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Guidance on Objective Evidence for Validating the Acceptability of Bubbles in Conformal Coatings

A White Paper Report Developed by IPC

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If a conflict occurs between the English language and translated versions of this document, the English version will take precedence.

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Users of this publication are encouraged to participate in the development of future revisions.

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Overview

Conformal coatings are used to increase the robustness of electronic assemblies against condensation risk and as protection against particles. The protection function is of highest priority for components with small pitch or low pin distances where the risk of bridging by water droplets or particles leading to an electric short is most critical. The trends of miniaturization and use in harsher environments combined with increasing lifetime expectations frequently requires electronic assemblies to be protected by conformal coatings.

The electrochemical performance of coated assemblies can be characterized by following the mindset of IPC-9202 test protocol where the package design effects on the ionic contamination, on the bias and on the present local humidity are taken into consideration, see Figure 1. Interactions of material and processes are evaluated during the surface insulation resistance (SIR) test using an assembled test board like B52 test PCB.

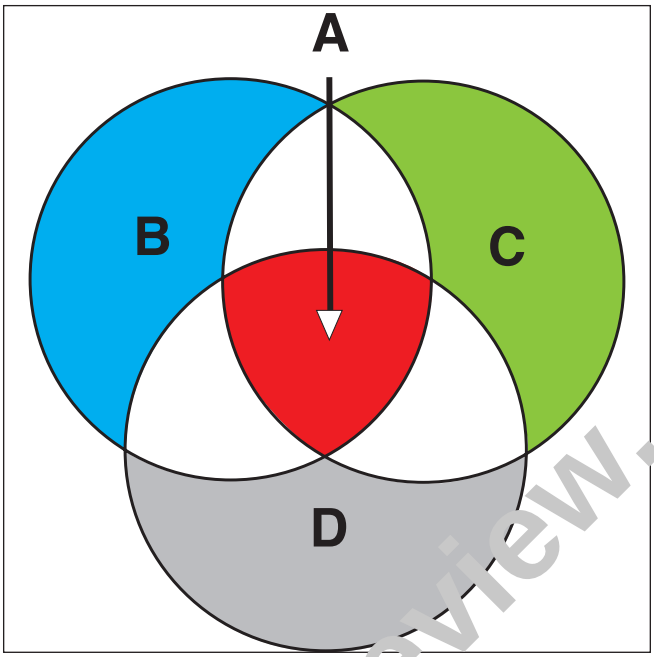

Figure 1. Venn diagram illustrating the variables affecting electrochemical failure

A. Electrochemical Failure Region
B. Humidity
C. Bias
D. Ionic Contamination

The concern of bridging bubbles in coatings is to activate a microclimate where humidity can condensate inside the bubbles and increase the local humidity load to a critical level. When adjacent non-common conductors are not protected by an insulating coating layer, an electric shortage failure by electrochemical migration can occur. This same concern applies to bridging bubbles between adjacent non-common conductors under components which can be the case for leadless components. Such bubbles under the component are not found by optical inspection; only destructive testing or removal of the component will exhibit the non-coverage of conformal coating. This difficulty in inspecting hidden terminations is described in the IPC-HDBK-830 and a solution for coating inspection for terminations is not available.

It is the purpose of this white paper to provide guidance on obtaining objective evidence for validating the acceptability of bubbles in conformal coatings.

General remark

This white paper focuses on a failure mode where bubbles in coatings could activate a microclimate involving condensation of humidity inside the bubbles resulting in an increase of the local humidity load to a critical level, thus generating electrochemical migration failures.

The use of coating as a mitigation measure against risks related to growth of whiskers is not considered in this white paper.