



Los Angeles & Orange County Chapter



San Diego Chapter of the SMTA
presents:
***“Eliminating the WAG in
Final Finish Selection”***

Kathleen S. Palumbo, CEO & Founder

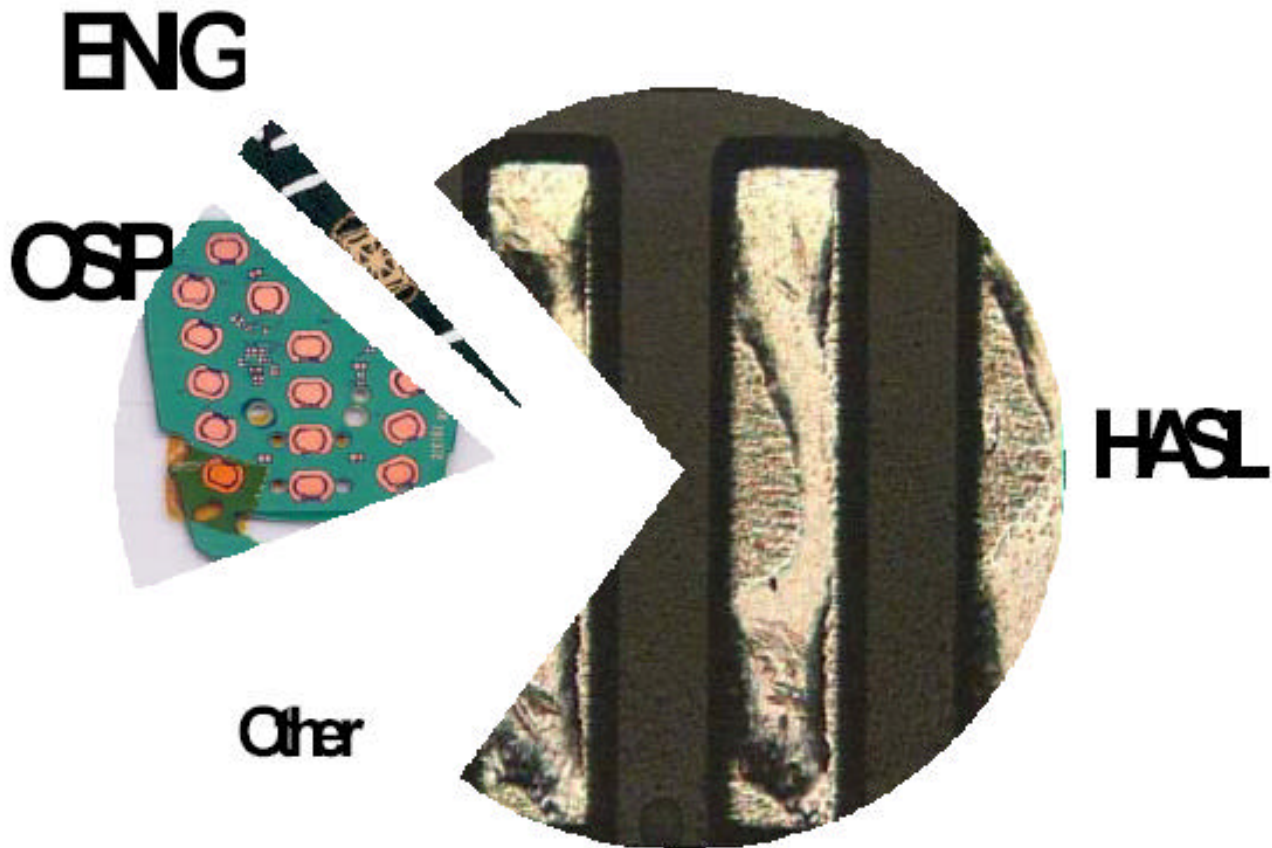
Member Of:



Final Finish Products Use

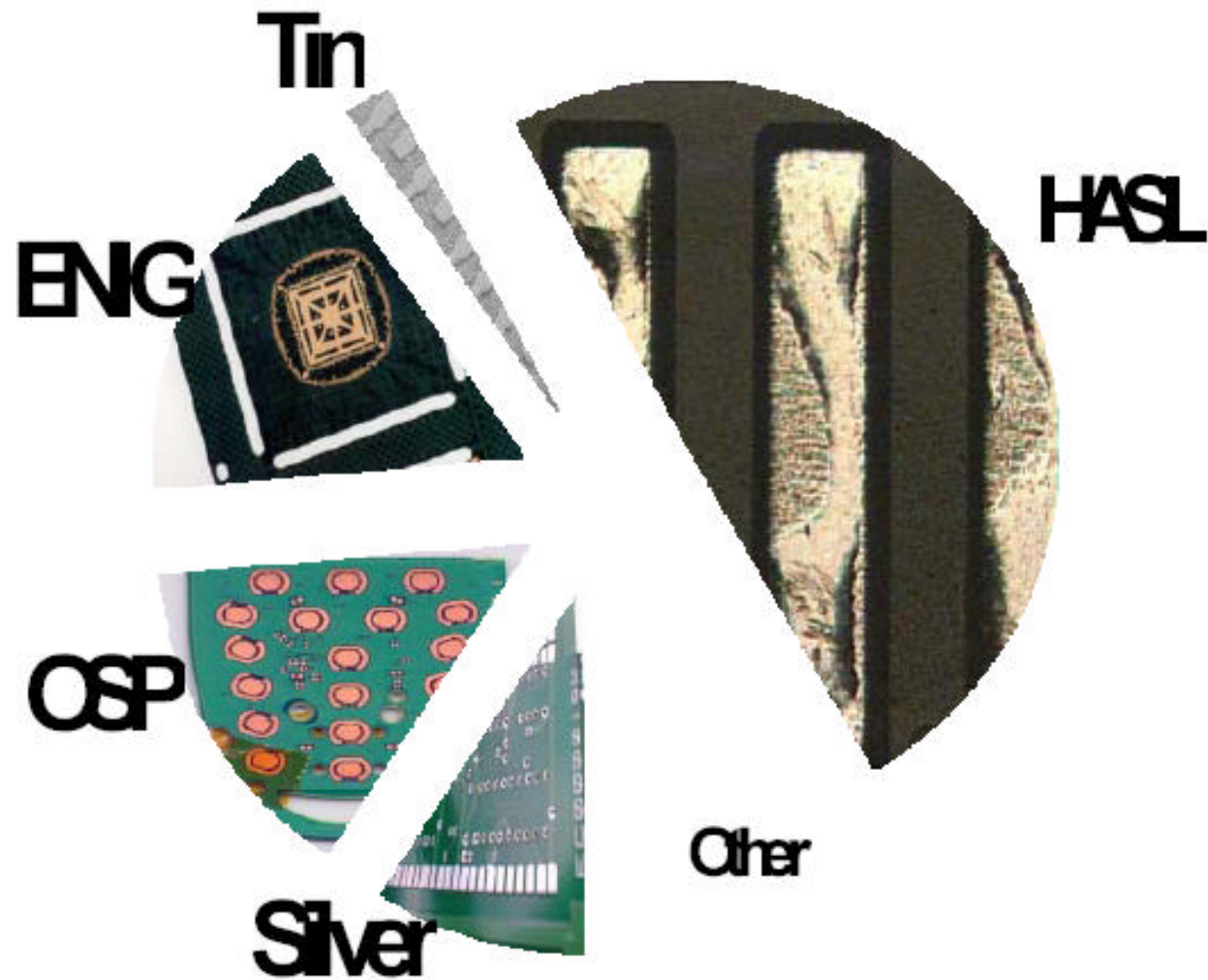
Final Finish Products Use

IPC Technology Marketing Research Council 1995



Final Finish Products Use

IPC Technology Marketing Research Council 2002



Conductivity Rating

Conductivity Rating

Gold + 1.4 Volts

Platinum

Iridium

Palladium + 0.83

Silver +0.80

Mercury

Osmium

Ruthenium

Copper + 0.344

Bismuth

Antimony

Tungsten

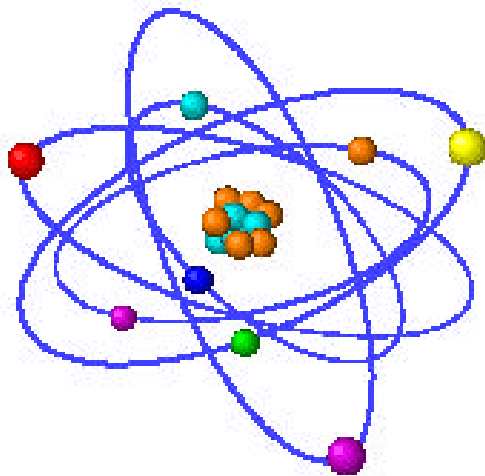
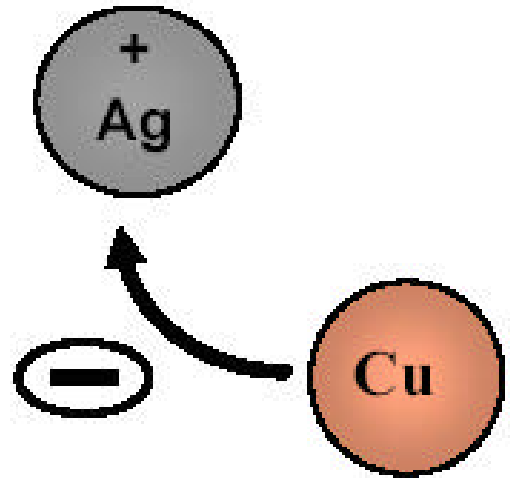
Hydrogen 0.0 Volts

Lead

Tin - 0.14

Molybdenum

Nickel - 0.25



Things
to
Consider

THINGS TO CONSIDER – Internal Needs

➤ Internal Needs

- ✓ Must Maintain Pristine Signal Integrity
 - ❖ Especially True When Dealing With Assemblies That Run at Very High Frequencies...mostly Above 3 GHz
 - Despite the Mass of the Trace Lines, the Electrical Signals Run Along the Outer Perimeter of the Traces
 - This Phenomenon Is Referred to As the "Skin Effect"

THINGS TO CONSIDER – Internal Needs

- ❖ Finishes That Rely on Electroless Nickel (ENIG, Ni-PD-AU) Do Not Perform Well on Boards That Run Speeds in Excess of 5 Ghz
 - Due to Nickel Plate Remaining on Copper Traces
 - Due to the “Skin Effect”
 - Slows the Signal Because Copper Is a Much Better Conductor

THINGS TO CONSIDER – Internal Needs

- ✓ High Joint Strength
- ✓ Assist in Controlling Electromagnetic Interference
- ✓ Low Contact Resistance for Life of Product (Some Systems)
 - ❖ Touch Pads (Such As Keyboards)
 - ❖ Plated Edge Rails (Make Electrical Contact With the System's Chassis)
- ✓ Wire Bonding May Also Be a Requirement

THINGS TO CONSIDER – External Needs

➤ External Needs

- ✓ #1 Need Is Wetting & Solderability
 - ❖ Wettability Is an Indication of the Solderability
 - Solderability Must Result in High Joint Strength
 - ❖ Cost, Cost, Cost!
 - Not Just Economical, but Reliable As Well
 - Remember the Hidden Cost of Yield Loss

THINGS TO CONSIDER – External Needs

- ❖ Inspectable & Testable
- ❖ Prevents Bridging and Misprints
- ❖ Shelf Life
 - Short Shelf Life Leads to Reduced Solderability and an Increase in Replacement Costs
- ❖ Reworkable (Saves Expensive Re-makes)
- ❖ Maintains All of Its Properties for the Life of the Product

Types of Final Finishes

Types of Final Finishes

- HASL
- Gold Immersion (over Electroless Nickel)
- Silver Immersion (directly over Copper)
- Tin Immersion
- OSP (Organic Solderability)
- Bare Copper
- PPT (Precision Pad Technology or SIPAD)

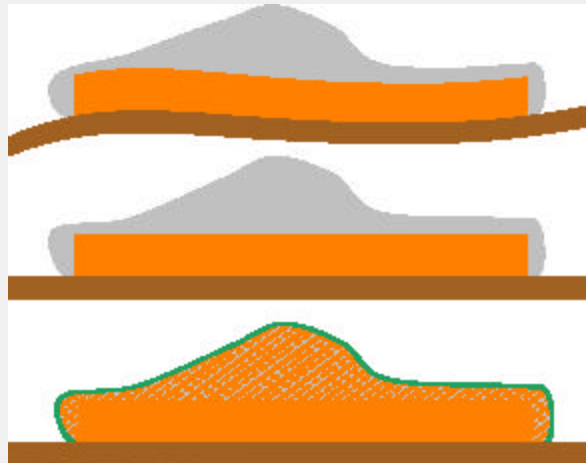
Final Finishes Overview

HASL Surface Finish Overview

- HASL=HOT AIR SOLDER LEVEL(directly over Copper)
 - ✓ Fabrication Design Note
 - ❖ Copper Lands/Pads Are to Be Coated With a Solder Composition of Sn60, or Sn63 of ANSI/J-STD-004 & ANSI/J-STD-006. PCB Must Pass ANSI/J-STD-003 Solderability Test C Category 2 by an Independent Lab. Certificate of Conformance and Passing Lab Report Shall Be Provided Prior to Lot Acceptance.

HASL Surface Finish Overview

- ✓ A Solder Coating Directly Over Bare Copper, Which Is Intended to Preserve the Bare Copper During Storage and Prior to Assembly
- ✓ Can Be Applied in Horizontal or Vertical Equipment



HASL Surface Finish Overview

✓ Advantages

- ❖ Widely Available
- ❖ In-expensive
- ❖ Cu/Sn Solder Joint

✓ Concerns

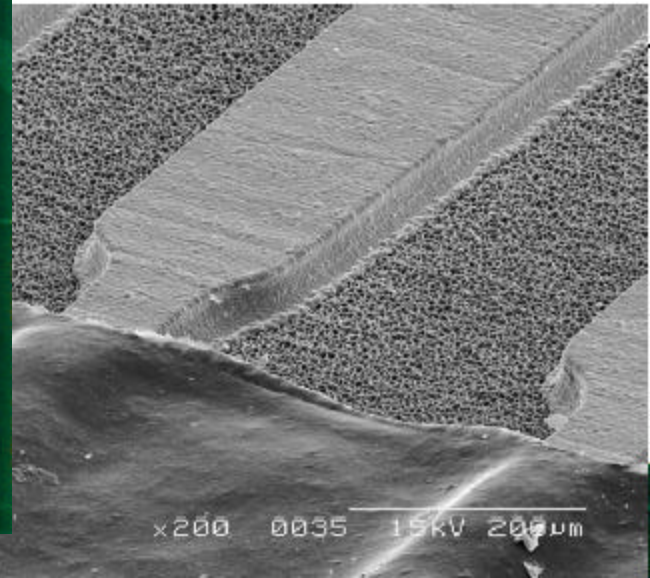
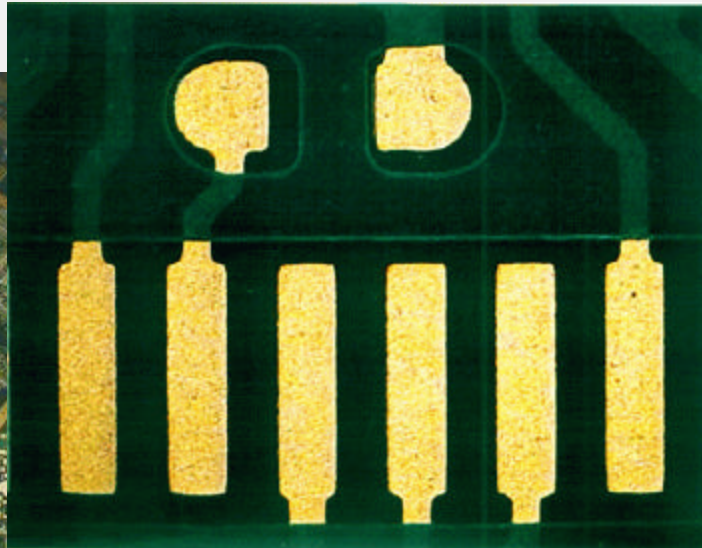
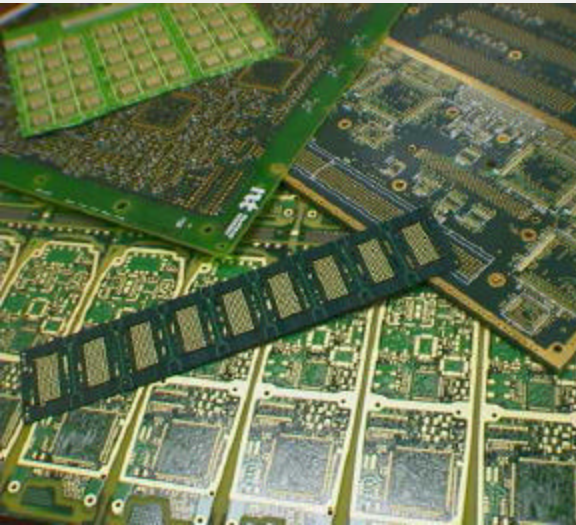
- ❖ High Maintenance / High Waste
- ❖ Poor Process Controls
- ❖ Not Flat / Paste Mis-Prints / No Fine Pitch Assembly
- ❖ Too Thin – Intermetallics
- ❖ Additional Thermal Excursion Affects MTBF of PCB
- ❖ Not Lead Free

Gold Immersion Surface Finish Overview

➤ Gold Immersion (over Electroless Nickel)

✓ Fabrication Design Note

- ❖ Copper Lands/Pads Are to Be Overplated With a Minimum of 150 Micro Inches of Low Stress Nickel Followed With 5 to 7 Micro Inches of Flash Gold



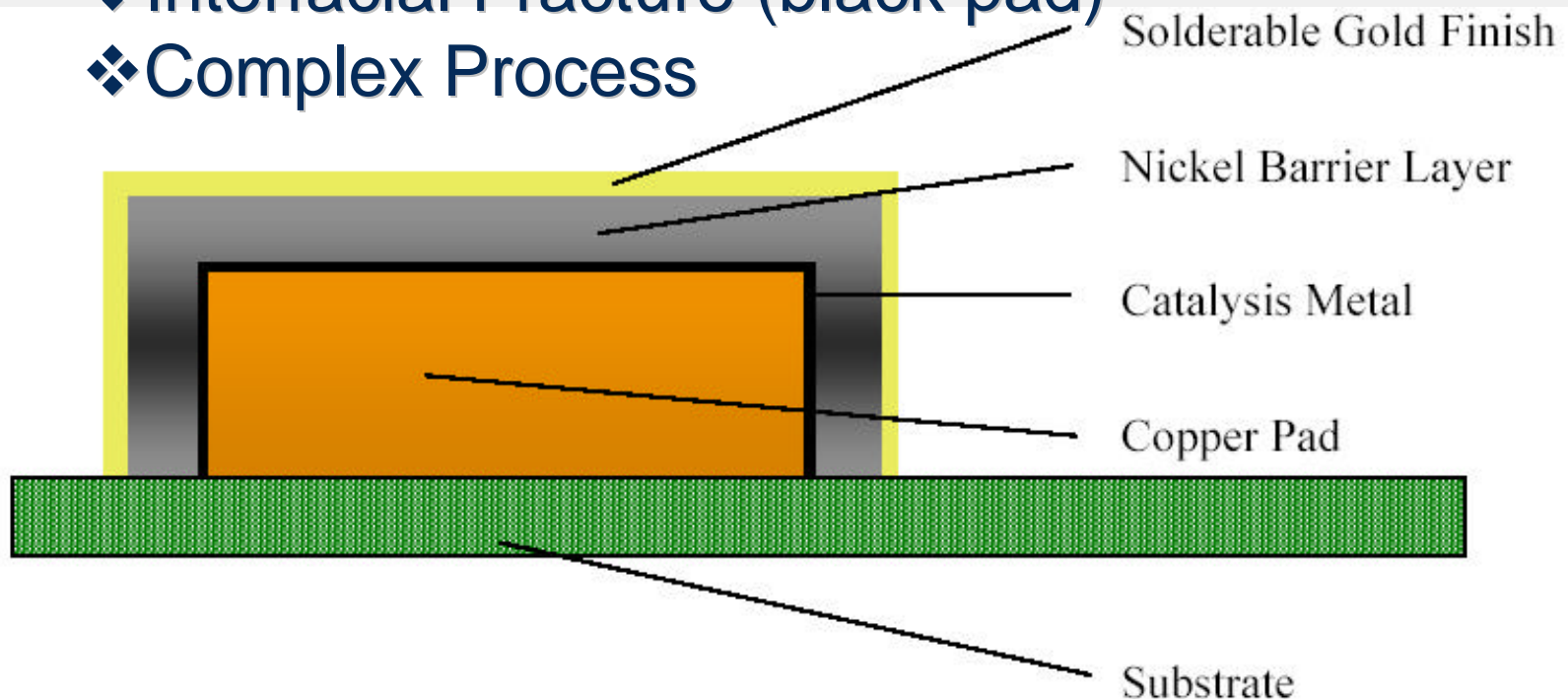
Gold Immersion Surface Finish Overview

- **Gold Immersion (over Electroless Nickel)**
 - ✓ Selective Metallization of Copper Surfaces
 - ✓ Specified by OEM's for Critical End-use Applications
 - ✓ Advantages
 - ❖ Widely Available
 - ❖ Surface Contact (wire bonding & keypads)
 - ❖ Durable & Flat (Ideal for Fine Pitch/BGA & Direct-chip Attach Assembly)
 - ❖ Good Solderability Both As Plated and After Accelerated Aging
 - ❖ Depending on Chemistry Supplier (& Fabricators Ability) Could Be Used in Aluminum Wire Bond Applications

Gold Immersion Surface Finish Overview

✓ Concerns

- ❖ Expensive
- ❖ Attacks Soldermask
- ❖ Porosity Issues
- ❖ Not Reworkable
- ❖ Brittle Ni/Sn Solder Joint
- ❖ Interfacial Fracture (black pad)
- ❖ Complex Process



Gold Immersion Surface Finish Overview

Cleaner

rinsing

Microetch

rinsing

Catalyst

rinsing

Acid

rinsing

Nickel

rinsing

Gold

rinsing

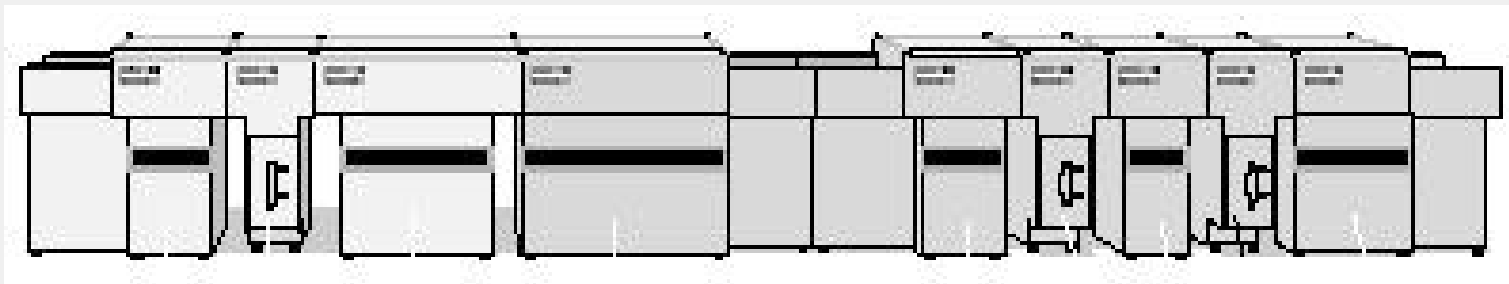


Silver Immersion Surface Finish Overview

➤ Silver Immersion (directly over Copper)

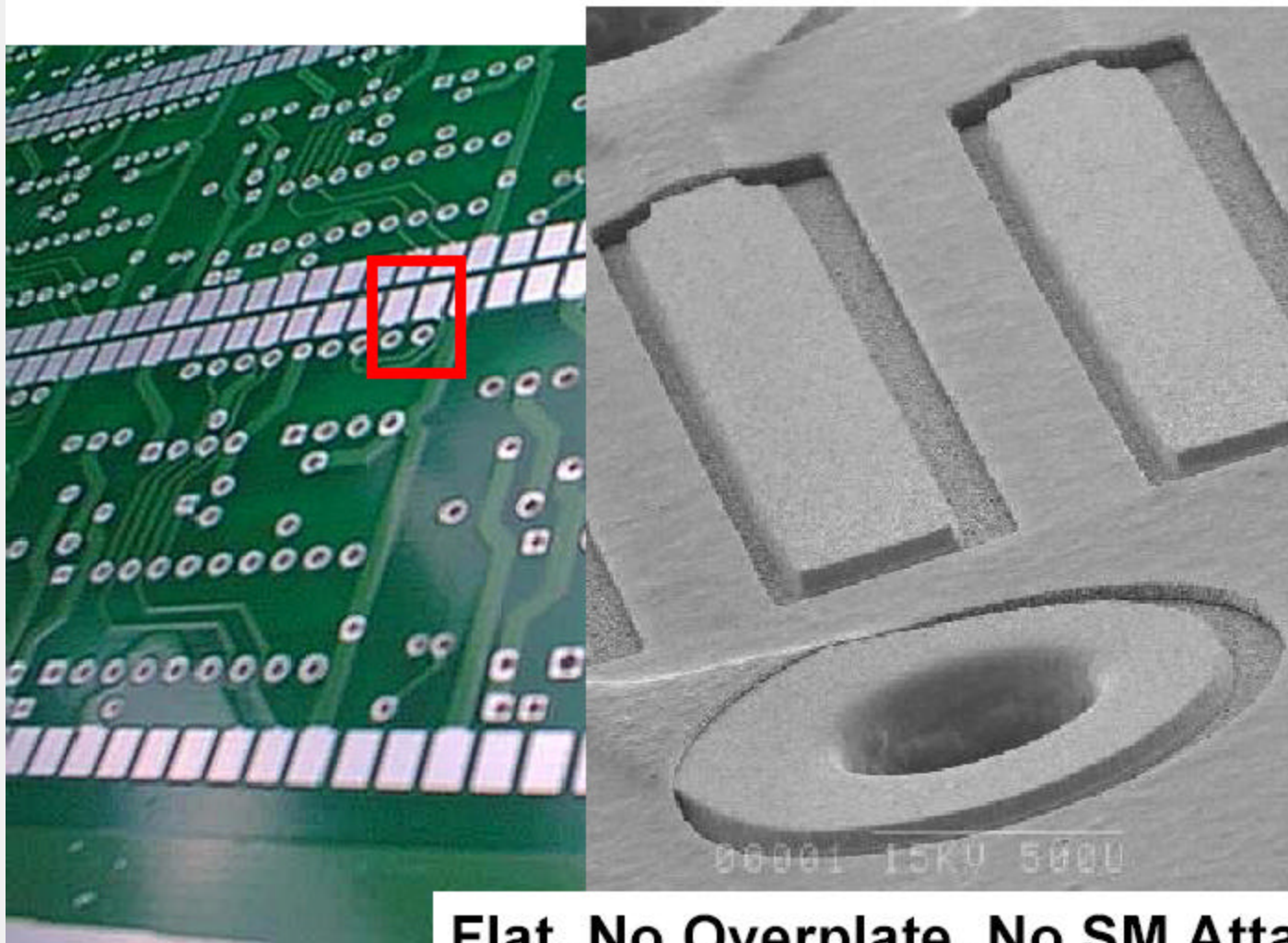
✓ Fabrication Design Note

- ❖ Copper Lands/Pads Are to Be Over-plated With 4 to 10 Micro Inches of Silver Using the Alpha Level Process or MacDermid Sterling Silver Process



Silver Immersion Surface Finish Overview

- ✓ A Metallic Solderability Preservative That Provides a Precious Metal, Oxide-resistant Board Coating
- ✓ Can Be Applied in Horizontal or Vertical Equipment



Flat, No Overplate, No SM Attack

Silver Immersion Surface Finish Overview

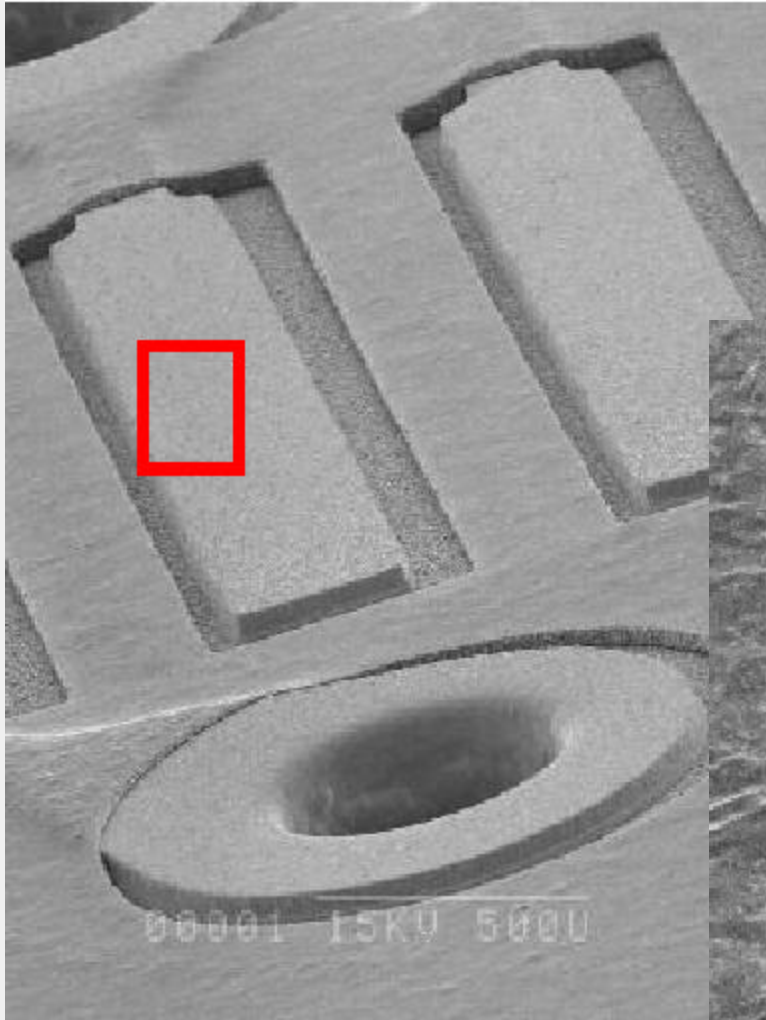
✓ Top Choice Among OEM's Worldwide

✓ Advantages

- ❖ Superior Solderability in a Variety of Assembly Applications
- ❖ Surface Contact (wire bonding, keypads, ICT)
- ❖ Compatible With All Solder Masks, Fluxes, and Pastes
- ❖ User Friendly Chemistry Is Stable, Versatile, & Flexible
- ❖ Low Cost
- ❖ Reworkable
- ❖ Simple Process
- ❖ Short Cycle Time

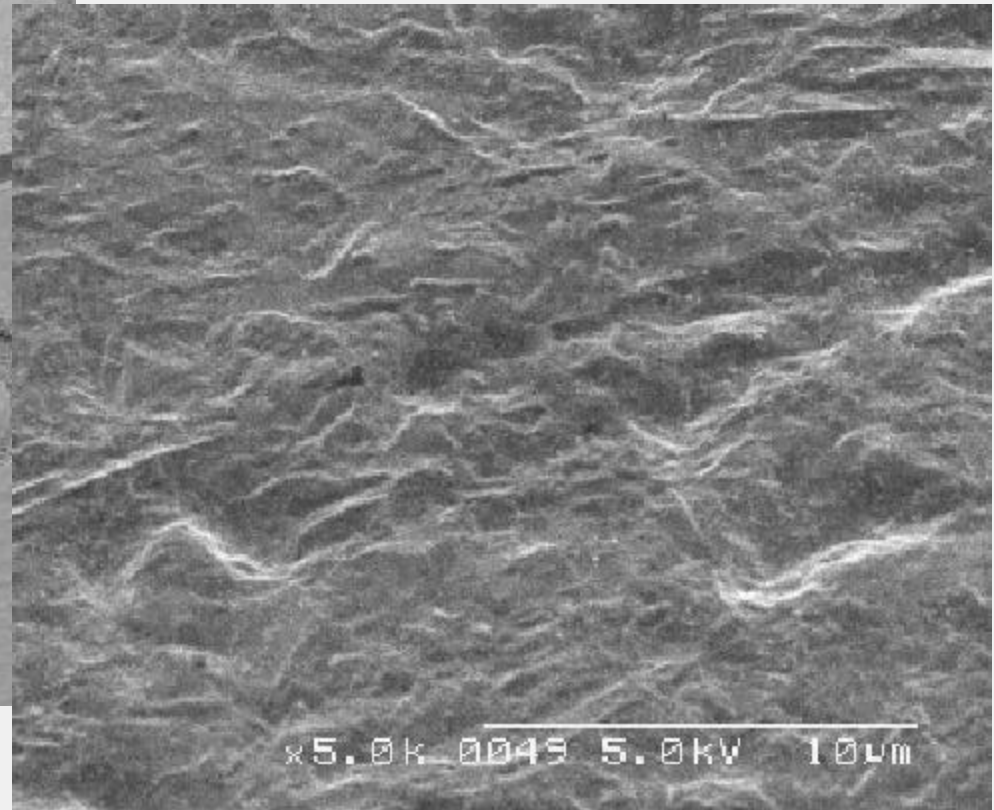
Silver Immersion Surface Finish Overview

❖ No Porosity Issues



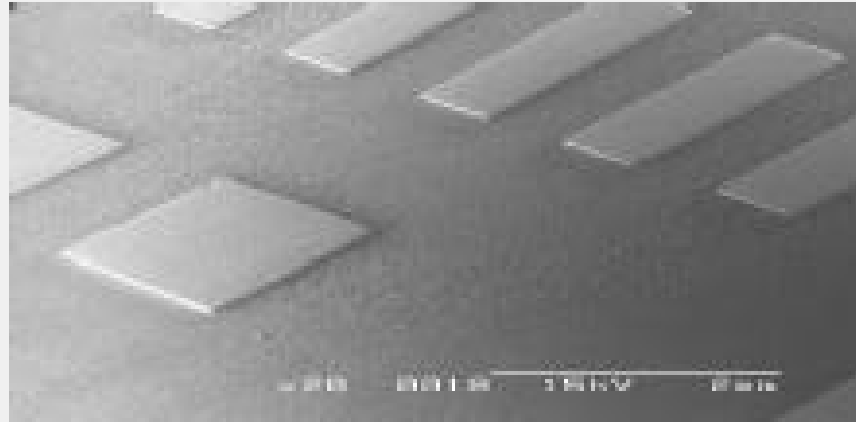
72X

5000X



Silver Immersion Surface Finish Overview

❖ Really Flat & Really Thin



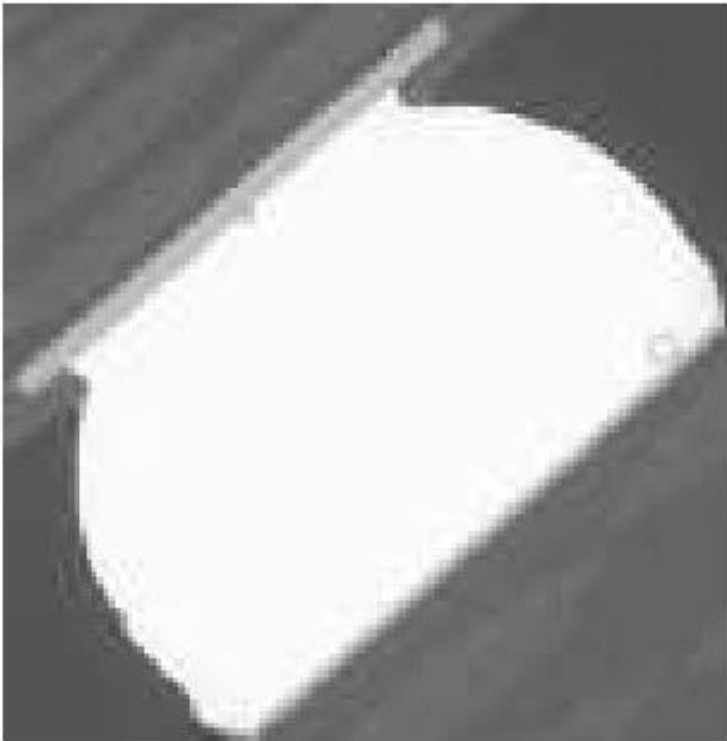
- HASL:
 - up to 1500 μin .



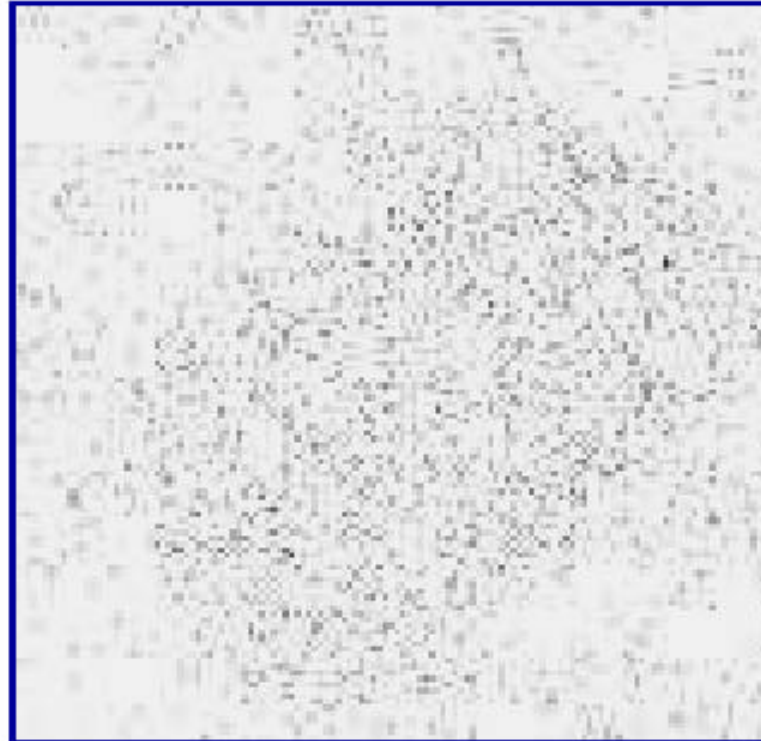
- Immersion Ag:
 - $\sim 10 \mu\text{in}$.
 - $< 1/100\text{th}$ of human hair

Silver Immersion Surface Finish Overview

❖ Strong Cu/Sn Solder Joint



Visual

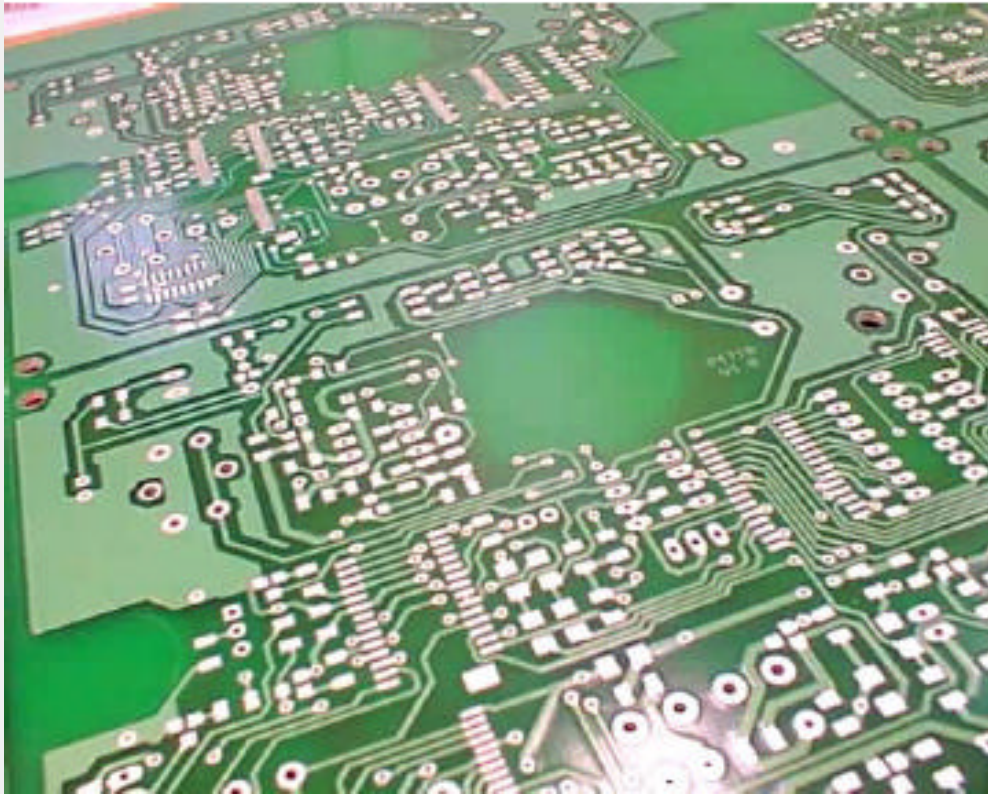


Ag Dot-Map

Ref: D.Hillman, Rockwell; AP EX 2000

Silver Immersion Surface Finish Overview

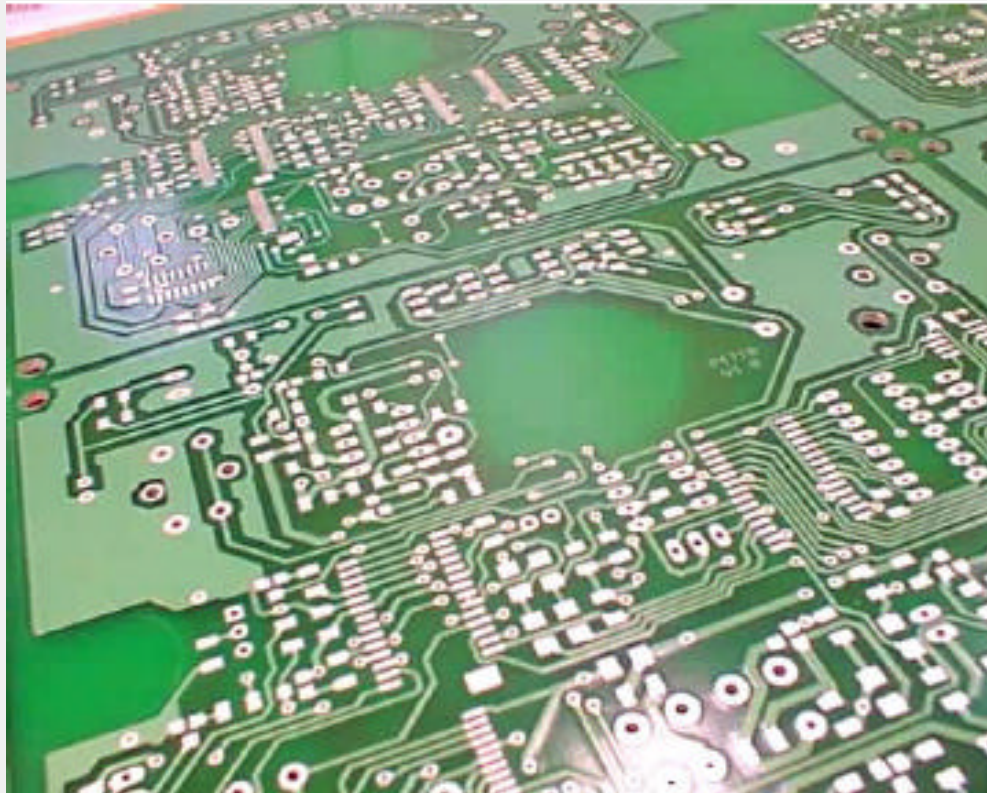
- ❖ Good Shelf Life – No Intermetallic Formation
- ❖ Visually Inspectable
- ❖ High Speed Signal Integrity



Silver Immersion Surface Finish Overview

✓ Concerns

- ❖ Tarnish Concerns
- ❖ Sliding Connector Limitation
- ❖ Electromigration **Resolved**

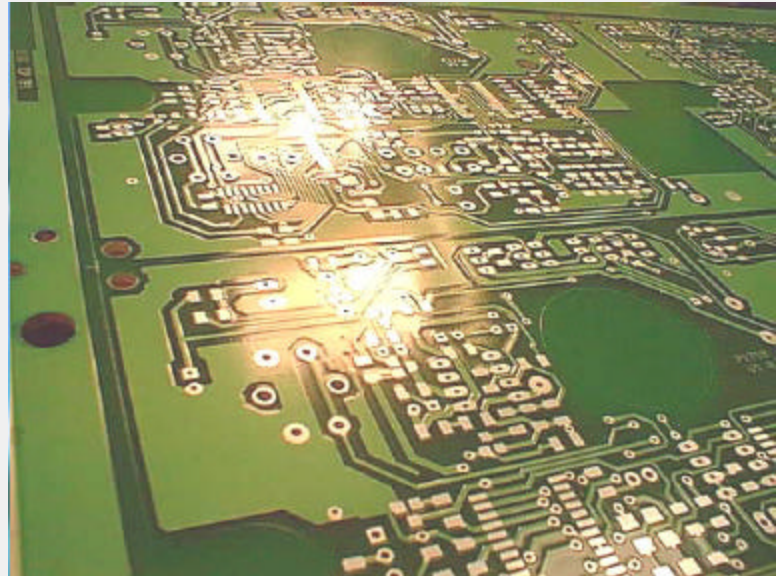


Tin Immersion Surface Finish Overview

➤ Tin Immersion (directly over Copper)

✓ Fabrication Design Note

- ❖ Copper Lands/Pads Are to Be Over-plated
With .7 to 1 Micrometers (Microns) of
Immersion Tin.



Tin Immersion Surface Finish Overview

- ✓ Selective Metallization of Copper Surfaces
- ✓ Depending on Chemistry May Be Applied Automatically With Horizontal or Vertical Processing Equipment
- ✓ Advantages
 - ❖ Low Cost
 - ❖ Reworkable
 - ❖ Flat Surface
 - ❖ Cu/Sn Solder Joint
 - ❖ Laser Structuring Capability
 - ❖ Excellent for Use in Compliant Pin and Press Fit Applications

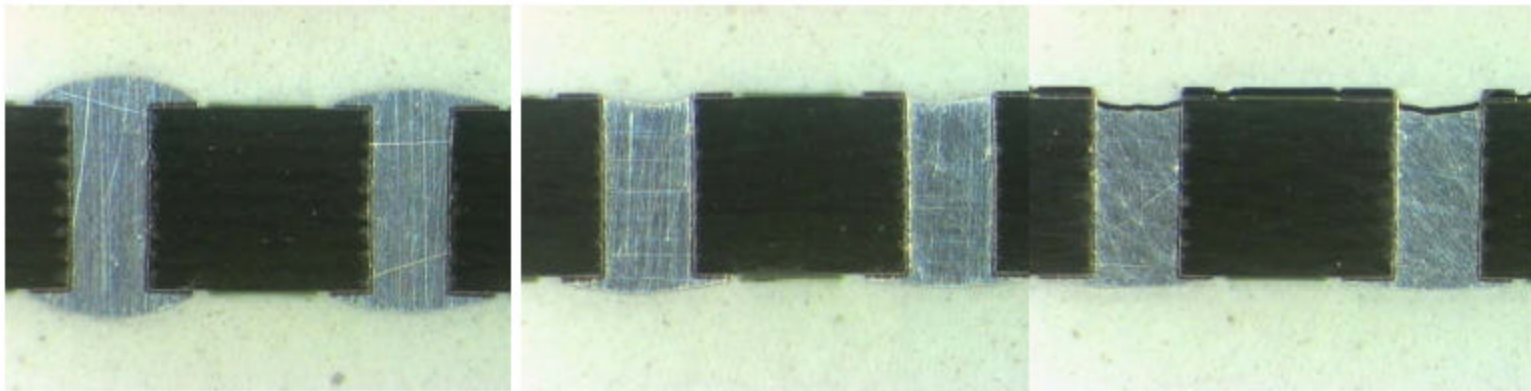


Tin Immersion Surface Finish Overview

✓ Concerns

- ❖ Solderability, Storage, & Handling Issues Are More Prevalent
- ❖ Quick Intermetallic – Reduced Shelf Life / Surface Conductivity
- ❖ Thickness Measurement
- ❖ Soldermask Attack – Like Ni
- ❖ Bath Contains Thiourea – A Known Carcinogen

IPC-J-STD-003 Test C



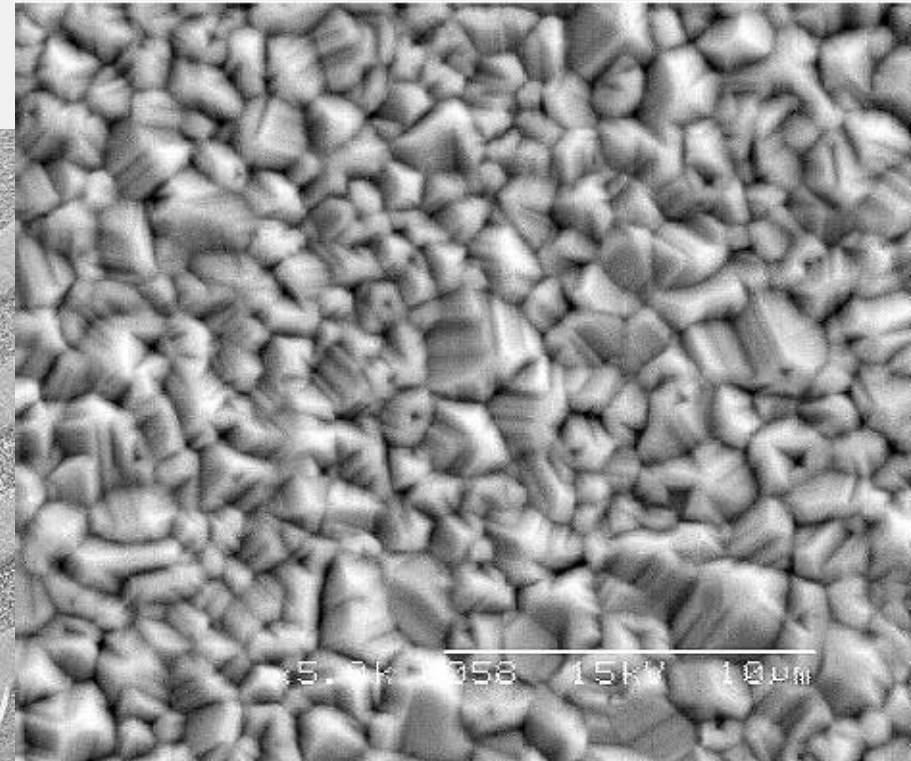
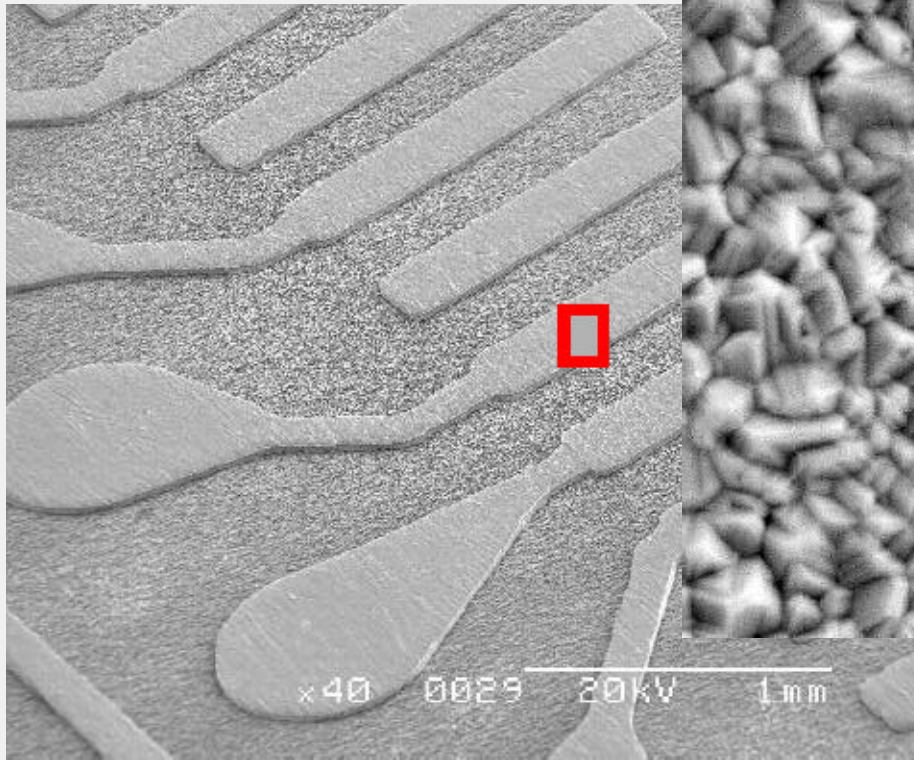
As Plated

4 h, 155 °C

8 h, 155 °C

Tin Immersion Surface Finish Overview

- ❖ Long Dwell Time Required
- ❖ Extra Rinsing Should be Considered
- ❖ Oxidized Tin in Plating Bath (By-Product Plating Reaction) Compromises Coating Integrity
- ❖ **Tin Whiskers!**

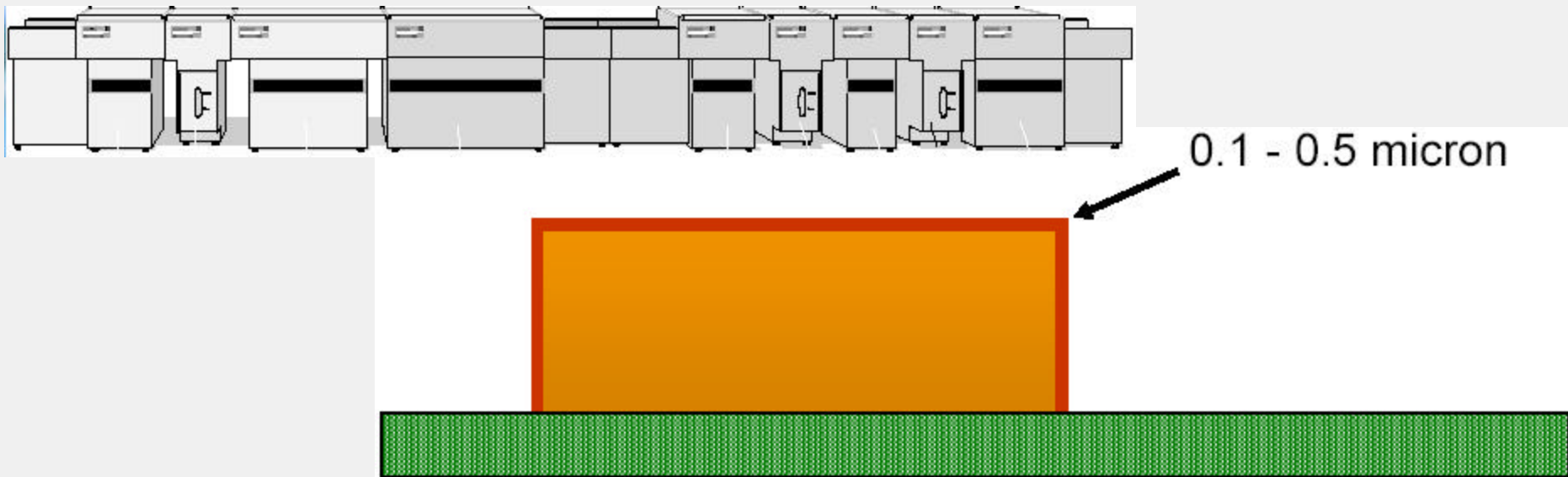


OSP Surface Finish Overview

➤ OSP=Organic Solderability Preservative
(directly over Copper)

✓ Fabrication Design Note

❖ Copper Lands/Pads Are to Be Over-coated With a Uniform Coating of OSP.



OSP Surface Finish Overview

- ✓ A Benzimidazole Based Solderability Preservative Coating Intended to Maintain Solderability of Bare Copper Boards Through Shipment, Storage, and Multiple Solder Paste Assembly Operations.
- ✓ Coating Thickness Uniformity Achieved Through Acidic Carrier
 - ❖ Thick Enough to Preserve Solderability
 - ❖ Thin Enough to Be Displaced by Low-clean Fluxes
- ✓ Advantages
 - ❖ Low Cost
 - ❖ Extremely Flat
 - ❖ Fast Process / Low Cycle Time
 - ❖ Reworkable
 - ❖ Cu/Sn Solder Joint

OSP Surface Finish Overview

✓ Concerns

- ❖ Limited Shelf Life – Degrades with Temperature
- ❖ Minimum Thermal Cycles & Sensitive to Elevated Reflow Temperatures (Such As Those Needed for Lead Free)
- ❖ Solderability, Storage, and Handling Issues Are More Prevalent
- ❖ No Surface Contact (No ICT, No Wire bonding)
- ❖ Difficult to Inspect for Skip Plating and Residues Left From Previous Process Steps
- ❖ Coating Thickness Critical Yet Impossible to Validate – Dissolve Coating and Perform UV Spectrometer Analysis
- ❖ Solderability Testing with Steam Age Pre-Conditioning a Must

Bare Copper Surface Finish Overview

➤ Bare Copper

- ✓ Cleaned Prior to Packaging and Shipment
- ✓ Cost Effective
- ✓ Solderability Is Good for at Least 3 Days
 - ❖ More If Proper Environmental and Handling Controls Are in Place
- ✓ Limited Thermal Cycles
- ✓ Excellent Solderability
- ✓ Fabrication Design Note
 - ❖ Copper Lands/pads Are to Be Clean Bare Copper.

PPT Surface Finish Overview

- PPT (Precision Pad Technology or SIPAD)
 - ✓ Patented Solid Solder Deposit Process
 - ✓ Coating Over HASL, Immersion Gold, Immersion Silver, Immersion Tin, OSP, or Just Plain Copper
 - ✓ Surface Is Flat With a “*Mesh*” Impression
 - ✓ CCA Does Gross Print With Tacky Flux
 - ✓ Capable of Handling Multiple Thermal Cycles

PPT Surface Finish Overview

✓ Fabrication Design Note

- ❖ Copper Lands/pads Are to Be Coated With a Solder Composition of Sn63 Using the Patented Precision Pad Technology or SIPAD Process. Solder Quantity Shall Allow for the Formation of Acceptable Solder Fillets Per IPC-A-610 CCA Requirements.

The Really
Big
Question...

The Big Question

- ✓ **Is There One Surface Finish That Can Fulfill All of My Needs?**
 - ❖ The Closest Is ***Silver Immersion***
 - ❖ Not Well Suited for Back Panel Applications

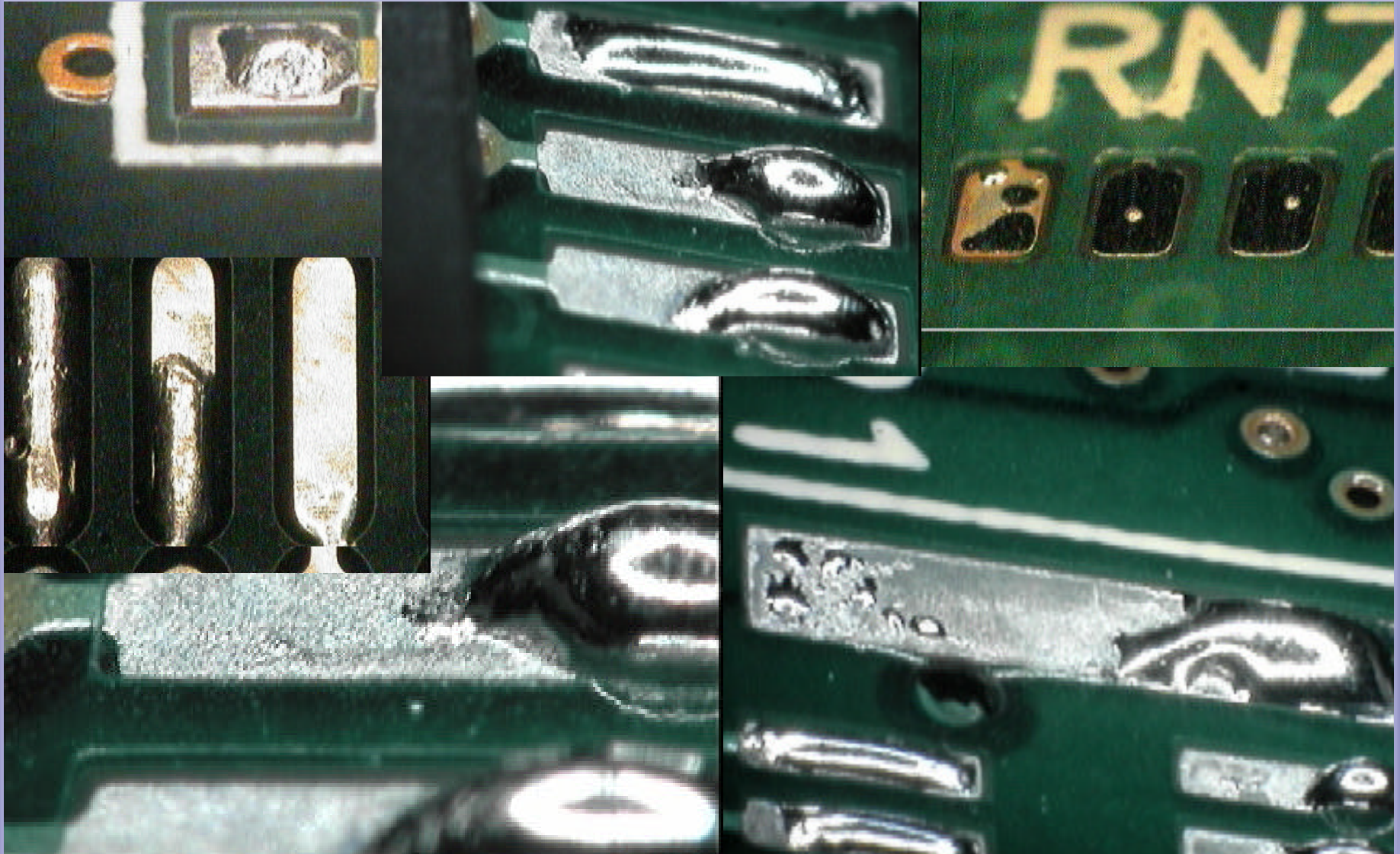
Final Finishes From A CCA Point of View

HASL Surface Finish – CCA View

➤ HASL

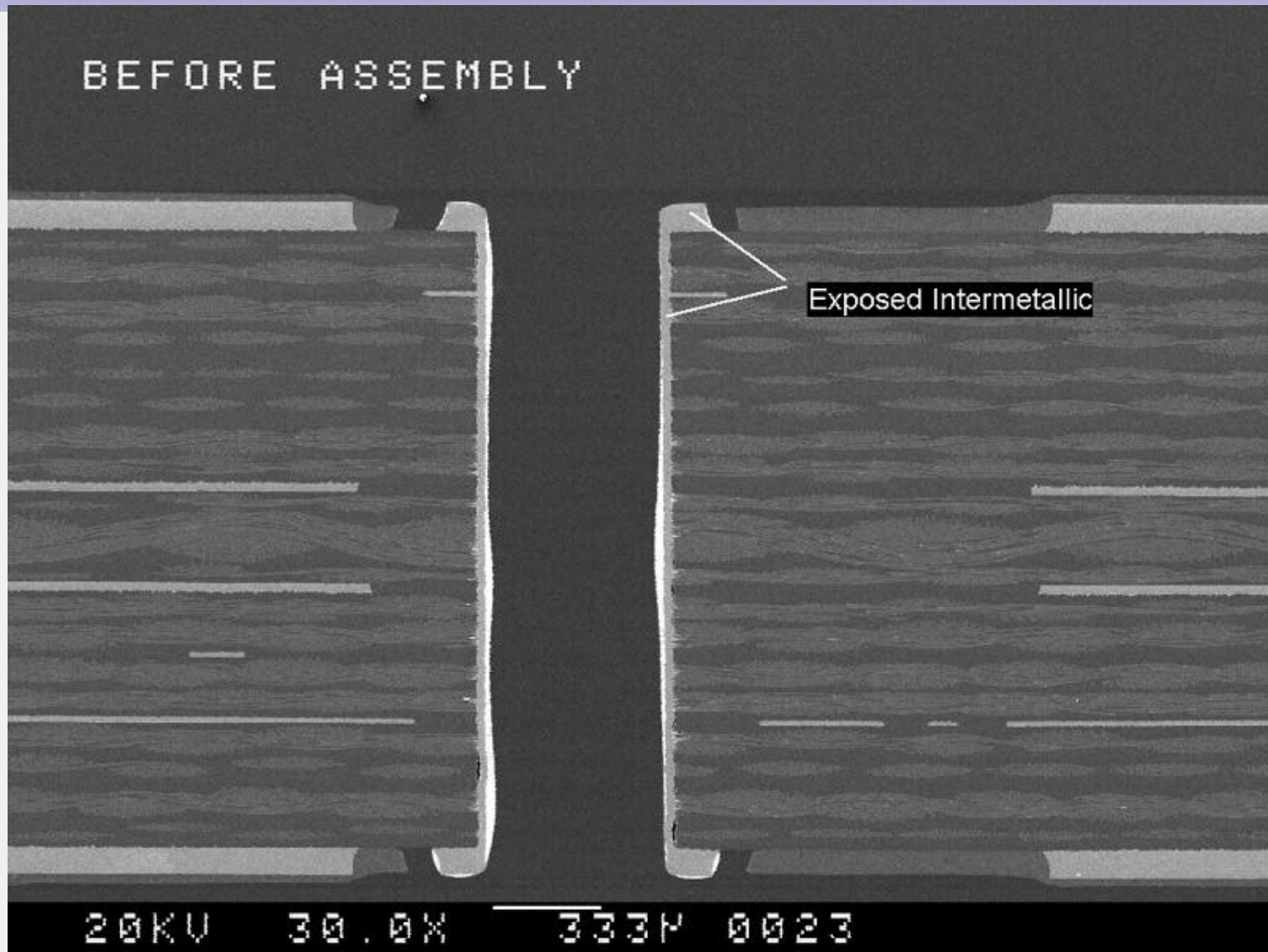
- ✓ Many Board Houses Sub-out Their HASL Process
- ✓ Many HASL Shops Lack Process Controls
 - ❖ If It Didn't Solder the First Time (Probably Due to Dirty Copper) They Send It Back Through
 - ❖ Each Thermal Excursion Affects PCB MTBF Rate
 - ❖ HASL Shops Do Not Properly Maintain Solder Bath
 - Copper Level Is Too High, Which Causes Dewetting
 - Dewetting? No Turning Back...it Can't Be Fixed!
- ✓ HASL Hides “*Real*” Issues
 - ❖ Solderability Testing with Steam-Age Pre-Conditioning An Absolute Must!
- ✓ Lead Free – Not Likely

Reasons For...



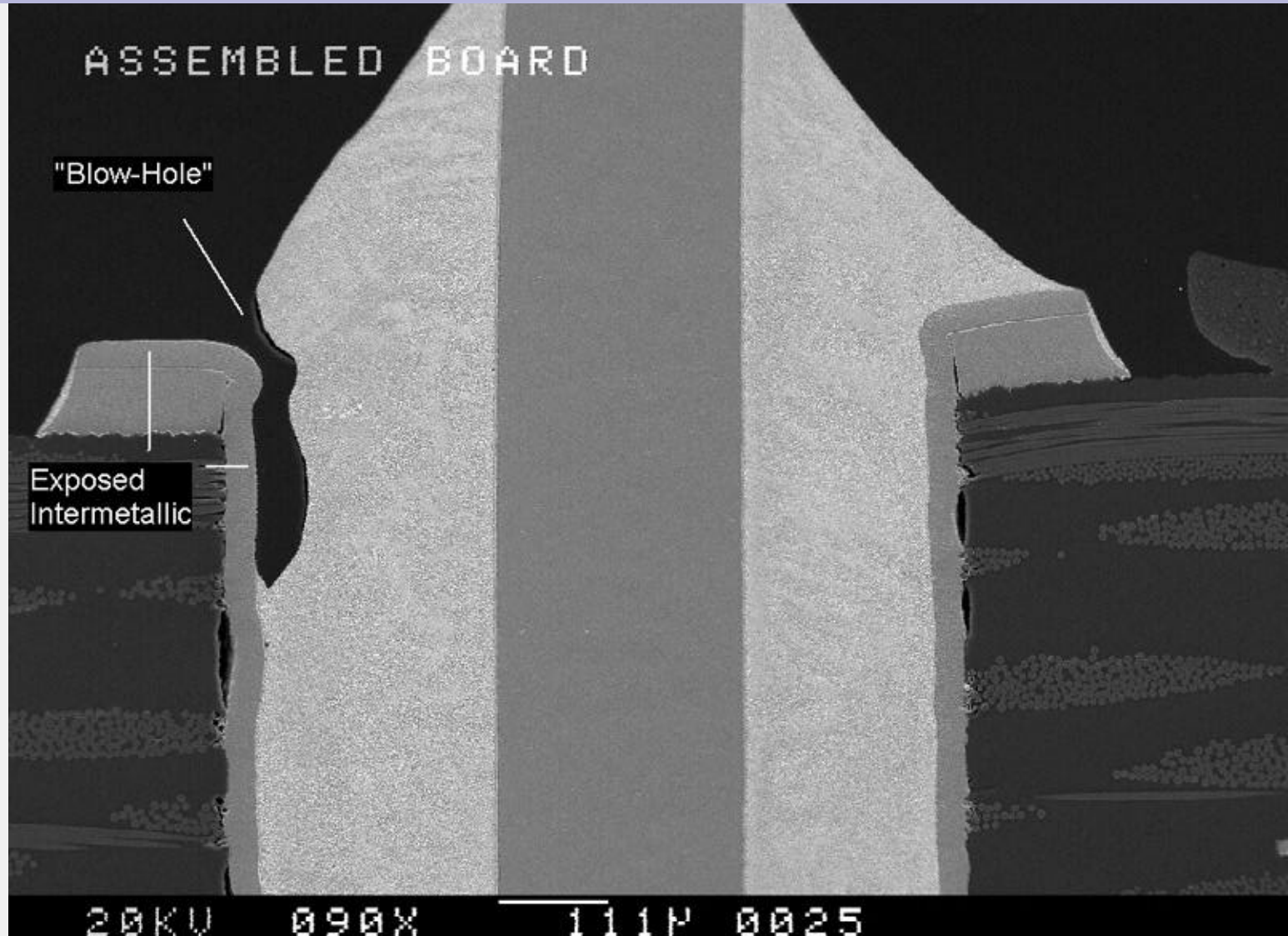
Solderability Testing

Reasons For...



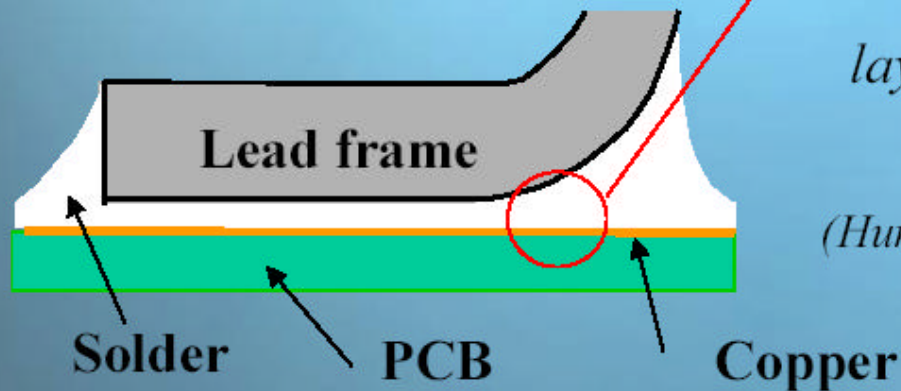
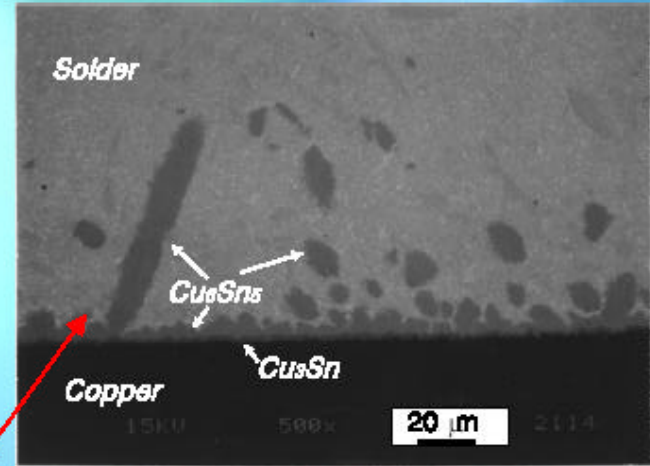
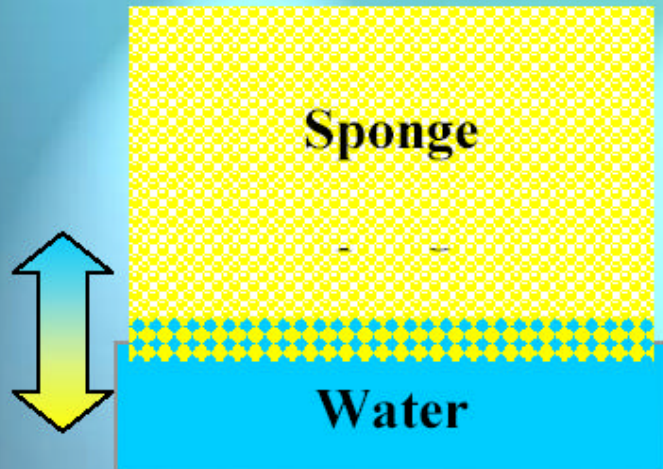
Solderability Testing

Reasons For...



Solderability Testing

Reasons For... Intermetallics



*Micrograph showing Intermetallic
layers at interface between PCB
and solder
(Human hair approximately $50\ \mu m$)*

Solderability Testing

Reasons For...

Intermetallic Impact on Solder Joint Reliability

- Intermetallics are present in SnPb joints.
- Intermetallics continually grow at ambient temperatures and rapidly at higher temp.
- Initial Intermetallic thickness is directly linked to soldering temperatures.
- Lead-Free processes will operate higher soldering temperatures.
- Hence thicker Intermetallic layer with lead-free soldering.

Solderability Testing

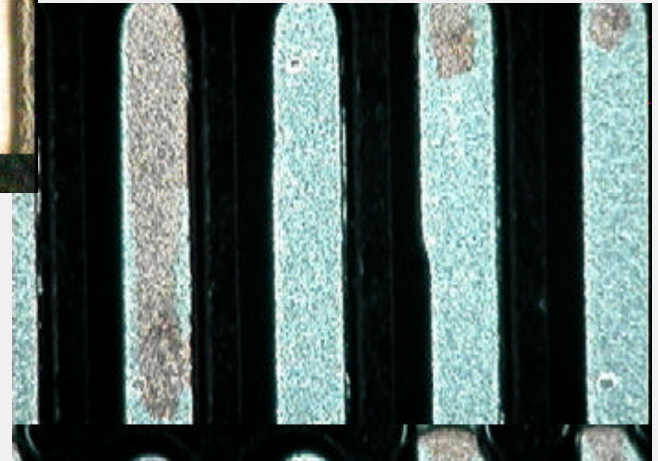
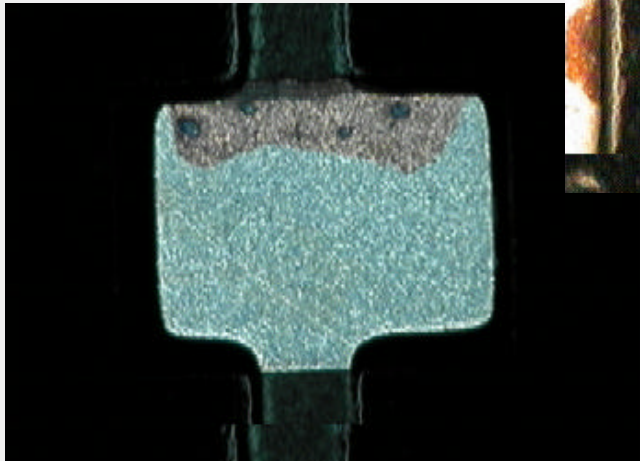
Silver Surface Finish – CCA View

➤ Silver Immersion

- ✓ Silver Molecular Structure Related to Solder
- ✓ Silver Amalgamates Into the Solder
- ✓ Surface Is FLAT, FLAT, FLAT!
- ✓ Great Shelf Life
- ✓ Neutral PH Bath at Low Temperatures
- ✓ Silver Migration...no!
 - ❖ Never Proven - Silver Is Too Thin of Coating
- ✓ Silver Won't Stick to Dirty Copper
- ✓ Great Contrast...allows Naked Eye Detection
- ✓ Silver Finish Is Actually REWORKABLE
 - ❖ Silver Can Be Removed, Copper Cleaned, and Recoated
- ✓ Lead Free - YES

Silver Surface Finish – CCA View

- Silver Won't Stick to Dirty Copper
 - ✓ Great Contrast Allows Naked Eye Detection
- Silver Finish Is Actually REWORKABLE
 - ✓ Silver Can Be Removed, Copper Cleaned, and Recoated



Silver Surface Finish – CCA View

➤ **WHAT EVERYONE SHOULD KNOW ABOUT SILVER IMMERSION...**

- ✓ Millions in the Field & No Reported Defects
- ✓ Co-deposition of an Organic Compound
Reduces Electromigration and Tarnishing
- ✓ Most Tested Surface Finish on the Market Today
- ✓ Minor Tarnishing From Improper Drying or Storage Will Not Degrade Functionality of the Deposit (Signal Integrity and EMI Leakage)
- ✓ Inexpensive
- ✓ Safe

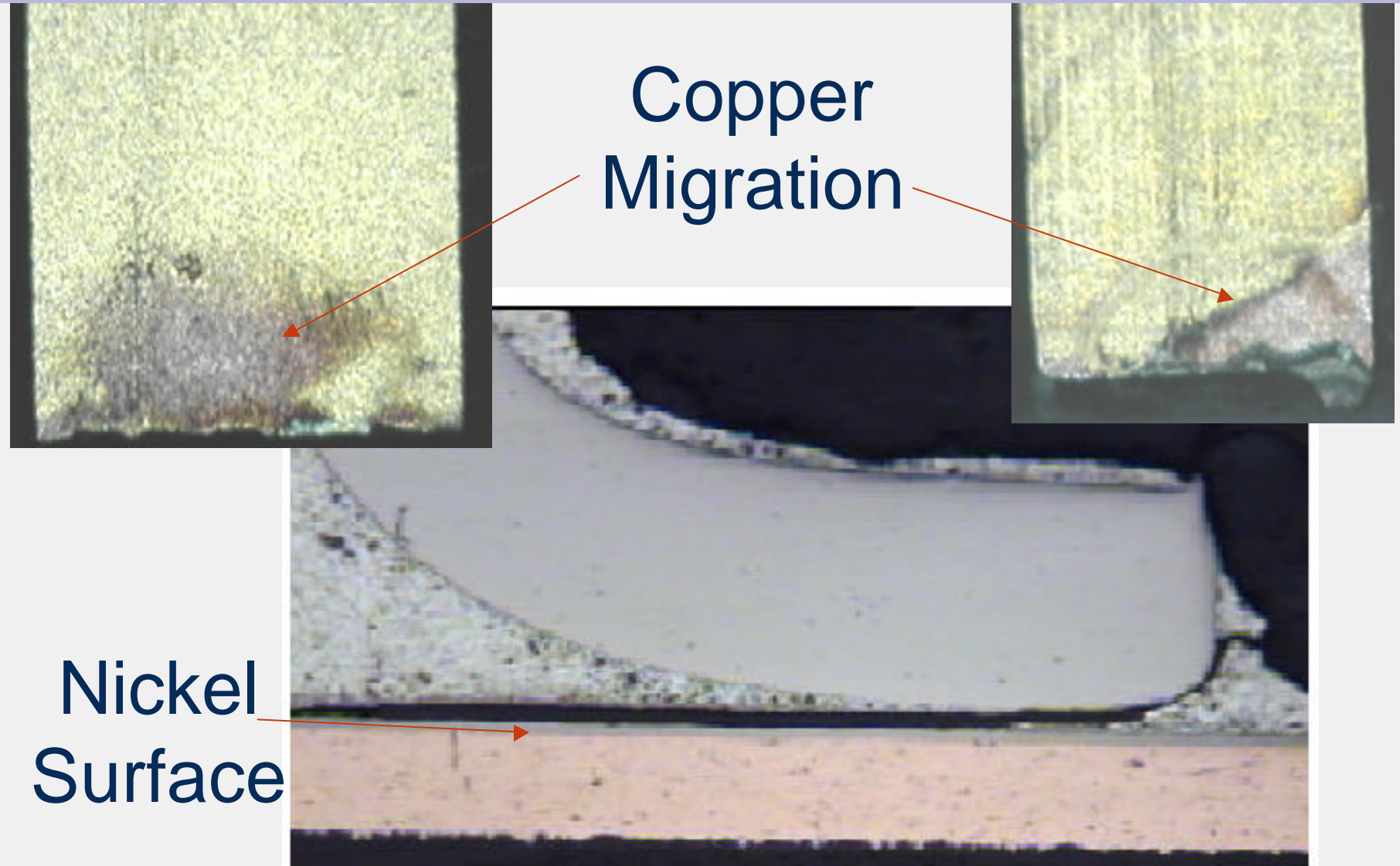
Silver Surface Finish – CCA View

- ✓ Co-planar
- ✓ Best for High Speed Signals and RF Boards
- ✓ Easy to Process
- ✓ Less Polluting
- ✓ Has a Long Shelf Life
- ✓ Can Be Stripped and Re-applied
- ✓ Doesn't Affect the Final Hole Size
- ✓ Incurs No Added Thermal Excursions to the PCB
- ✓ Is a Drop-in Process for the Assemblers
- ✓ Can Be Reworked Multiple Times by Fabricator and Assembler
- ✓ Excessive Tarnish Is Easily Detected

Gold Surface Finish – CCA View

- Immersion Gold over Electroless-Nickel
 - ✓ Can't Get Silver...then It Will Have to Do
 - ✓ Gold Is Porous and Does Not Seal Nickel Well
 - ❖ Nickel Will Oxidize Over Time
 - ❖ Becomes Impervious to Solder
 - ❖ Typical Max Shelf Life = 3 Months
 - ✓ Sensitive to Handling
 - ✓ Ni Bath - High Ph / High Temp
 - ❖ Attacks Soldermask
 - ❖ Another Thermal Cycle...Affects MTBF of PCB
 - ❖ Major Issues With Black Pad
 - ✓ Requires a HOTTER Oven Profile During CCA Reflow Process
 - ✓ Lead Free - YES

Gold Surface Finish

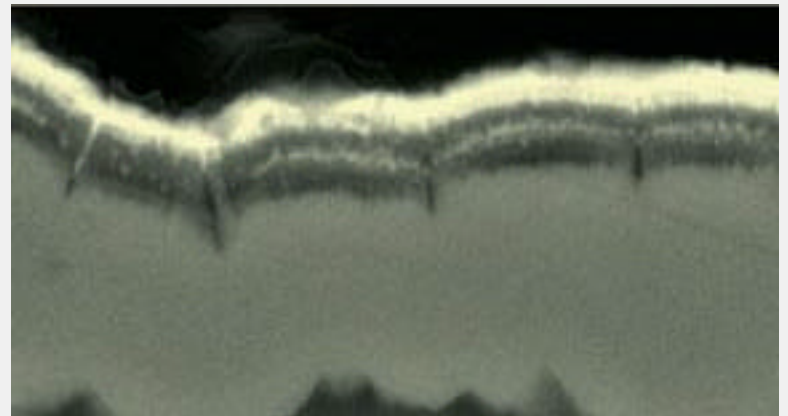
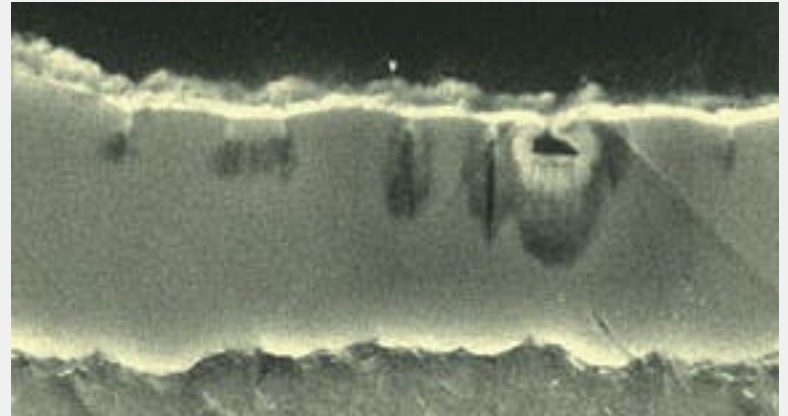


The Type of Failures to Expect

Gold Surface Finish

- Early 1990s ENIG Was Almost Qualified As a Universal Finish
- Rise of "Black Pad" Dashed Those Hopes
- Defect Has Not Been Solved

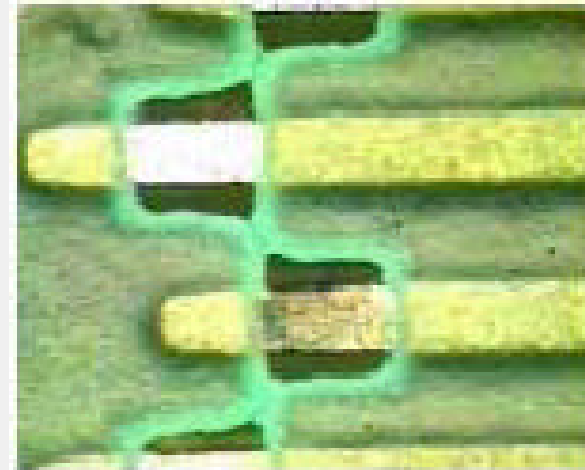
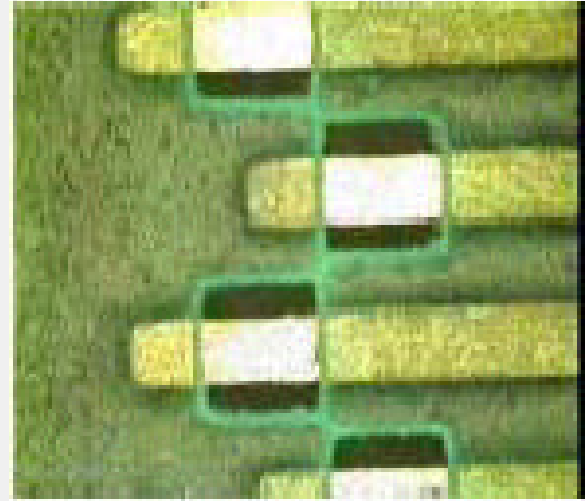
Examples of Black Pad



The Type of Failures to Expect

Gold Surface Finish

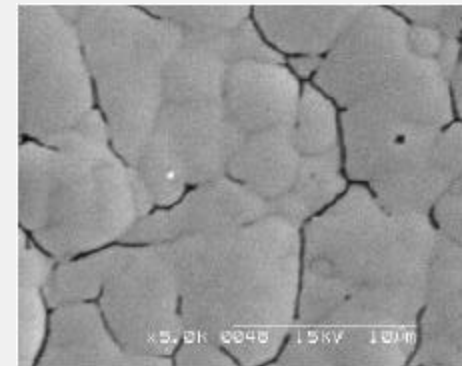
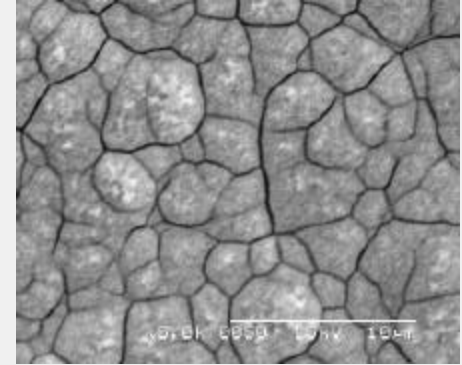
- Every ENIG Process on the Market Is Prone to This Defect
- Tight Process Controls & Proper Service From Vendor Can Limit Its Formation



The Type of Failures to Expect

Gold Surface Finish

- Fine Pitch Boards More Prone to Black Pad
 - ✓ Reduced Spacing Cause PCB Feature to Exhibit a “Galvanic” Effect
 - ✓ Essential for Formation of a Hyper-corrosive Nickel Species, AKA: Black Pad



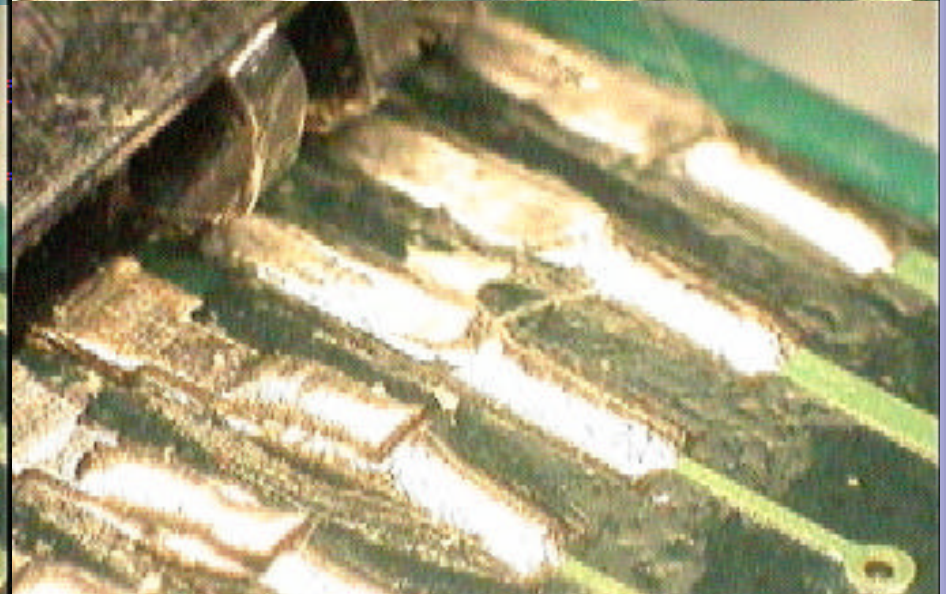
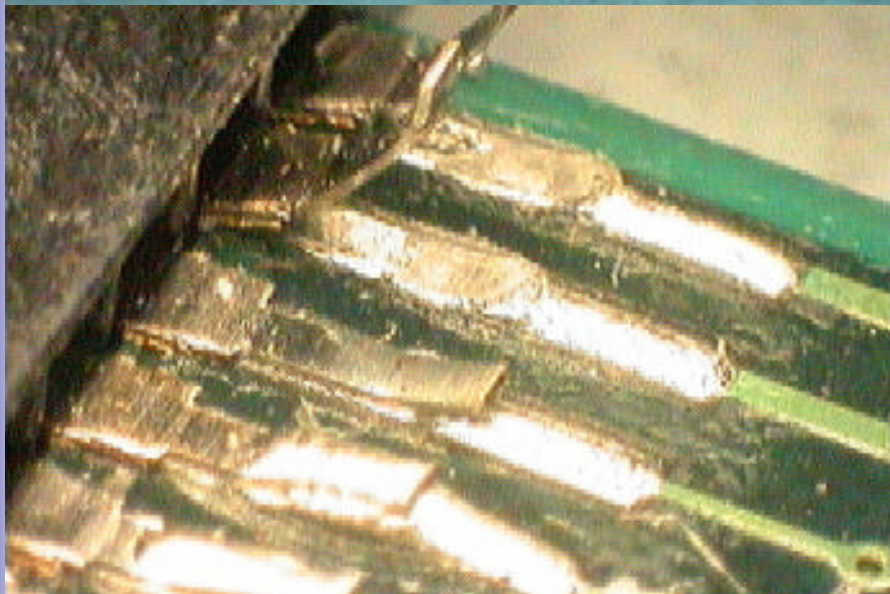
The Type of Failures to Expect

Tin Surface Finish – CCA View

➤ Tin immersion

- ✓ Soldering Issues Are More Prevalent
- ✓ Multiple Handling Issues
- ✓ Poor Shelf Life
- ✓ Oxidizes Easily
- ✓ Soldering Process Requires...
 - ❖ Lots and Lots of Highly Active Flux
 - Typical Activator is Fluoride or Chloride
 - Both are Extremely Corrosive
 - ❖ Lots and Lots of Heat
- ✓ Hazardous Waste Generated by Bath is Costly
- ✓ Lead Free - Yes

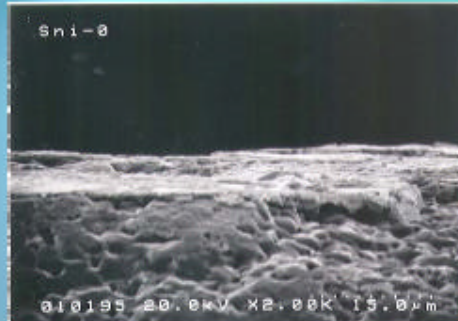
Reasons Most CCA's Tend To Avoid



Tin Surface Finish

Reasons Most CCA's Tend To Avoid

Whisker Growth Examples Sn plating (on nickel) chip resister (0805)



Zero cyc. No whiskers



100 cyc. 10.2 μm



500 cyc. 13.5 μm



1000 cyc 8.2 μm

1. Whisker growth was confirmed with both SnPb & Sn after TCY -55 / +125 °C*
2. No whiskers were confirmed after high temp high humidity test 60 °C @85%RH

* 70 minutes @ 55 °C - 30 minutes @ +125 °C

Tin Surface Finish

OSP Surface Finish – CCA View

➤ OSP

- ✓ Proper Thickness...No Problem...Otherwise

Forget It...

- ❖ Be Prepared for Soldering Issues

- ✓ Major Handling Issues

- ❖ No Finger Cots or Gloves...then OSP Is

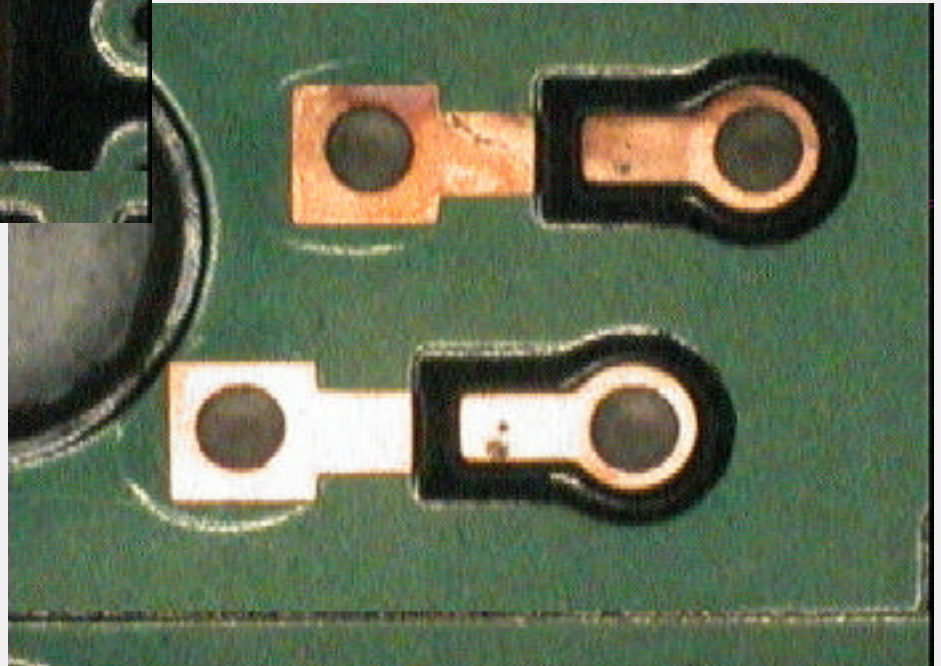
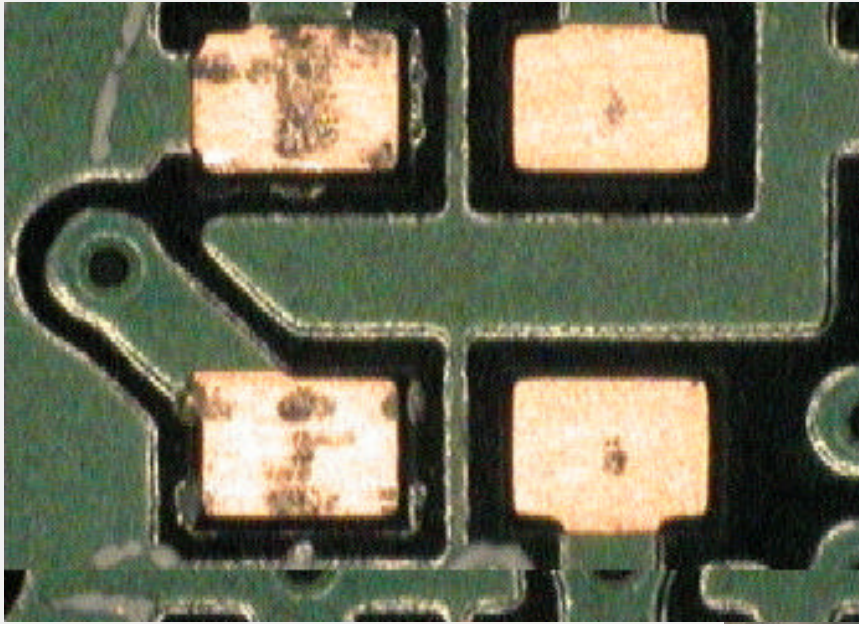
Not for You

- ✓ Major Storage Issues

OSP Surface Finish – CCA View

- ❖ No Environmental Controls...then OSP Is Not for You
 - Storage of Raw Materials Is by the Back Door With the Wind Blowing Through
- ❖ Typical Shelf Life With Good Controls Is 3 Months or Less
- ✓ Lead Free – Yes, the Coating Is; However Evidence Has Shown That OSP's Can Not Withstand the Elevated Temperatures Needed for Lead Free Soldering...so, NO...

OSP Surface Finish – CCA View



Bare Copper Surface Finish – CCA View

➤ Copper - Just Bare Copper

✓ A Clean Copper Surface Can Remain Solderable for up to 3 Days

❖ Copper Will Only Oxidize So Far, and Then It Will Stop

✓ Great Approach to Consider for Prototype Builds

PPT Surface Finish – CCA View

- PPT or SIPAD
 - ✓ Extremely Flat Solder Coating With “*Mesh*” Impression
 - ✓ CCA Does Gross Print With Tacky Flux
 - ❖ Phenomenally Better End Results
 - ❖ 100% Yields
 - ❖ PPT Passed HALT & HASS Testing
 - Pad & Laminate Tore While Solder Joint Remained in Tact
- Ideal For:
 - ❖ Parts With a Pitch of .015” (.381mm) or Less

PPT Surface Finish – CCA View

- ❖ uBGA's With Solder Spheres .015" (.381mm) or Less

- ❖ 0201 Devices

✓ Cost:

- ❖ 5-cents/sq. Inch for Single-sided PCB

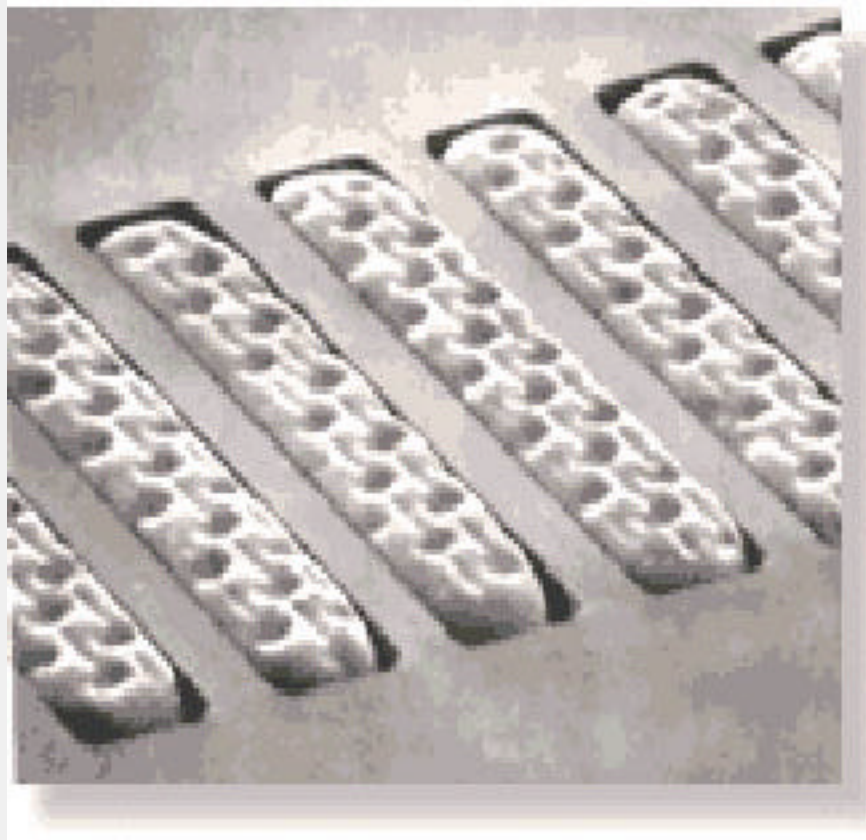
- ❖ 10-cents/sq. Inch for Double-sided PCB

- ❖ Potential Cost Center for a PCB House

- Typical Charge for HASL = 1 Cent/sq. Inch

- Catch 22 - If You Don't Ask, They Don't Offer! So Ask!

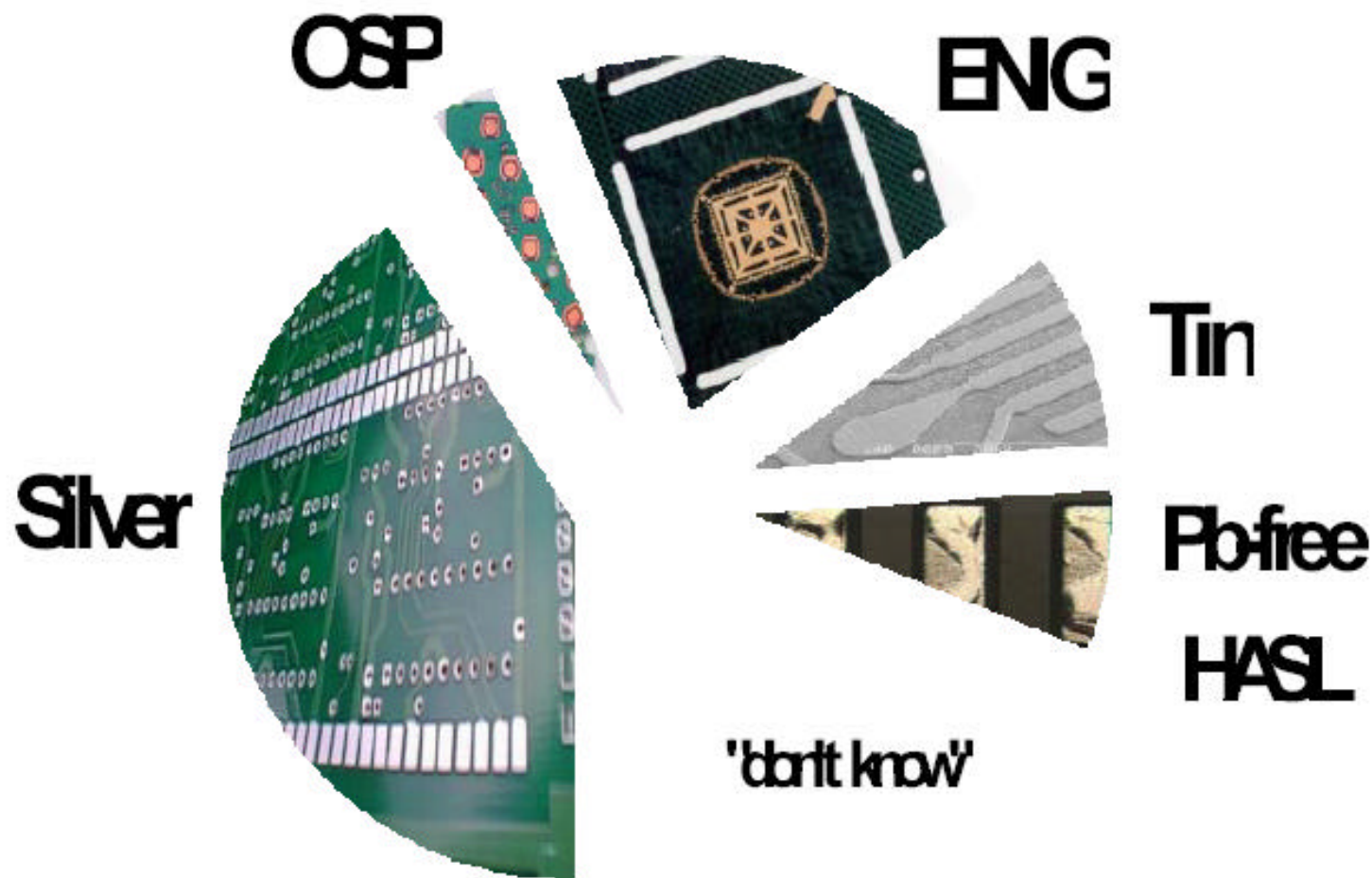
PPT Surface Finish – CCA View



What Lead Free Finish
Will You Use?

What Pb-Free Finish Will You Use?

Continued Growth?
National Physical Laboratories Survey 2003



105 OEM/EMS/Fab respondents:
"What Pb-free finish will your company use for RoHS compliance"

Final Finish PRO's & CON's

FINAL FINISH PRO'S & CON'S GUIDE

Category	Sn Pb	A g	A u	Sn	O S P	Cu	PPT
Applied Directly Over Bare Copper	Y	Y	N	Y	Y	N/A	Y
Good Application Controls	N	Y	N	Y	N	N/A	Y
Low Maintenance / User Friendly	N	Y	N	Y	N	N/A	Y
Either Vertical or Horizontal	Y	Y	Y	Y	Y	N/A	N/A
No Additional Thermal Stresses	N	Y	N	Y	Y	N/A	Y

FINAL FINISH PRO'S & CON'S GUIDE

Category	Sn Pb	A g	A u	Sn	O S P	Cu	PPT
Coating Thickness Controllable	N	Y	Y	Y	N	N/A	Y
Stable Chemistry	N	Y	N	Y	N	N/A	N/A
Finish is Reworkable	N	Y	N	Y	N	Y	Y
Same or Less Cost (vs. HASL)	N/ A	Y	Y	Y	Y	Y	N
Readily Available	Y	Y	Y	Y	Y	Y	N

FINAL FINISH PRO'S & CON'S GUIDE

Category	Sn Pb	A g	A u	Sn	O S P	Cu	PPT
Flat/ Planar Surface	N	Y	Y	Y	Y	Y	Y
Storage Life (G=Good, F=Fair, P=Poor)	F	G	F	P	P	P	G
No Finger Cots Required	Y	Y	Y	N	N	N	Y
Multiple Reflow Compatible	Y	Y	Y	N	N	Y	Y

FINAL FINISH PRO'S & CON'S GUIDE

Category	Sn Pb	A g	A u	Sn	O S P	Cu	PPT
LF Compatible	N	Y	Y	Y	N	Y	Y
Wire Bond Capable	N	Y	Y	N	N	N	N
Touch Pad Functionality	N	Y	Y	N	N	N	N

PCB Fab House Technology Guide

PCB Fab House & Final Finish Technology Guide

Category	Level I	Level II	Level III	Level IV
Board Thickness	=.054	=.034	=.025	=.020
Part Pin Pitch	=.050	=.025	=.025	=.025
Surface Finish	HASL LF = Ag/Au	HASL LF = Ag/Au	LF = Ag/Au	LF = Ag/Au /LF PPT
Line Width	=.010	=.008	=.004	=.003
Line Spacing	=.010	.008	.004	=.004

PCB Fab House & Final Finish Technology Guide

Category	Level I	Level II	Level III	Level IV
Impedance	None	= 500	= 280	= 280
Smallest Hole Size	=.030	=.010	=.010	=.010
Layer to Layer Precision	=.005	.004	.003	.002
Solder Mask Material	LPI	LPI	LPI	LPI
Buried Via's	NO	NO	NO	Yes

PCB Fab House & Final Finish Technology Guide

Category	Level I	Level II	Level III	Level IV
Blind Via's	NO	NO	NO	Yes
Via any Layer	NO	NO	NO	Yes
Copper Weight (oz.)	1	1	1/2	=3/8
Minimum Core Thickness	.008	.006	.0025	=.0025

PCB Fab House & Final Finish Technology Guide

Category	Level I	Level II	Level III	Level IV
Edge Contact Plating	Sn	Au/Tin	Au	TBD
Plating Technique	Panel	Panel	Pattern	Pattern
Imbedded Resistors	No	No	No	Yes
Imbedded Capacitors	No	No	No	Yes
HDI (Micro-Via's)	No	No	No	Yes

PCB Fab House & Final Finish Technology Guide

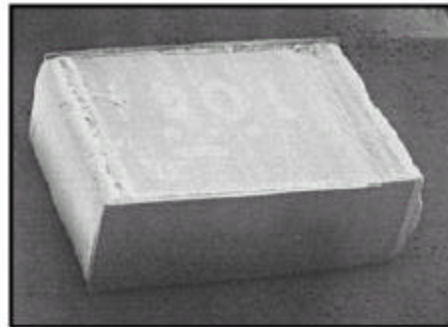
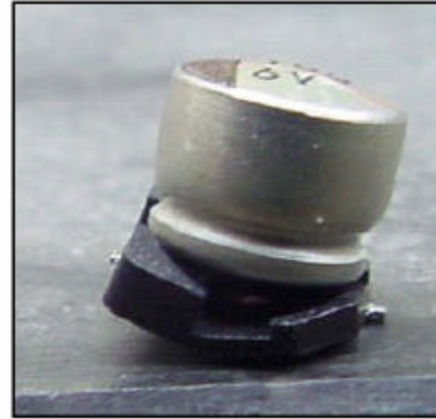
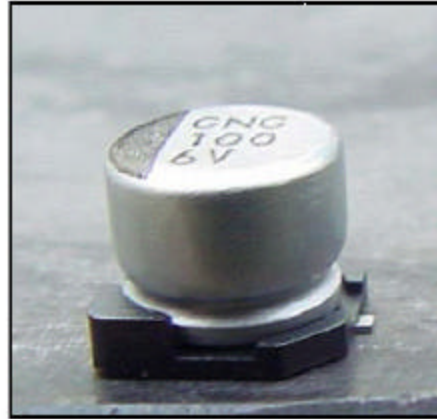
Category	Level I	Level II	Level III	Level IV
Material Type	IPC-4101/21	IPC-4101/24	IPC-4101/24	TBD
IPC-2221 Class	1	1,2	1,2	1,2,3
IPC-2222 Type	1,2,3	1,2,3	1,2,3	1,2,3,4,5,6

LEAD FREE

&

WHAT YOU SHOULD KNOW



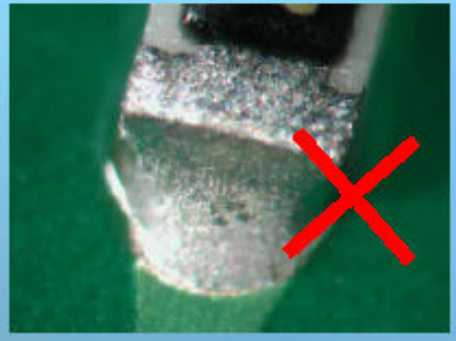

Effects of High Temp Soldering Process On Non-lead Free Devices



225°C

250°C

Lead-free Technology – Barrel Electroplating (Sn passives)

Paste	Peak (°C)	Termination Finish	
		Sn/Pb	Sn
Sn-37Pb	200		
Sn-3.0Ag-0.5Cu	230		

Note: Lead-free joints may look slightly duller and uneven



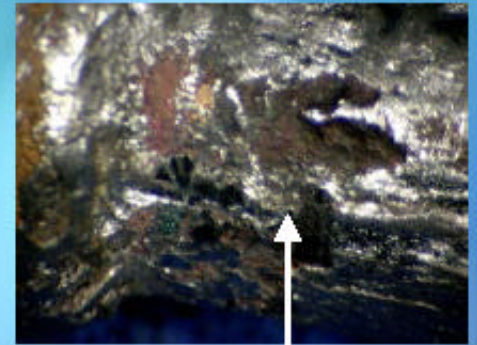
Not recommended because of lead contamination issue

Lead-free component Implementation Summary

- ❑ Lead-free components can be reliably mixed with leaded components in a SnPb assembly process with NO adjustment to the current process parameters.
 - ❑ Lead-free component plating gives solder joint strengths equivalent or superior to current SnPb plating in a leaded solder process. *(Improved thermal cycling)*
 - ❑ Wetting times of lead-free components in a leaded solder process are comparable with current soldering systems.
 - *Component wetting is slower in a totally lead-free process.*
 - *Increase solder temperature / Nitrogen gas.*
-

Solder Machine Erosion with Lead-Free Solders

- Solder bath and impellor shaft erosion
- New problem within lead-free trials.
- Iron erosion of metal parts & contamination of expensive lead-free solder.
- High Sn(Tin) content solders will erode metal bath.



Manufacturing survey and investigation by TWI, DTI and NPL

**Two views of a 6mm diameter, 316 stainless steel shaft after rotating at
1,500rpm in tin/silver/copper solder at 400°C for only 30 hours**