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# Optimization of Tin Plating Process For Adhesive Bonding

## Introduction

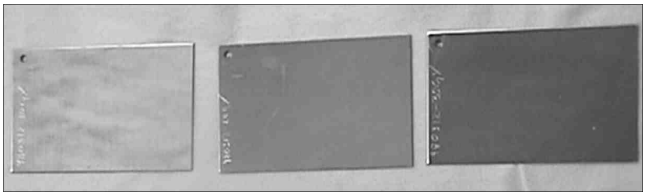
A supplier of electrically conductive adhesive and a printed wiring board (PWB) manufacturer were developing a new environmentally benevolent technology for attaching aluminum (Al) heat sinks to tin-plated PWBs to replace SnPb solder. The end user was a leading manufacturer of cellular phone communication systems.

## Problem

Reflow of the PWBs was required to mount devices. The difference in the thermal expansion coefficient of the PWB and the aluminum pallet caused intermittent delamination at the interface. This failure was occurring at the tin-adhesive interface and implied that the bond strength between the Sn and conductive adhesive was weak.

## Analysis

PWB sample lots without the Al heat sinks attached were visually examined (Fig. 1). The tin surface appeared "duller" on boards that exhibited acceptable adhesion and passed the reflow test.



Fail Fail Pass

*Fig. 1—Variation in tin surface appearance.*

To develop an understanding of this phenomenon, the tin surfaces were examined by the following techniques:

1. Scanning Electron Microsopy (SEM)—Surface appearance.
2. Surface Profilometry—Quantitative measure of surface roughness.
3. Peel Strength—Quantitative measure of bond strength (adhesive/Sn).
4. Colorimetry Spectrophotometer—Surface reflectance at 400 nm–700 nm.

SEM examination (Fig. 2) and surface profiles (Fig. 3) demonstrated that tin on boards that passed the reflow test exhibited a "rougher" surface structure.

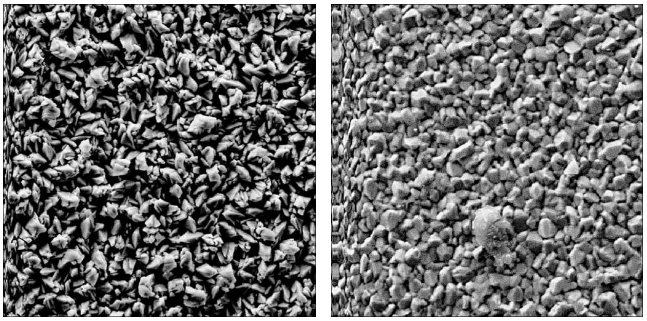


*Fig. 2—SEM at 1,200X of smooth tin (left) and rough tin (right).*

## Solution

A tin plating process, SnTech,* was optimized to provide maximum surface roughness without the presence of dendrites. Deposits were bonded with conductive adhesive to aluminum substrates, and the peel strength was measured. The optimized tin process with an RMS of 0.9 µm exhibited the highest peel strengths (Fig. 3).

Furthermore, it was necessary to develop a QC method to control the surface roughness of the electroplated tin prior to processing the PWBs. A non-destructive method utilizing a hand held spectrophotometer was developed (Fig. 4). As can be seen, the optimized tin process exhibits the lowest percentage reflectance compared to the highest reflectivity of tin deposits responsible for the weak bond to the conductive adhesive.

Obviously, this method can easily be adapted for quality control.

The optimized tin plating process was installed at the PWB manufacturer. P&SF

**SnTech is a proprietary product of EC&S.*

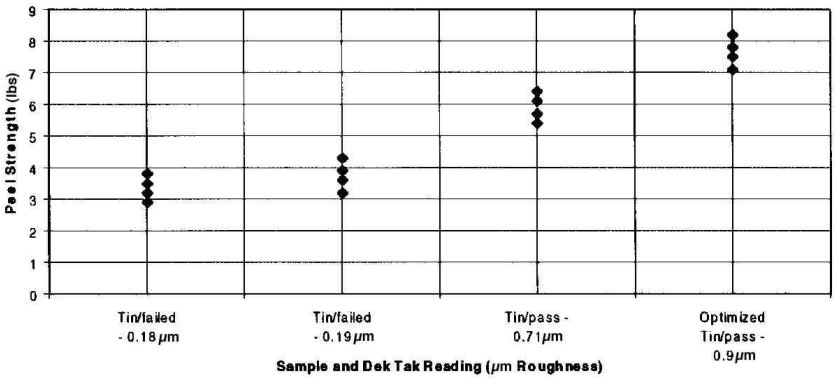



*Fig. 3—Comparison of tin roughness and peel strength.*

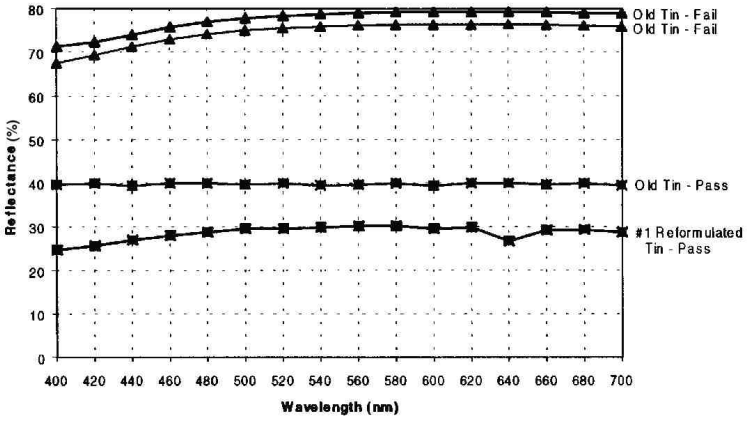



*Fig. 4—Reflectivity spectra of passing and failing tin finishes.*