
SEVENTEENTH ANNUAL
BiTS
Burn-in & Test Strategies Workshop
March 6 - 9, 2016
Hilton Phoenix / Mesa Hotel
Mesa, Arizona
Archive- Session 2
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Session 2
Ashok Kabadi
Session Chair

BiTS Workshop 2016 Schedule

Frontiers Day

Monday March 7 - 1:30 pm

Material Matters

"Long Life Probe Pin by Electroforming Process"
Makota Kondo & Hirotada Teranishi - Omron Corporation
Takahiro Sakai & Naoyuki Kimura - Omron Corporation

"Carbon Nanotube Polymer Composites as High Performance Thermal Interface Materials for Burn in and Test Applications"
Leonardo Prinzi - Georgia Institute of Technology
Craig Green & Baratunde Cola - Carbice Nanotechnologies, Inc.

"Requirements and Solutions for Test PCBs"
Markku Jamsa - Aspocomp Group Oyj

"PCB Test Fixture and Socket Challenges for mmWave Applications"
Don Thompson Jose - R&D Altanova
Jose Moreira - Advantest Europe GmbH
Giovanni Bianchi - Advantest

BiTS 2016 Burn-in & Test Strategies Workshop

Long Life Probe Pin by Electroforming Process

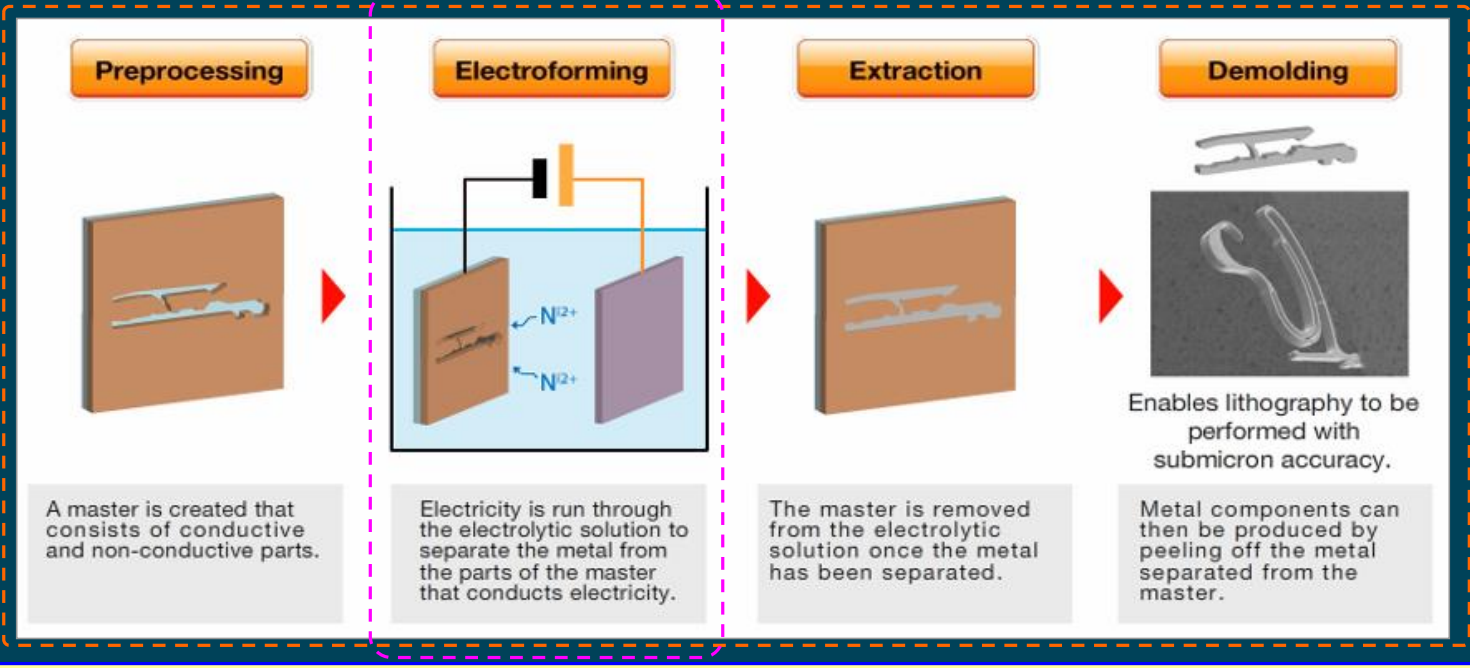
Makoto Kondo, Hirotada Teranishi
Takahiro Sakai, Naoyuki Kimura
OMRON Corporation
ELECTRONIC AND MECHANICAL COMPONENTS COMPANY
CONNECTOR DIVISION

2016 BiTS Workshop
March 6 - 9, 2016

Agenda

- What is Electroforming Process
- Characteristic of Electroforming Process
- Development to Probe Pins
- Unique Head Shape for Au Plated Pad
- Basic Study for Solder Ball Test
- Conclusion

What is Electroforming Process



Feature

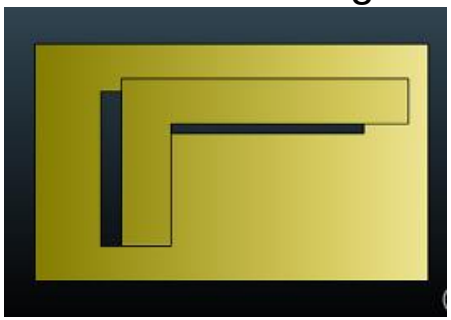
1. **Possible to make high precision micro profile which have never been made by traditional press work.**
2. **Easy and speedy trial sample providing because of lower investment than traditional press work.**

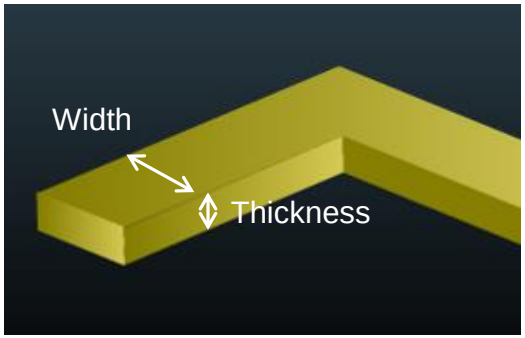
Characteristic of Electroforming Process

【Micro-Profile Fabrication Technology -High Aspect Ratio- 】

Possible to fabricate 30mm width work with high aspect ratio 1/3

Press Work / Etching Work

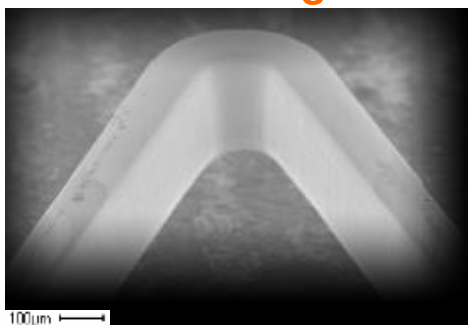


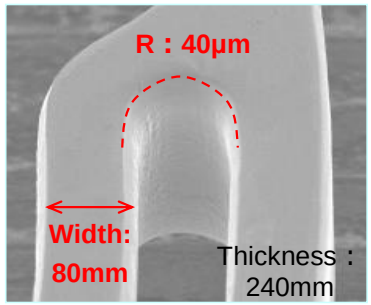


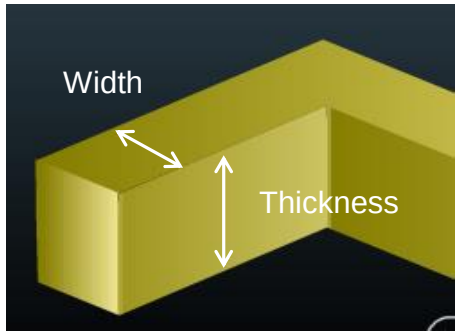
Width ≧ Thickness

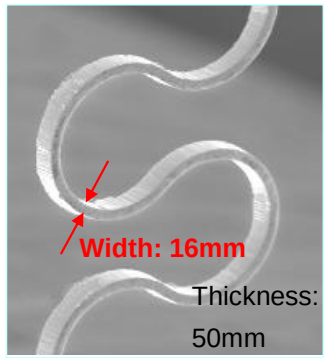
Aspect Ratio (T/W) = 1

Electro Forming









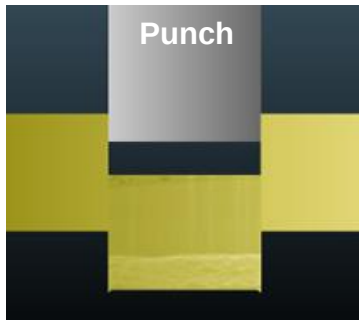
Width = Thickness × 1/3

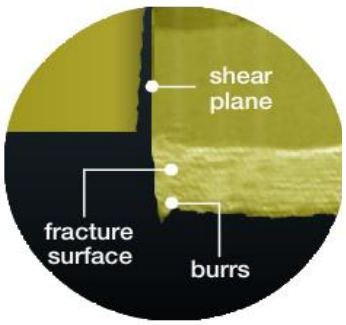
Aspect Ratio (T/W) = 3

【Micro-Profile Fabrication Technology -Smooth Surface-】

Possible to fabricate end of Ra<0.1μm

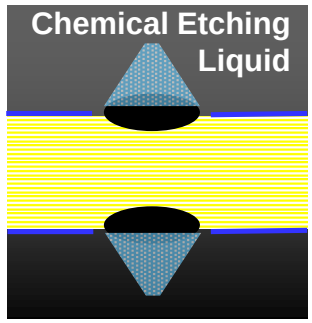
Press Work

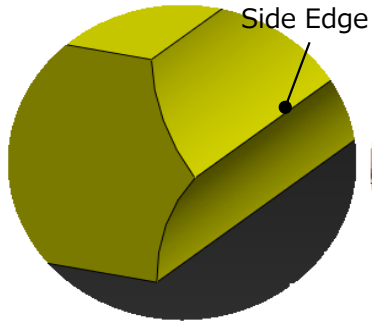




Fracture /Burrs

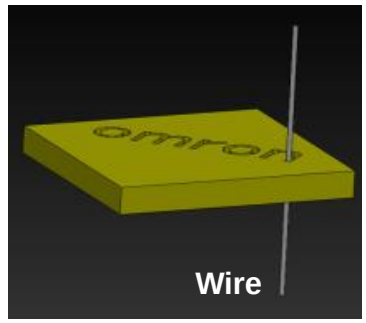
Etching Work

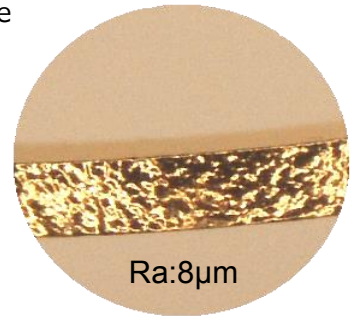




Unnecessary Side Edge

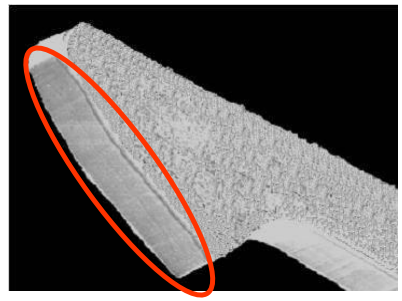
Wire Cut

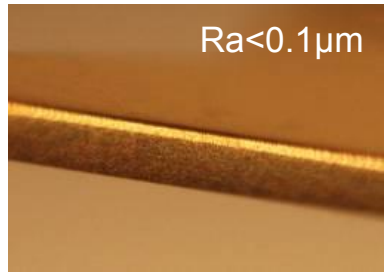




Ra:3～10μm at 4th cut

Electroforming



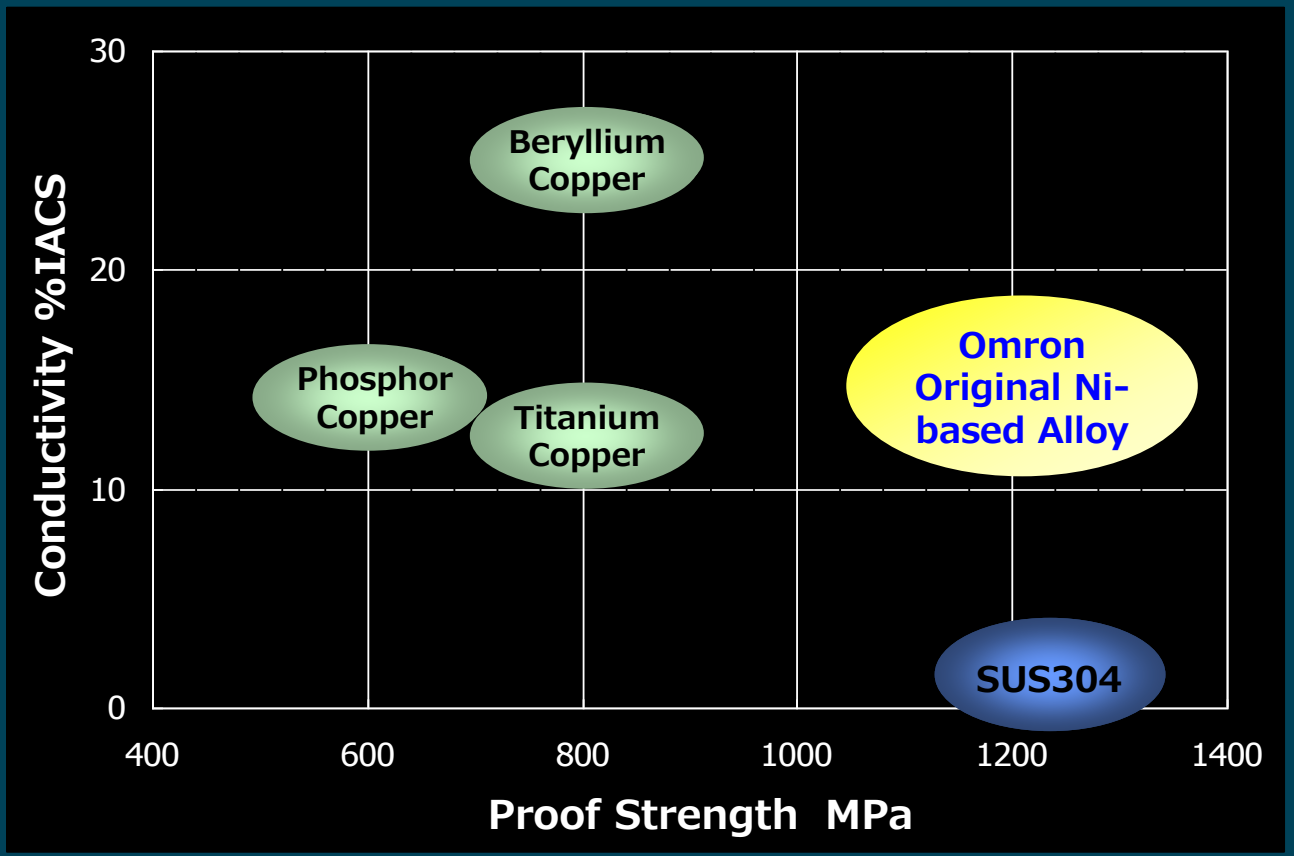


Smooth Surface at all planes

【Unique Material】

Originally Blended Material :

Mechanical SUS-level / Electrical Copper alloy

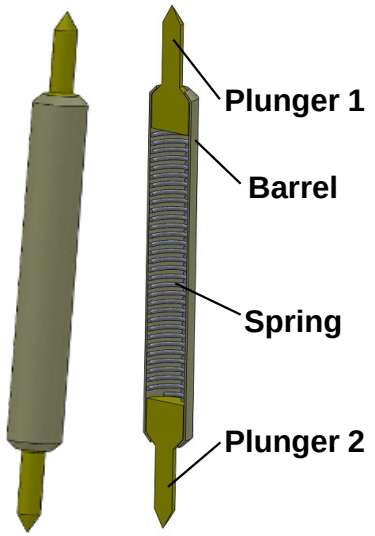


※ Proof stress: Stress not to cause plastic deformation

Development to Probe Pins

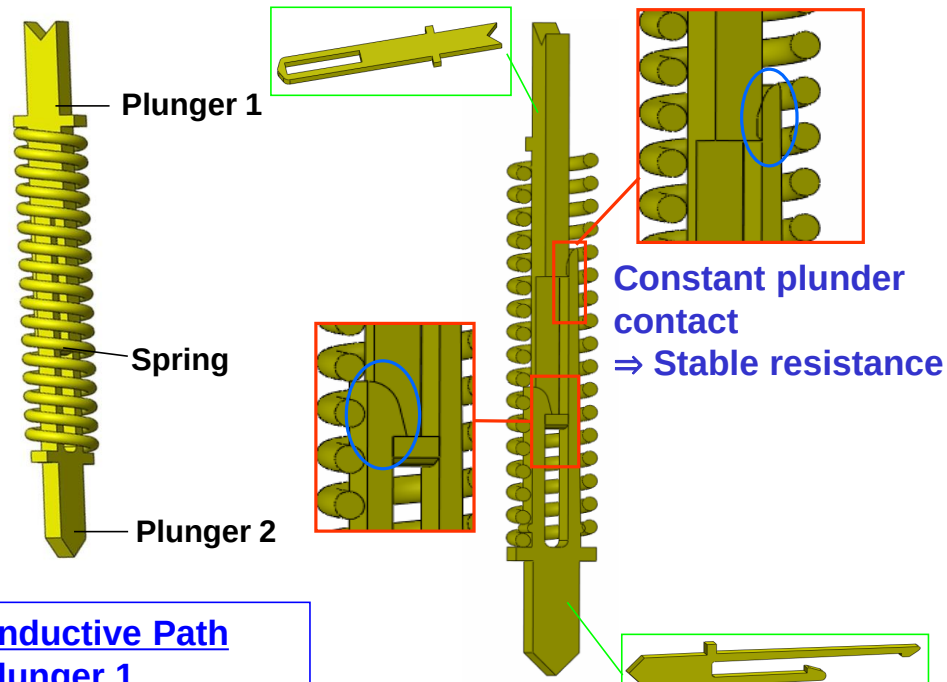
- Stable resistance by microfabrication relay structure
- High durability by smooth flat
- Compatible with socket for conventional probe pin

General Probe Pin



Conductive Path
Plunger 1
⇒ Tube
⇒ Plunger 2

Electroformed Probe Pin

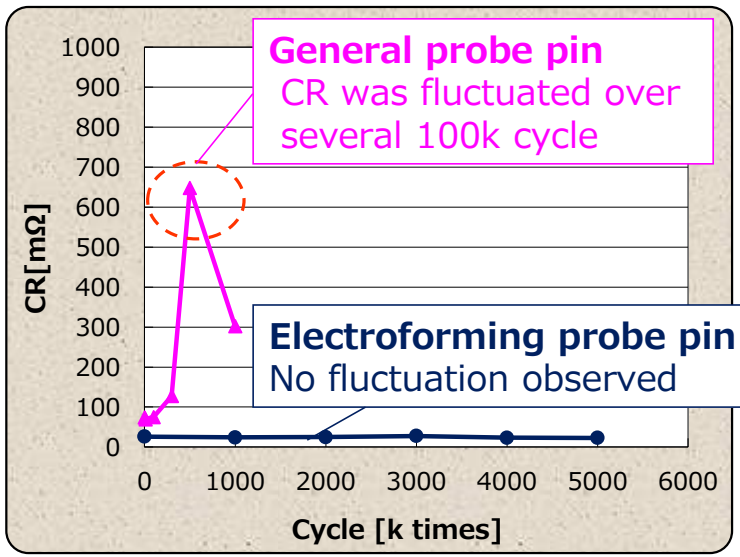


Conductive Path
Plunger 1
⇒ Plunger 2

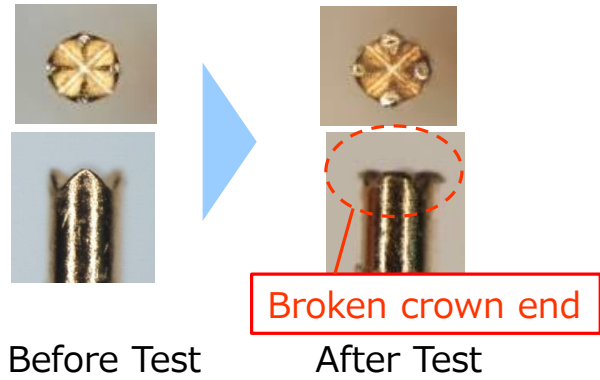
【Electroformed Probe Pin vs General Probe Pin –Durability Test-】

Test Condition
DUT: Au plated PAD
Temp: 20±5 degree C

Test Result



General probe pin

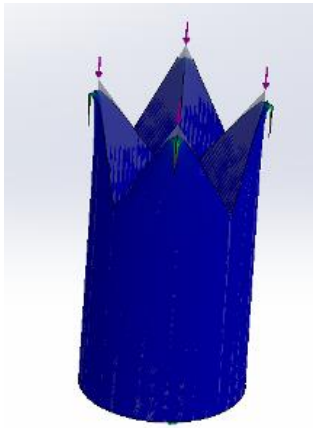


Electroforming probe pin

【Mechanism of Long Life】

■ Executed simulation of deformation amount at three conditions

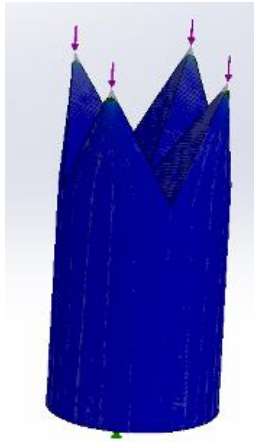
100gf at 4 points



Crown Profile
Material: Be-Cu (120GPa)

Deformation: 72μm

100gf at 4 points

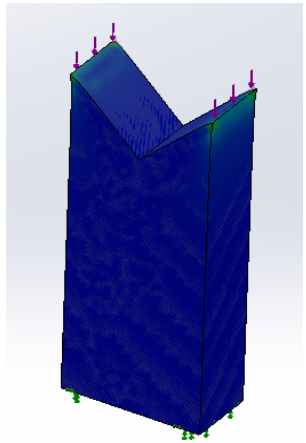


Crown Profile
Material: Ni Alloy(180Gpa)

Deformation: 40μm

Electroforming

200gf at 2lines



Plane Profile
Material: Ni Alloy(180Gpa)

Deformation: 4μm

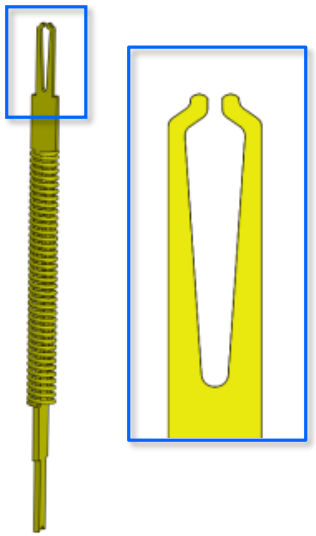
- Material strength ∝ 1/deformation => Low deformation at high material strength
- Line contact leads stress dispersion => Low deformation at line contact

Unique Head Shape for Au Plated Pad

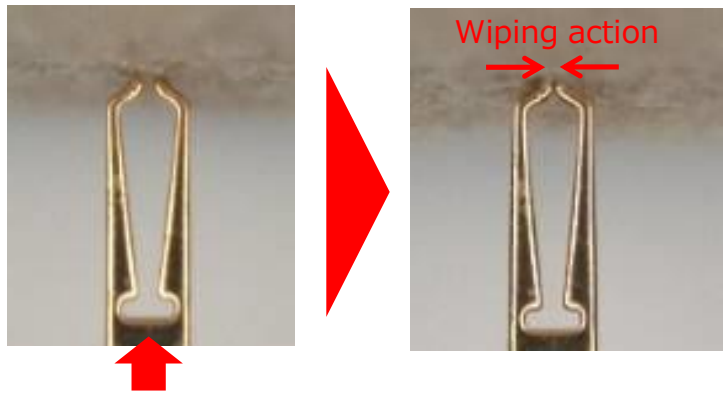
【Wiping Probe Pin】

Removal of foreign material by unique two arm wiping probe tip

Probe Tip Shape



Mechanism



Contact probe tip with pad and add force
=>Horizontally moving on pad surface
=>Wipes foreign material on pad surface
=>Contacts on fresh surface

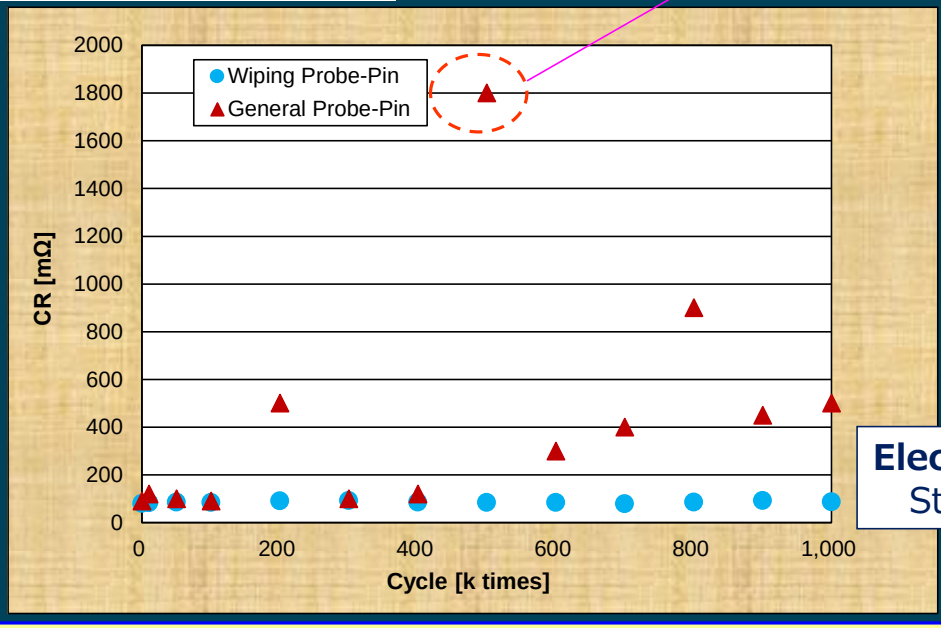
【Wiping Probe Pin vs General Probe Pin –Contact Reliability-】

Test Condition

DUT: Au plated PAD

Temp: 20±5 degree C

General probe pin
Significant deterioration has been observed.



Electroforming probe pin
Stable contact at 1M cycles.

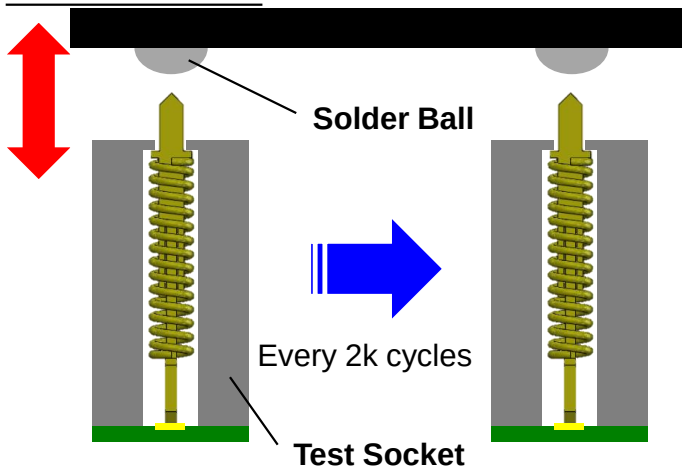
Electroformed probe pin can improve contact reliability by unique wiping probe tip

Basic Study for Solder Ball

【Purpose and Test Method】

Purpose : To derive the most suitable contact force and tip shape

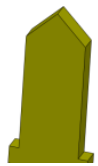
Test Method



-Room Temperature
-Apply 0.1A current at every contact.
-Change the solder ball per 2k cycles.

Tip Shape

Crown
(General Probe Pin)



Single

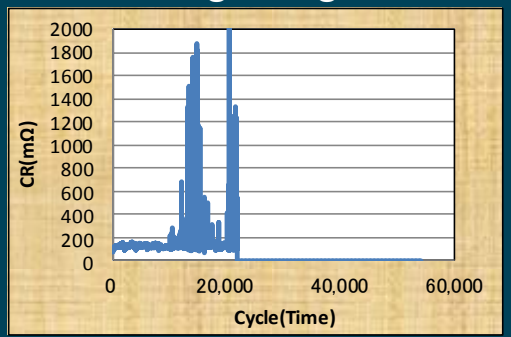
Wiping

Criteria

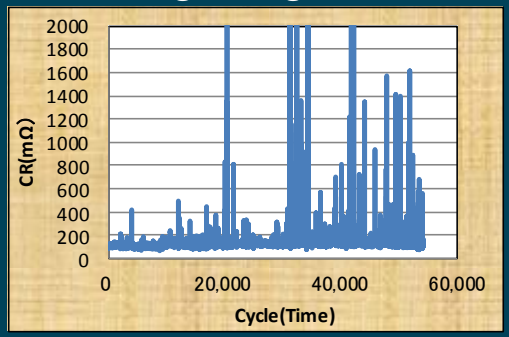
Over 200mΩ CR is measured at 100 times per 2k cycles (5%)

【Test Result -Influence of Load-】

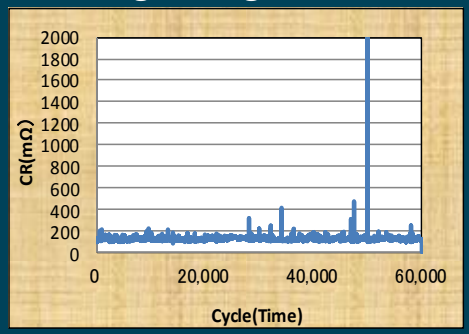
3gf Single



5gf Single



10gf Single



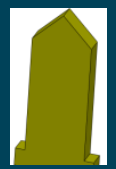
Contact Force	3gf	5gf	**10gf**	25gf
Crown			**60,000 times or more**	14,000 times
Single	14,000 times	32,000 times	**60,000 times or more**	18,000 times

Most suitable contact force is 10gf for each tip shape

■ Supposed Mechanism

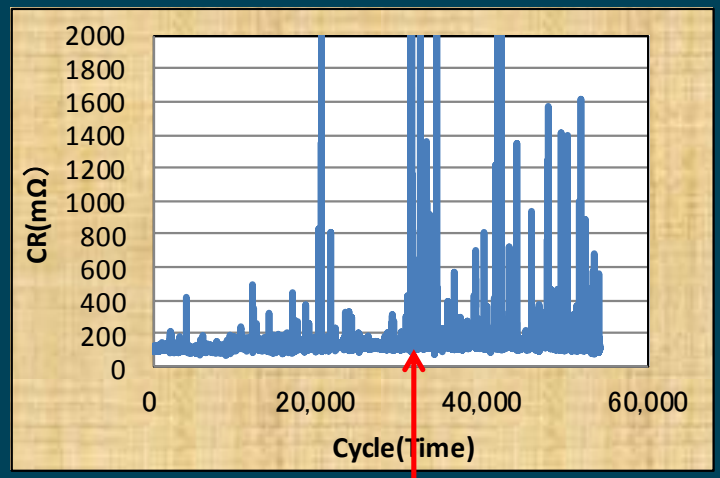
Low Contact Force Region : A spark due to oxide layer causes lower durability
Suitable Contact Force Region : Able to break oxide layer and less solder adhere
=> Keep good contact reliability
High Contact Force Region : Able to break oxide layer, but much solder adhere
=> Causes lower durability

【Test Result -Influence of Tip Shape-】

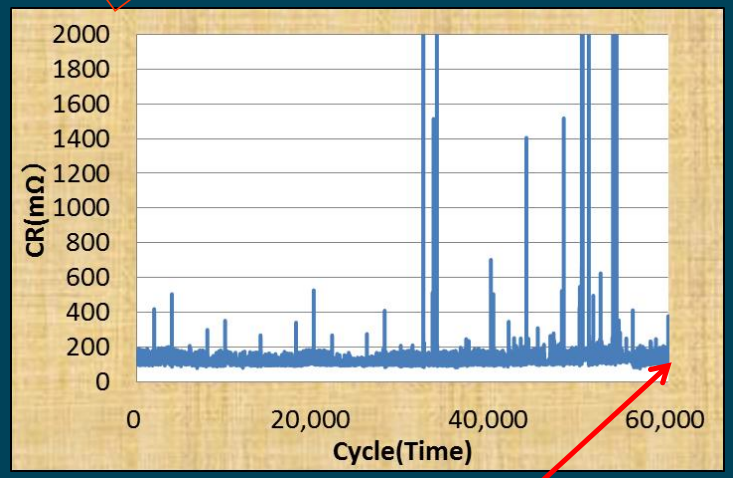


5gf Single

5gf Wiping



32,000 times



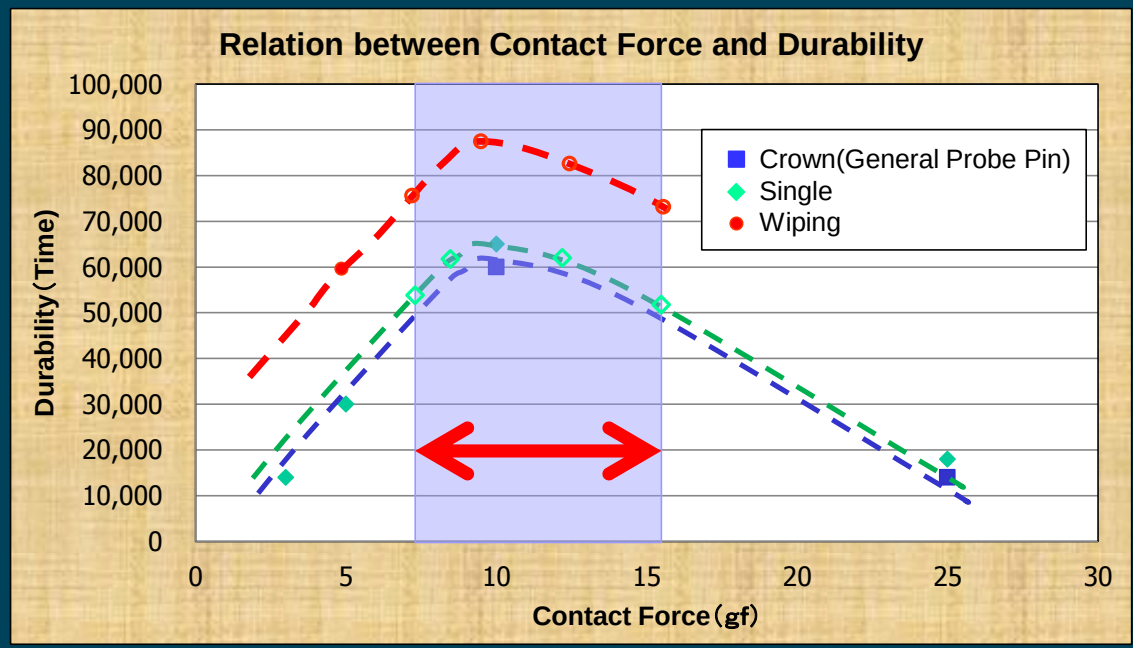
60,000 times or more

■ Supposed Mechanism

Wiping tip : Remove oxide layer by wiping shape and have wide contact area
=> Improve durability even at low contact force

【Future Work】

- Add the contact force point to seek the suitable range.
- Increase the number of data to improve the data reliability.
- Analyze the mechanism between contact resistance and solder adhesion.



Conclusion

- Features of electroforming process provide probe pin with stable contact resistance and high durability.
- Good contact reliability with Au plated pad is achieved by wiping probe tip.
- Basic study show a path toward suitable contact force range and tip shape for solder ball.