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Soldering to Gold Over Nickel Surfaces

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There are many things that can go wrong when soldering to gold plate over nickel surfaces. First of all, we know that gold and solder are not good friends, as any time solder comes into contact with gold, something seems to go wrong. Either the solder bonds to the gold and eventually pulls off as the tin and gold cross-migrate, leaving voids; or the solder completely removes the gold and is expected to bond to the metal which was under the gold.

If the gold is thicker than 40-50 micro-inches, the solder most likely may not dissolve all the gold and will bond to it. The solder will be dull-looking and, if the gold content in the solder exceeds about 5%, the solder joint will be brittle.

If the gold is thin, less than 20 micro-inches, it easily dissolves into the solder, making the solder joint look grainy. If the metal that was under the gold is not oxidized, the gold-contaminated solder will bond to it. However, as gold plates usually in a columnar structure, the gold should be at least 10 micro-inches thick to protect the base metal (in this case, nickel) from oxidation.

There are a couple of problems with nickel. If the nickel plate is electroless, quite often the plating bath contains phosphorous which codeposits with the nickel. We have found in the semiconductor industry that the phosphorous content in the nickel plating must be less than about 8% for the nickel to be solderable. If the nickel is applied by electroplating, it is possible for $Ni(OH)_2$ to precipitate with the nickel plating. If the nickel is not properly activated by acid rinsing before the gold plating is applied, it will not solder when the gold is dissolved away into the solder. In effect, the gold-contaminated solder may stick to some clean areas of the nickel. Another possibility is the codeposition of carbon with the nickel, another contamination that could cause solder not to bond.

As is often the case, a company is able to get good soldering with a stronger flux. This would point to the formation of nickel oxide that requires a stronger flux to remove. So, we could surmise either thin gold did not provide protection for the nickel, or the gold was plated over passive (unactivated) nickel.

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