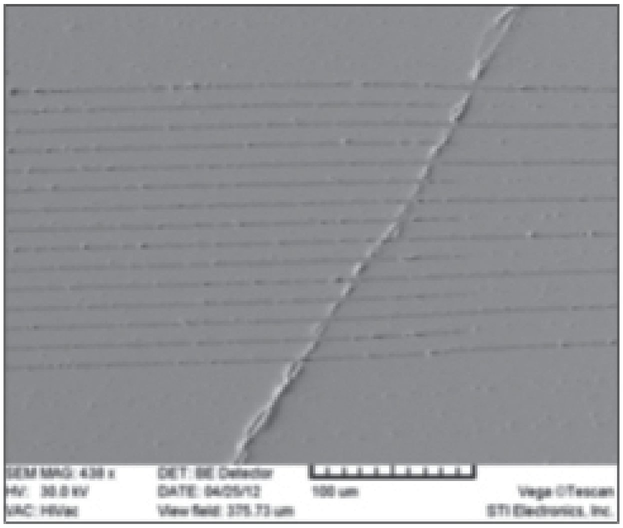

Figure 6: Close-up fracture through metallization

Some analyses typically applied to electronic components would include: solderability/wetting balance testing, ESD/EOS analysis, SEM/EDS surface evaluation, micro-sectional SEM evaluation, electrical testing, visual inspection, real-time x-ray analysis, ionic contamination testing and accelerated aging testing. In part B we will explore further failure modes and examples of why electronic failure analysis is important. If you have any questions concerning techniques or failure modes please call Marietta Lemieux at 256-705-5531.