Session 1

Monday 3/10/14 10:30am

A CLEAN START

There's no doubt about it, clean contacts in contactors and sockets work a lot better than dirty ones. So what better place to start looking at burn-in and test strategies than with a close look at contamination control and cleaning processes to improve yields, test time and re-test reduction? This session begins with three hypotheses of the causes for contact contamination, Along with guidance on procedural changes for improved performance. The next presentation offers a solution to the havoc high temperature burn-in can wreak on devices under test (DUTs) with a specialized coating process to prevent solder contamination of contacts and deformation of the solder bumps on the DUT. The final two presentations examine online cleaning processes. The first focuses on a characterization tool that determines the effectiveness of online cleaning, while the second is directed at an automatic cleaning solution for a bowl fed handler used with a RF contactor. Hey, it's a dirty job, but somebody's got to do it.

This Paper

Contamination Mechanisms of Contact Probes
Jon Diller, Kevin DeFord—Smiths Connectors | IDI

Special Coating Cleans-Up a Mess
Paul Ruo—Aries Electronics, Inc.
Erik Orwoll—Contact Coatings, LLC

Unique Methodologies for Investigating On-line Cleaning Process Parameters and Recipe Optimization
Jerry J. Broz, Ph.D., Soheil Khavandi, Bret Humphrey—International Test Solutions

Yield and Test Time Improvement via Automated Online Cleaning
Brent Edington—TriQuint

Contamination Mechanisms of Contact Probes

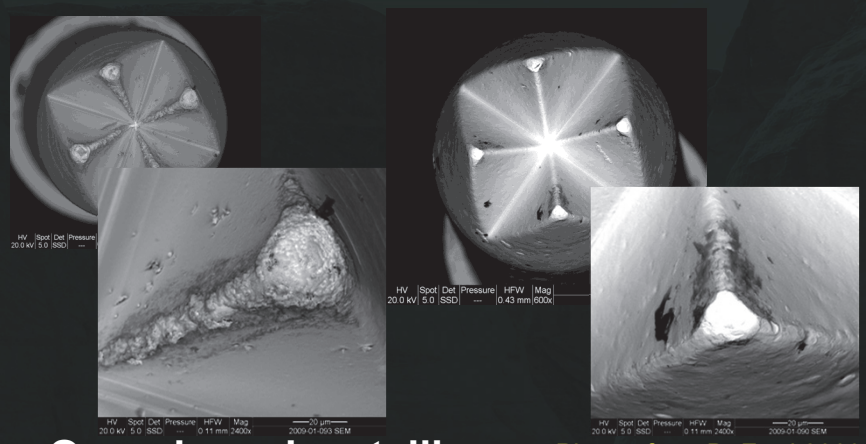
Jon Diller, Kevin DeFord
Smiths Connectors | IDI

2014 BiTS Workshop
March 9 - 12, 2014

Content

- BGA probe contamination today
- Why 'how' matters
- Thermal interdiffusion
- Voltaic transfer
- Fretting transfer
- Further work

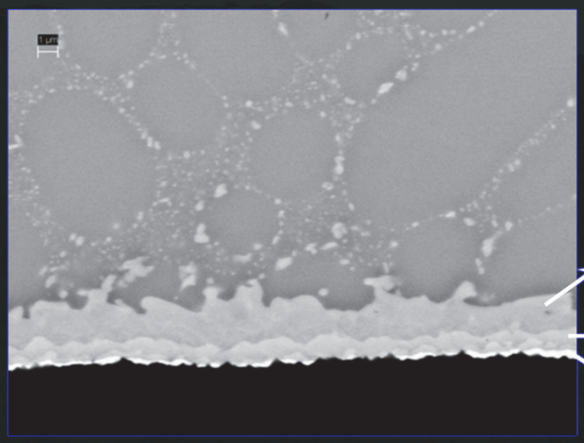
BGA Contamination



- Organic and metallic
- Externally reducible rise in CRES

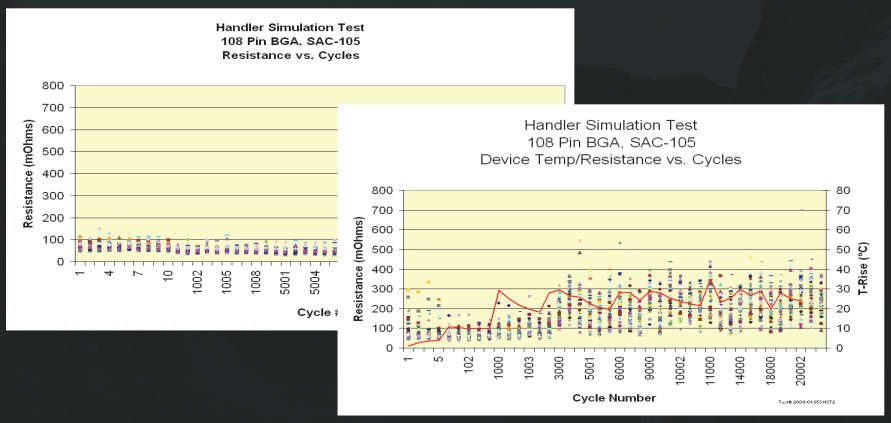
Photos from DeFord 2009

BGA Contamination



- Langston (2008) demonstrates Sn-Au intermetallic layer

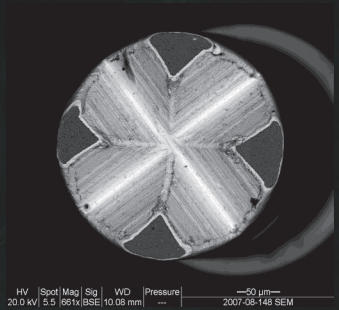
BGA Contamination



DeFord (2009) correlated rate of contamination with current volume and density

Why 'How' Matters

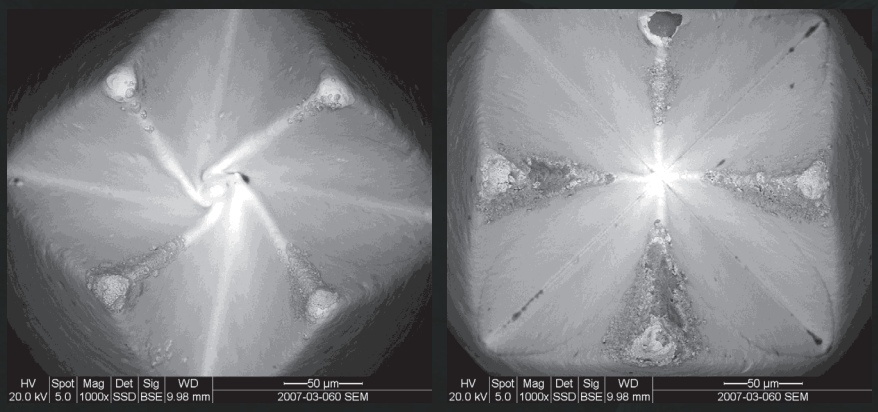
- Homogeneous probes make cleaning effective
- Cleaning is still 'bad'
- Sensitivity of devices can be predicted
- Intermediary layers may be available



Interdiffusion as a Function of Temperature

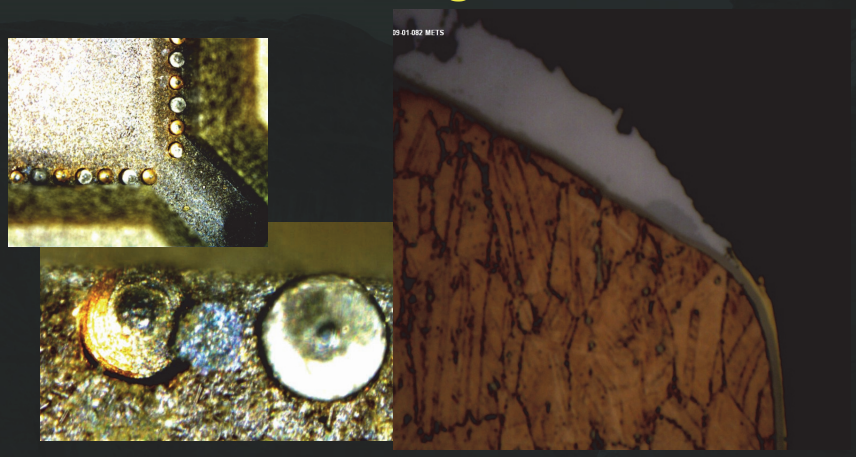
"The formation of intermetallic layers arises from the inter-diffusion of materials across a bimetallic interface. In electrical contacts, this interdiffusion occurs when the electrical interface is operated in a high-temperature environment or when sufficient electric current is passed through the contact to raise the temperature of the α-spot to well above the ambient temperature."
-- Timsit (2013)

Interdiffusion as a Function of Temperature



Before and after 24 hours at 125C SAC105

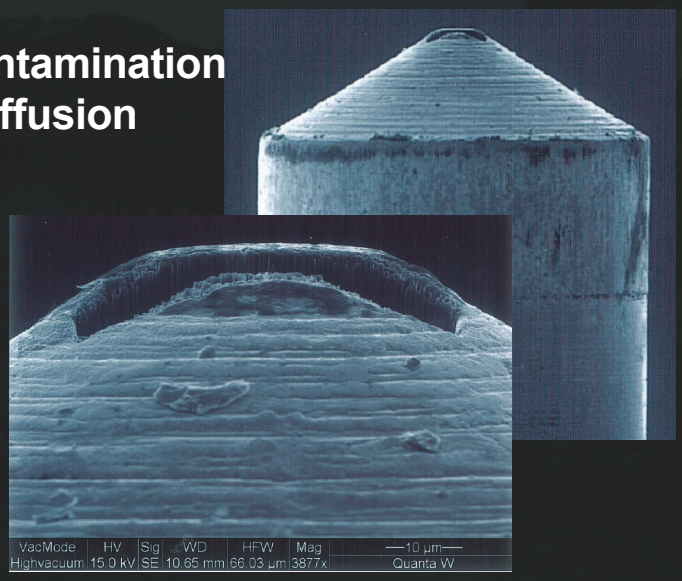
Electromigration



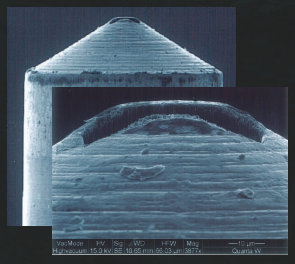
- DeFord (2009) demonstrates cathodic – anodic behavior in series with diffusion

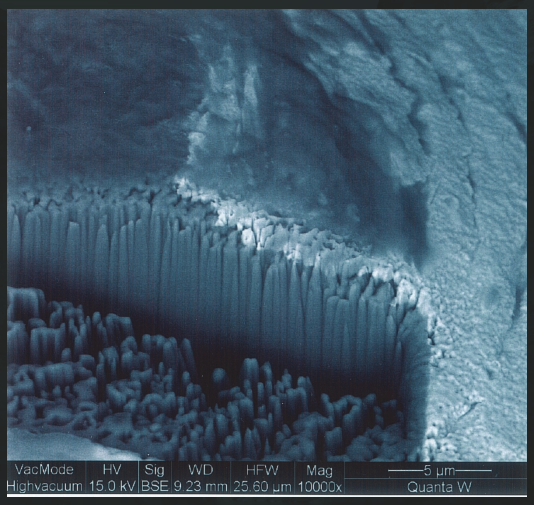
Fretting Transfer

- Some contamination has no diffusion



Fretting Transfer





- Timsit (2013) describes fretting transfer
- Lubricant affects contamination

Summary

Mechanism	Inter-diffusion?	Lubri-cant?	Hardness ?	Smooth-ness?	Force?
Thermal	Yes	No	Negative	Positive	Positive
Galvanic	Maybe	Maybe	Negative	Neutral	Positive
Fretting	No	Yes	Positive	Positive	Positive

- All rely on differing metals
- Suggests further evaluation of:
  - Lubricants
  - Smoothness

Acknowledgements

Smiths Connectors | IDI's Test Laboratory and Engineering staff, especially:

- Kevin DeFord
- Khaled Elmadbouly
- Rick Westpfahl
- Frank Zhou

References

- DeFord, Kevin. "Moore or Less: Effects of Higher Current on Socket Life." BiTS Workshop 2009, Hilton East Mesa, Mesa, AZ. March 2, 2009. Presentation.
- Timsit, Roland. "Fundamental Properties of Electrical Contacts." BiTS Workshop 2012, Hilton East Mesa, Mesa, AZ. March 4, 2012. Tutorial presentation.
- Timsit, Roland. "Electrical Contact Resistance: Fundamental Principles." *Electrical Contacts: Principles and Applications.* Paul Slade, ed. CRC Press, Boca Raton, Florida. 2013.
- Langston, Nick. "An Examination of the Causes of CRES Degradation Which Affect the Life of a Test Socket." BiTS Workshop 2008, Hilton East Mesa, Mesa, AZ. March 11, 2008.