The Flash Gold Surface Finish Technology

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Introduction

The advent of surface mount technology and now the lead free issue have ushered in a new wave of solderability treatments, in particular the flat hard metal finishes. Among others these include electroless nickel immersion gold (ENIG), immersion tin and immersion silver. All of these treatments are presently being used within the industry, but each has its own set of issues. Recently a new coating has been introduced using electro plated nickel and gold. This coating was used by North American suppliers in the 80's, but lost its popularity with the introduction of Sn/Pb HASL.

Recently, a modified version of this technology has been resurrected, principally by Chinese PCB shops and is now being offered at very competitive prices compared to the other hard metal finishes. The coating is referred to as "Flash Gold" and consists of a soft gold over nickel structure. It is normally applied in a continuous electrolytic plating line. The discussion below will describe the process and how it has been modified from the original process used by domestic shops two decades ago.

Evolution of Flash Gold

During the 80s many North American PCB suppliers, especially the captive shops, offer a gold nickel surface finish. The finish not only served as a solderability finish, but an etch resist as well. Essentially, a panel plate process was used and then imaged. A nickel gold structure was then plated and used as the etch resist. For historic reasons, the gold was several micro inches thick and the plating was time consuming. Adding to the expense of the process was the deregulation of the price of gold. These factors were further compounded by the introduction of HASL as a cost efficient, inline process suitable for the surface mount footprints of the time. Consequently, most North American suppliers migrated to HASL and the electrolytic nickel gold finish was abandoned.

The process also was hampered by the final geometry of the plated features. A typical cross section is depicted below in Figure 1. Since a panel plate, print and etch process was typically used, there was an appreciable overhang of the nickel gold structure which extended into the space between the conductors. At this time, the leading edge feature sizes were eight mils or more, consequently; this overhang did not present a serious issue, but as the technology was pushed to smaller feature sizes this overhang became a substantial reliability concern.

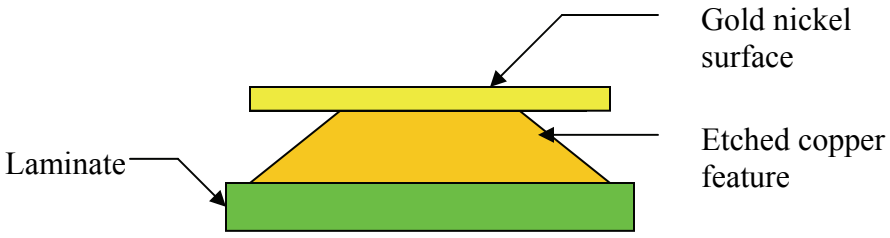


Figure 1 - Typical Feature Profile After Etch1

This problem was of course circumvented by the HASL process which is free of any overhang and is compatible with the pattern plate process popular today.

Flash Gold

More recently, the electrolytic gold nickel process has been modified for the most part by Chinese PCB fabricators and reintroduced to the market. The finish consists of approximately 200 micro inches of nickel with a soft gold over coating of two to four micro inches.

Since an electrolytic process is used for both metals, the plating process is quick and the porosity of the coating is very low. Because the thickness of the gold plating is restricted; gold embrittlement is not an issue. Also, it should be pointed out that by electrolytically plating the metal structure, the problems associated with ENIG: black pad, skip plating etc. are avoided.

A typical Flash Gold line is shown in Figure 2. The line is a continuous rack plating process similar to the electrolytic copper process used in the industry. The chemistry is available from several suppliers including Cookson. The current density of the gold process is typically 20 amps per square foot which is manageable for a thin coating.

Figure 2 - Flash gold line

Cross sections of PTHs with the flash gold coating are shown below.

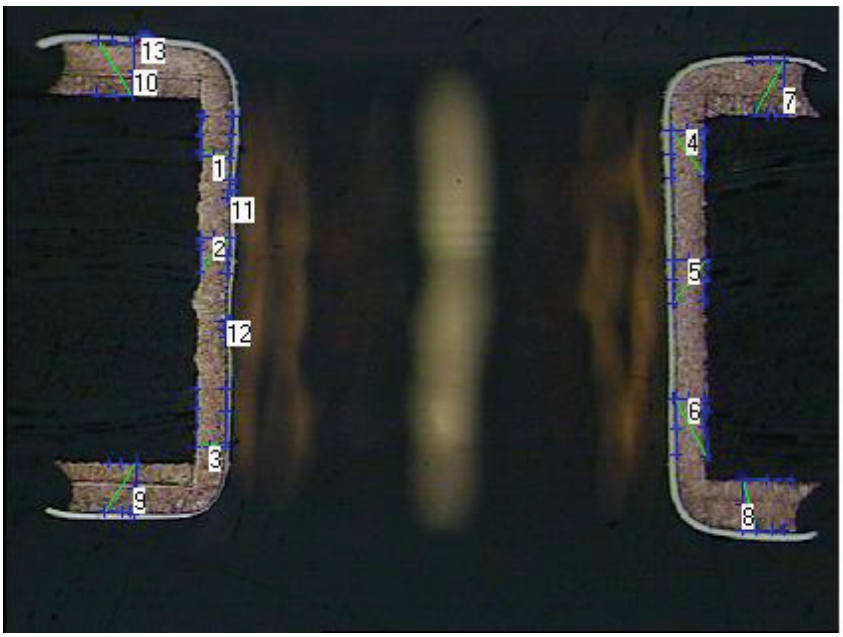


Figure 3 - Flash Gold Cross Sections

The solderability of the coating has been functionally tested by many users and found to be excellent. Cross sections of coupons that have been tested according to IPC 650 Method 2.4.14, the solder dip test, are shown below. The coating met the requirements of the test.

Also, Pulse Engineering has performed a battery of reliability test on Flash Gold surfaces including thermal shock as well as 1000 hour temperature/humidity testing. The test coupons were free of defects.

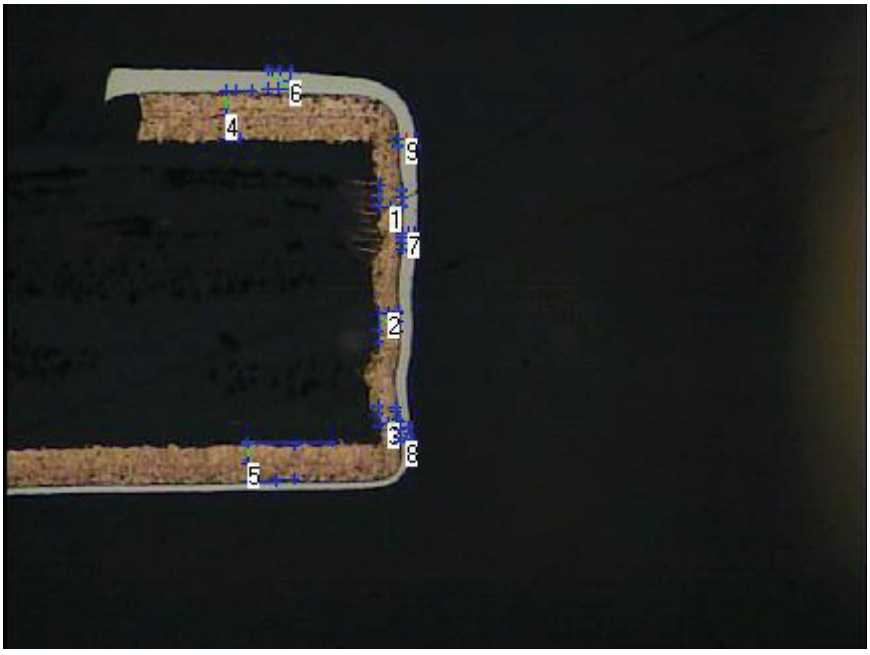
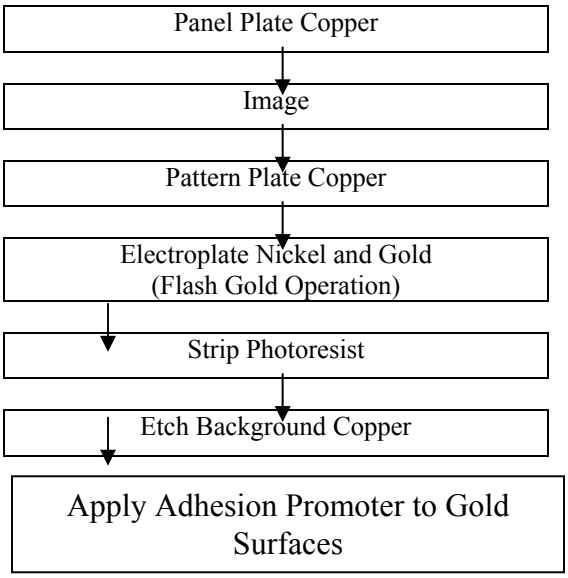


Figure 4 - Solderability Test

The Flash Gold Process

As mentioned above, in the past, an electrolytic nickel gold surface finish was offered by many North American PCB shops. A panel plating process was typically used and the surface finish also became the etch resist. This, however, left an overhang of the nickel gold structure.

This issue has been minimized by many Chinese fabricators who have replaced the panel plating process with a "panel-pattern-plate" process sometimes referred to P^3. In this procedure a two-step copper plating process is used; a flow chart is shown below.



The advantage of the P^3 strategy is that it reduces the thickness of the background copper that in turn reduces the amount of etching required. Consequently, the amount of over hang is restricted. A conceptual drawing is shown below.

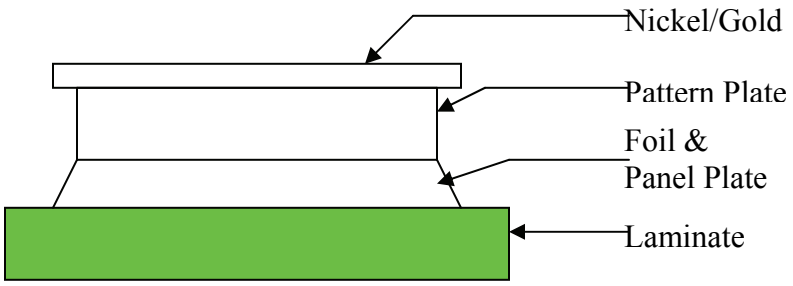


Figure 5 - Panel-Pattern-Plate Feature

By incorporating the Panel-Pattern-Plate copper plating process along with Flash Gold, the reliability issue, presented by the over hang, is minimized and essentially avoided.

Summary

Flash gold has recently been re-introduced into the PCB market along with a copper plating process that presents a viable surface finish alternative. The technology has found wide acceptance with Chinese fabricators and many domestic OEMs. The technology is cost competitive and reliable.