Circuit Technology

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Verifying Solderability

There exists a major trend for assemblers of printed circuit boards—they are beginning to recognize that a close relationship with their board fabricator is crucial for an economical and efficient manufacturing operation. Advancements in component technology have added to the complexity and circuit density of PWBs, thereby mandating high first-pass yields that are essential for profitability.

Design for manufacturability should consider both fabrication and assembly issues. A cooperative program for fabricators/assemblers must also involve suppliers in order to be successful. Success will only be attainable if all recognize that competitiveness in world markets is at stake.

The higher packaging density required to maximize the potential of advancements in component technology has drastically increased the cost of printed circuits. To remain competitive, improvements in first-pass assembly yields are critical.

Oxidation or chemical attack during storage is a key issue for component attachment. This includes soldering, thermal compression bonding, and conductive adhesives. There is a great need for quantitative tests to determine the surface conditions of the coatings that promote bondability.

Sequential Electrochemical Reduction Analysis (SERA)

A sequential electrochemical reduction analysis (SERA) is currently used to determine the bondability of the surface finish on PWBs. Analytical results from various aging treatments have been found to correlate with solderability as determined by the wetting balance method. The solderability of both pads and plated through-holes can now be tested.

Prior tests used to assess solderability on PWBs were the rotary dip and the edge dip test. Both were destructive and very subjective. The rotary dip test found wide acceptance in Europe, while the edge dip test was popular in the U.S. The latter is outlined in ANSI/IPC-804-A. The wetting balance provides quantitative results, but is destructive and can only measure the solderability of a small section of the PWB.

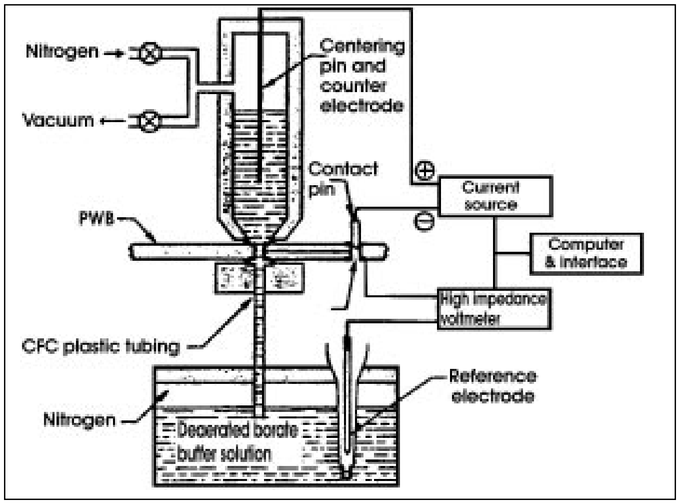

Fig. 1—Schematic representation of SERA through-hole test equipment.

On December 22, 1993, Military Specification P-55110-E was issued, which allows the use of the SERA method as an alternative to the edge dip test. This was a result of extensive research by the defense industry for characterizing surface conditions that adversely affect solderability. This specification is limited to Sn/Pb coatings.

In the SERA method, a small constant cathodic current is applied in a de-aerated electrolyte via an inert counter-electrode, and the cathode voltage vs. a reference electrode is followed as a function of time.

A plot of the cathode voltage vs. charge density (current density x time) yields a series of plateaux corresponding to sequential reduction of oxides present on the surface of the part. The plateau voltage reflects the nature of the oxide and the charge passed is a measure of the amount of oxide present.

An electrolyte used for electrochemical reduction is a borate buffer (9.55 g/L sodium borate and 6.18 g/L boric acid at pH 8.4 under an argon atmosphere). The initial work was performed on tin/lead surfaces and was used to detect the intermetallic species that form at the Cu/Sn-Pb interface and affect solderability, both directly and indirectly.[1, 2]

Further data are now being generated on the effectiveness of solderability protection provided by organic solderability preservatives (OSPs) and precious metal coatings.

Computerized with user-friendly software, this procedure is gaining acceptance as a reliable tool to more definitively determine PWB solderability.

Fig. 2—Computerized sequential electrochemical reduction analysis (SERA) instrument. (Courtesy of ECI Technology, East Rutherford, NJ.)

The effects of storage and the multiple heat cycles on solderability can now be quantitatively evaluated (Figs. 1 and 2).

Need for a Quantitative Test

With the desire of electronic manufacturers to utilize no-clean fluxes wherever possible, it is extremely important to evaluate the storage conditions and processing parameters for assuring reliability.

Initial results indicate that the SERA method can be useful in establishing optimum manufacturing parameters and in providing a quantitative test on incoming inspection of not only PWBs, but also components. ❏

References

1. D.M. Tench, D.P. Anderson, D.D. Hillman, G.K. Lucey, and T.J. Gher, "Production Validation of SERA Solderability Test Method," *Soldering and Surface Mount Technology*, **13**, pp. 46–50, (Feb. 1993).
2. D.M. Tench, D.P. Anderson, "Electrochemical Assessment of Sn/Pb Solderability," *Proc SUR/FIN Conference* (1990).

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Call for Papers

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4th AESF Hard Chromium Plating Colloquium

The AESF Hard Chromium Committee is organizing the next Hard Chromium Plating Colloquium, for early in 1996 (dates and location to be announced). Papers for the two-day program are solicited for the following planned sessions:

- Regulatory compliance case studies with air, water and solid waste regulations.
- Fundamentals on "how-to" of hard chromium plating, and its applications across industry.
- Alternatives or competing technologies to conventional, hexavalent chromium-based, hard chromium plating.
- A "Survival/Guidance" session for platers who plate hard chromium from hexavalent chromium.

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