Session 3

Tuesday 3/11/14 8:00am

SHOW THEM WHAT WE'RE MADE OF

Microelectronics continually tests the limits and ingenuity of test and burn-in strategies. So, more and more, the onus falls on materials solutions for sockets. This session kicks off with an examination of available socket materials to foster a better understanding of their relative merits for various applications, plus there's a sneak preview of coming material trends. The continuing trend of tighter pitches, higher temperatures and higher density contacts places heavy demands on test probes and equipment, particularly the materials used to manufacture them. As these materials continuously evolve, finite element modeling can help designers demonstrate the effects of material properties and performance as you'll learn in the second paper. The third presentation focuses on high temperature burn-in for automotive applications, emphasizing advancements in contact pin plating and surface finishing technologies to address the thermal challenges being faced. Wrapping up this session is a case study comparing three types of palladium alloys for spring pin contactors to determine what the best material is for test.

The Stuff We're Made Of
An Examination of the State of the Art in Socket Materials
Jon Diller—Smiths Connectors | IDI

Rising to the Challenge: Material Evolution to Enable Reliable Performance at Tighter Pitches and Higher Temperature
Mike Gedeon—Materion

180 Deg. C BGA Burn-in, Is It Doable?
Kenji Ichihara, Masaru Sato, Noriyuki Matsuoka—Yamaichi Electronics Co., Ltd.
Jec Sangalang—Yamaichi Electronics USA

This Paper

Palladium Alloy Hardening and Wear Away Characteristics
Takuto Yoshida, Craig Hudson—Test Tooling Solutions Group

Palladium Alloy Hardening and Wear Away Characteristics

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Test Tooling Solutions Group

2014 BiTS Workshop
March 9 - 12, 2014

Content

- Introduction to Pd Alloy
- Precipitation Hardening Process
- Hardness Measurement Process
- Hardness vs. Heat Treatment Temperature by Supplier
- Breaking Force by Bending Test
- Plunger Tip Wearing by Cycling Test
- Summary

Introduction to Pd Alloy

- Palladium (Pd) alloy is a common option for spring pin plunger creation.
- The primary demerit of using Pd alloy is the finished plunger cost; so to offset this demerit, Pd alloy should be deployed only when appropriate.
- Pd alloy's primary merit for IC testing is the alloy's hardness, helpful in preventing solder migration to the spring pin's plunger tip.
- The primary targeted results for deploying Pd alloy plungers are:
  - Reduced variability of Cres over life of pin
  - Improvement of pin tip longevity
  - Throughput improvement by less frequent cleaning

But how does the hardness of the Pd alloy impact wear away?

Precipitation Hardening Process

Steps:

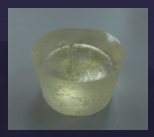
- **Pre-heat the hardening chamber**
- **Insert the parts into the hardening chamber for heat treatment in nitrogen**
- **Cool down in nitrogen**

Hardening Chamber

Hardness Measurement Process

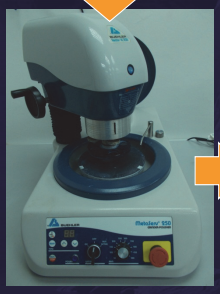
Steps:

- **The sample is encased in epoxy**
- **A grinder and polisher are used to remove the material until a cross section is revealed**
- **Measure hardness by Vickers hardness tester**



Epoxy block

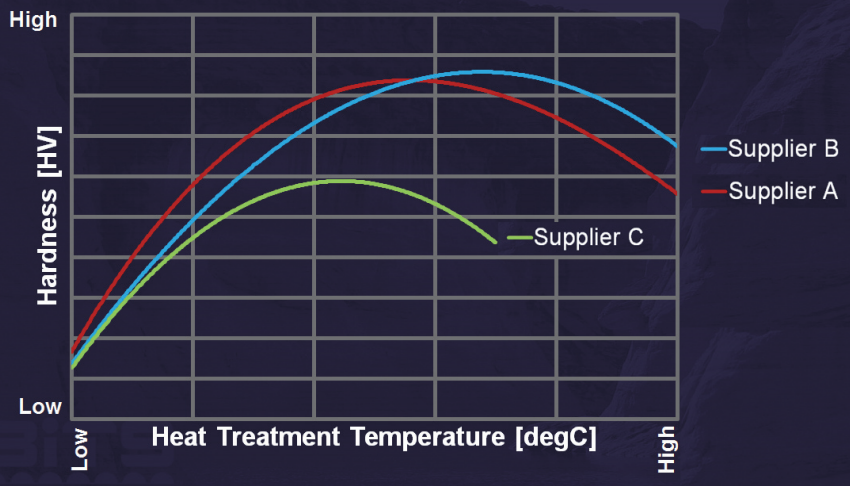
Measurement sample



Grinder & Polisher

Vickers Hardness Tester

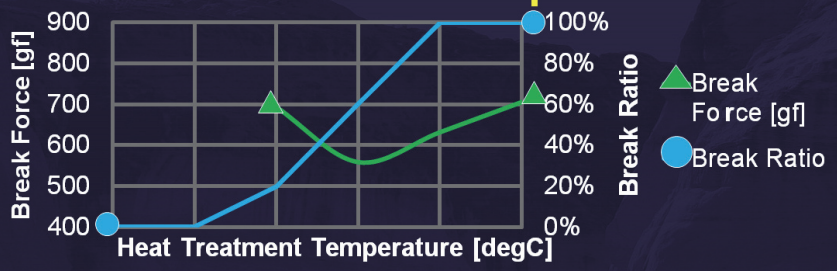
Hardness vs. Heat Treatment Temperature by Supplier

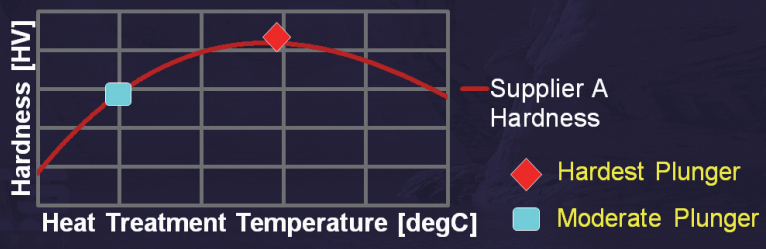


Breaking Force by Bending Test

- For the breaking force, we are using a three point bending test (flexural) method
- Reading is recorded once the material breaks
- Breaking counts are recorded

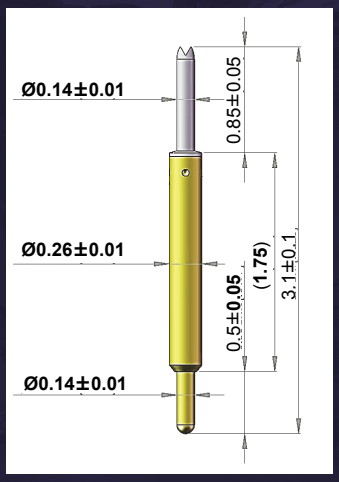
Breaking Force and Heat Treatment Temperature



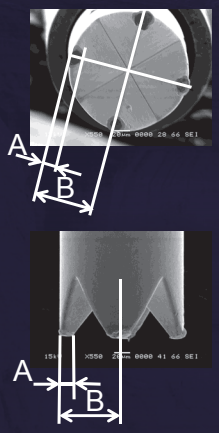


Plunger Tip Wearing by Cycling Test

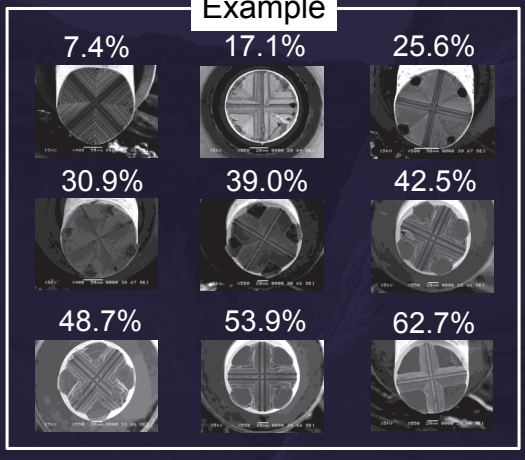
- Sample pin
  - Hardest plunger and moderate hardness plunger
  - Single ended pin for 0.35mm pitch
  - Spring force is 28gf
- Cycle test
  - Two kind of pin insert into same socket
  - Cycle test until 200K
  - Golden plated flat dummy device
  - Measure Plunger Flat Ratio every 25K cycle



Definition of Plunger Flat Ratio



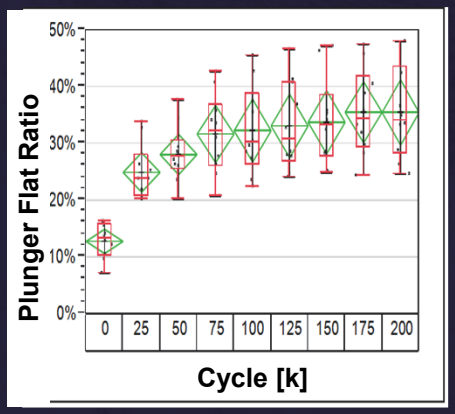
Example

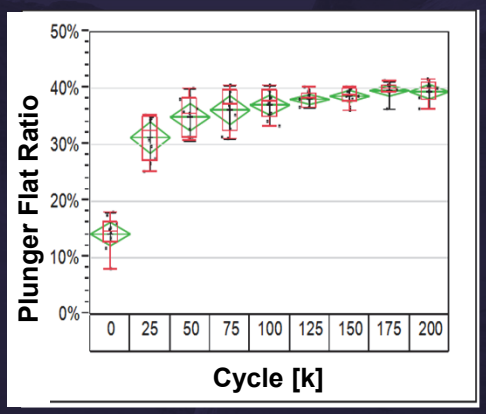


Plunger Flat Ratio = A/B

A: Crown tip length
B: Plunger radius

Plunger Tip Wearing

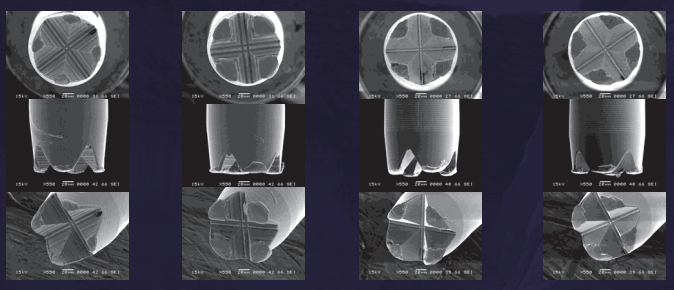




Hardest Plunger Flat Ratio

Moderate Plunger Flat Ratio

Plunger Tip Wearing After 200k Cycle



Tip Wearing Minimum Maximum Minimum Maximum

Hardest Plunger Sample Moderate Plunger Sample

Summary

- Pd alloy material hardness and heat treatment condition
  - The heat treatment temperature are different by supplier
  - The hardest value are different by supplier
- Pd alloy material bending characteristics
  - The hardest sample breaks minimum bending force
  - Higher heat treatment temperature introduce higher braking ratio
- Pd alloy material wear away characteristics
  - Hardest plunger average Plunger Flat Ratio (wearing) is smaller than moderate plunger
  - Hardest plunger wearing variation is wider than moderate plunger
  - Hardest plunger wearing is worse than moderate plunger
- **Moderate hardness Pd alloy material is the best for the plunger**