

Lead-free Finishes Whisker Evaluations Contact Interface Evaluations

IEEE Holm Conference
Lead-free Workshop
9 September 2003

Lead-free Finishes

■ Candidates

- Pure Tin
- SnCu
- SnBi
- SnAg
- Pd/Au

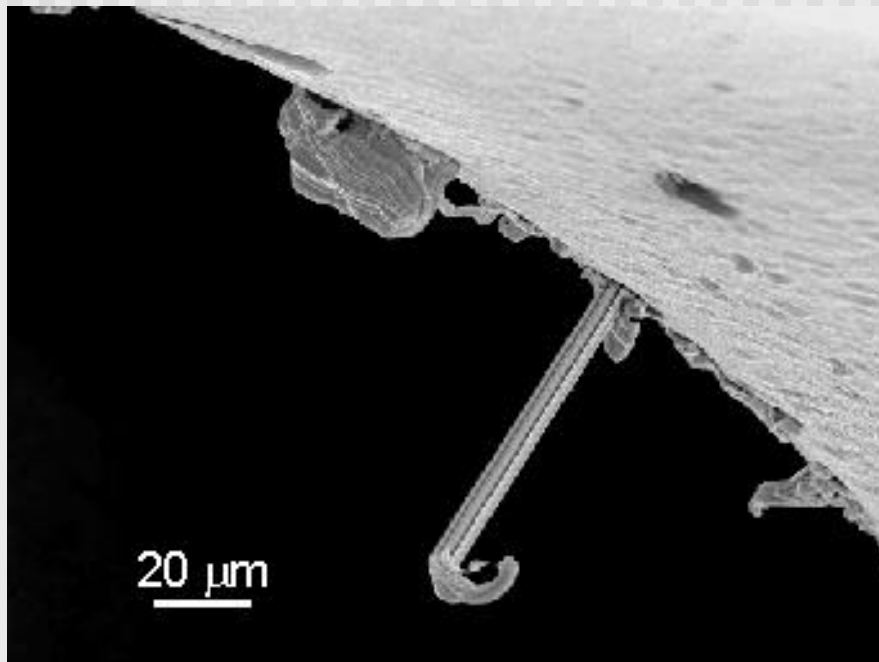
■ Criteria

- Solderability
- Solder Joint Reliability
- Tin Whisker Susceptibility
- Pb-free & SnPb Compatibility
- Contact Resistance
- Fretting Resistance
- Coefficient of Friction
- Plating Process
- Scrap Value
- Cost

Lead-free Finishes

Criteria	Sn	SnBi	SnCu	SnAg	Au flash/PdNi	Au flash/Pd
Solderability	OK	OK	OK	OK	OK	OK
Solder Joint Reliability	OK	SnPbBi reliability ³	OK	Not tested	OK	OK
Tin Whisker Susceptibility	Slightly higher risk ¹	Slightly higher risk ¹	Significant Risk ²	Slightly higher risk ¹	No whisker risk	No whisker risk
SnPb and Pb-free Process	OK	SnPbBi reliability ³	OK	Not tested	OK	OK
Contact Resistance	OK	OK	OK	Not tested	OK	OK
Fretting Resistance	OK	OK	OK	Not tested	Better than SnPb	Better than SnPb
Coefficient of Friction	OK	OK	OK	Not tested	OK	OK
Plating Process	Easier than SnPb	Difficult ⁴	Difficult ⁴	Very Difficult ⁵	OK	OK
Scrap Value	OK	Bismuth content ⁶	OK	OK	OK	OK
Cost	OK	OK	OK	Expensive	Very Expensive	Very Expensive

Whisker Evaluation



- Form spontaneously
- Can grow to lengths greater than 200mm
- Highly conductive

Fundamental mechanism of growth not understood

Whisker Evaluation

■ Test Exposures

- Because mechanism of growth not understood, acceleration factors cannot be defined
- Test exposure trends:
 - Dry Heat (e.g. 50 +/- 5°C, uncontrolled humidity)
 - Temperature/Humidity (e.g. 52 ± 5°C, 90% ± 5% R.H.)
 - Ambient Storage (e.g. 23 ± 5°C)
 - Thermal Cycling (e.g. -55°C to 85°C, 20 min cycle, 7 minute dwell)

Contact Interface Evaluation

- What Impacts Performance?
 - Insertion Force
 - Withdrawal Force
 - Normal Force
 - Application Environment
 - Coating Material

Contact Interface Evaluation

■ Coating Materials

- Pure Sn, Au/Pd and Au/PdNi
 - Significant body of knowledge as contact interface
- SnCu, SnBi, SnAg
 - Limited experience