"Green" Plating Systems

Greener, lean—and even more effective.

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In printed wiring board manufacturing and assembly facilities, far-reaching processing changes are being evaluated and implemented to address specific environmental concerns. The industry moved away from solvent-developable imaging materials in the late 1970s and throughout the 1980s; today's manufacturer is still faced with a long list of environmentally unfriendly chemicals. The challenge to change lies in using new technologies in a way that preserves end-product quality, yet demonstrates a clear transition toward greener manufacturing practices. Plated througth-hole (PTH) metallization presents one of the must formidable challenges.

The PTH Challenge

Today's waste treatrment technology is capable of producing the metal discharge results needed to meet current EPA requirements.[1,2,3] The interest in direct plating systems arose from increasingly strict regulations governing worker exposure to formaldehyde.[4] Although direct metallization is still in its infancy, the potential to lower costs by eliminating electroless copper further justifies interest in the newer technology.[5]

According to the Executive Summary of the IPC's Technology Roadmap, the elimination of electroless copper may not be the most environmentally responsible action since additive electroless-copper techniques inherently generate less waste than subtractive processes. Also, many of the higher-technology, more complex printed wiring boards seem destined for electroless-copper plating in the form of either full additive or partially additive processes.[6,7] Taking these two factors into consideration, the question remains: Which printed wiring board facilities and what product types will be amenable to direct plating systems ?

The global penetration of direct metallization techniques is still well under 10%. A somewhat regional pattern appears in that the more long-standing installations arc found in the Pacific Rim region (most notably, Japan) and in the Midwest area of the United States, with penetration into larger European accounts still lagging. Since the first installation at Photocircuits (Glen Cove, NY) in 1986, the largest volume of printed wiring boards produced using direct metallization processing has been double-sided. Even today, the industry's expertise in double-sided PWB production outweighs its multi layer experience by at least 10 to 1. It is expected that the emergence of the more advanced direct metallization systems will encourage more multilayer board installations and increase expertise in this market segment.

Direct Metallization Benefits

The most important benefits sought at early installations were the reduction of waste treatment equipment and costs. Over the past few years, however, the quality of printed wiring boards produced with improved direct metallization techniques has led more fabricators to

Figure 1: Interface of innerlayer copper foil and electrolytic-copper boundary *formed with direct* plating system (photos courtesy of Enthonc-OMI Inc.).

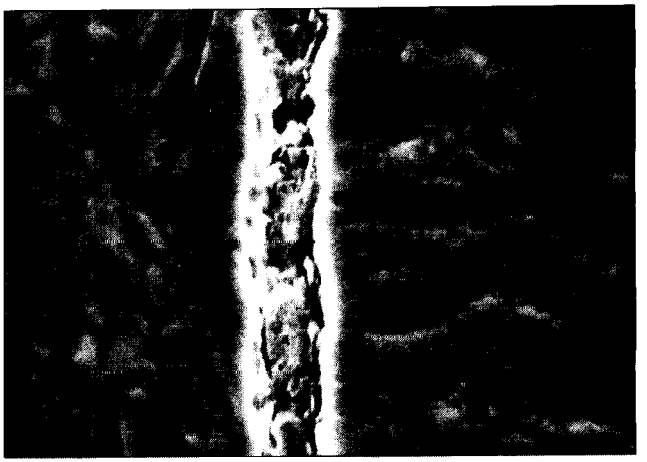

Figure 2: Interface of innerlayer copper *foil, conventional* high-build (100-micron) electroless- and electrolytic-copper boundaries.

evaluate the benefits of this process option.

In addition to the avoidance of electroless copper and its associated environmental impact, direct plating holds the potential for building higher-quality boards. One of the most significant improvements is in the quality of the bond between the inner-layer and the plated through-hole barrel. Figures 1 and 2 show a comparison of the boundary between the innerlayer face and the electrolytic-copper plating in a multilayer board, produced using the Envision DPS process and a conventional high-build electroless-copper process. In the DPS process, the boundary is most detectable by the differences seen in the grain structures of the foil and the electrodepo-

sited coppers. The high degree of adhesion yielded by direct plating is made possible because the chemical etching occurs on the innerlayer face after the application of the plateable film. In this case, the plateable film is thin (0.3 to 0.5 microns), and the degree of etching required to achieve clean copper is easy to control. This allows the innerlayer face to be completely cleaned prior to the bonding of the electrolytic-copper plate.

Conclusion

We will continue to see a movement away from conventional electroless copper through the 1990s. The adaptation will occur gradually because the long-term reliability of products made using direct metallization can only be answered with the passage of time. The industry as a whole needs to determine if direct plating alone will be sufficient to fulfill all of its future requirements. There is already a strong indication that some combination of direct plating (or conventional subtractive processing) and full or partially additive copper technology will be necessary to address the full range of printed wiring board products, including complex SMT multilayer configurations. For the PWB fabricator, the critical decision on direct metallization will involve the targeted product mix. FAB

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