

SIXTEENTH ANNUAL

# BiTS

TM

## Burn-in & Test Strategies Workshop

March 15 - 18, 2015

Hilton Phoenix / Mesa Hotel  
Mesa, Arizona



# Archive – Session 7

## Session 7

Valts Treibergs  
Session Chair

BiTS Workshop 2015 Schedule

## Solutions Day

Wednesday March 18 8:00 am

### All That Glitters Is Or Is Not Gold

"One piece spring probes in one piece house socket (The best cost socket solution)"

AJ Park & JD Cho - IWIN Co. Ltd.

"MEMS rubber contact for TEST socket"

Justin Yun & BoHyun Kim - TSE Co., Ltd.

### Do You Believe In Leprechauns?

"Marketplace Report"

Ira Feldman - Feldman Engineering Corp.

"A Testing Time for Test Socket Suppliers"

John West - VLSI Research

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# MEMS Rubber Contact for TEST Socket

**Justin Yun  
BoHyun Kim  
TSE Co., Ltd.**



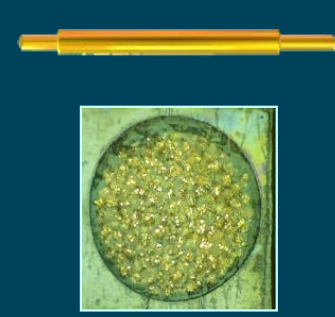
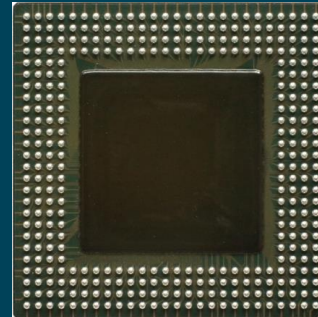
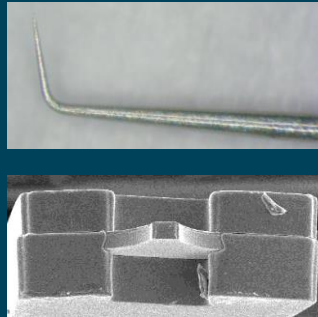
**2015 BiTS Workshop  
March 15 - 18, 2015**



## Overview

- Introduction
- Wafer & Final Test Contacts
- MEMS Powder Fab. Process
- PCR vs. MRC Contact Comparison
- Lab & Production Test Results Evaluation
- Conclusion

## Wafer Sort & Final Test Contacts

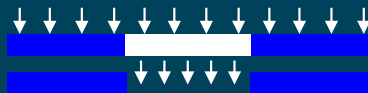


- Al/Cu pad
- Tungsten probe, MEMS Probe (Ni alloy+Rh+Au)
- 50~200um O.D
- SnAgCu ball
- Spring probe(BeCu/SK/Pd)
- Rubber contact(Ni+Ag+Au)
- 120~500um O.D

# MEMS Powder Fab. Process

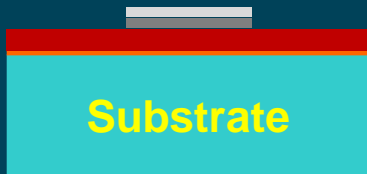
Substrate

Seed metal sputtering



Substrate

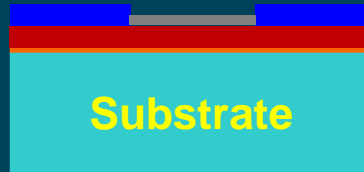
Exposure ► Develop



PR strip

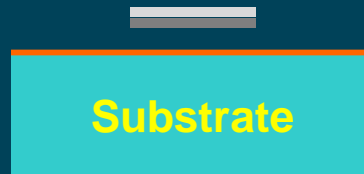
Substrate

Sacrificial layer  
electro plating



Substrate

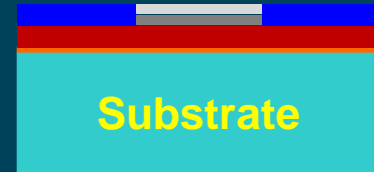
Electro plating(NiCo)



Etching

Substrate

Photoresist spin coating



Substrate

Electro plating(Rh)

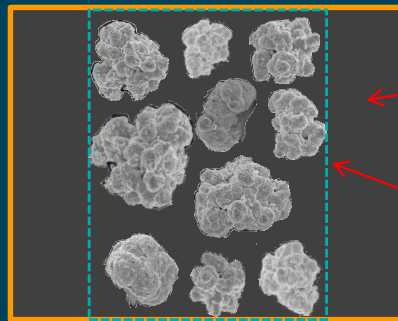




# PCR vs. MRC Comparison

## 1) Size & Shape of Powder

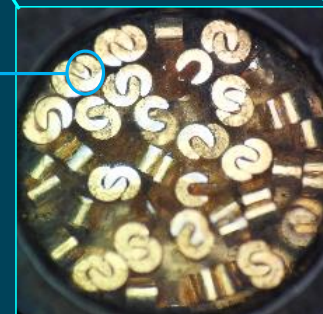
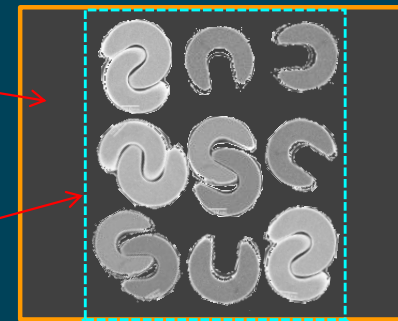
Conventional PCR powder



Tolerance :  $\pm 15 \mu\text{m}$   
Non-Uniform Size  
Non-Uniform Shape

Non-Uniform  
Sphere Powder

MRC powder



Tolerance :  $\pm 2 \mu\text{m}$   
Uniform Size  
Uniform Shape

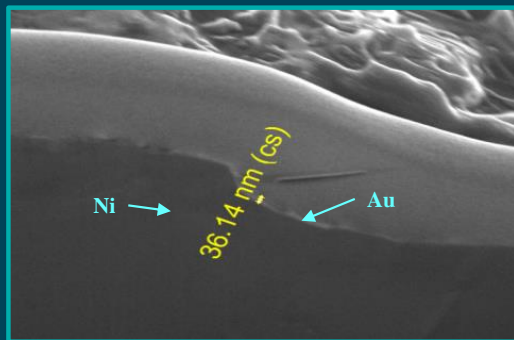
Uniform Powder



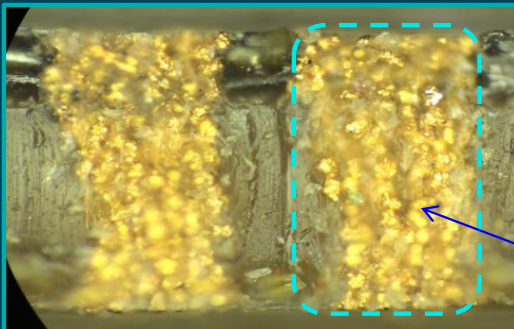
# PCR vs. MRC Comparison

## 2) Plating

Conventional PCR powder



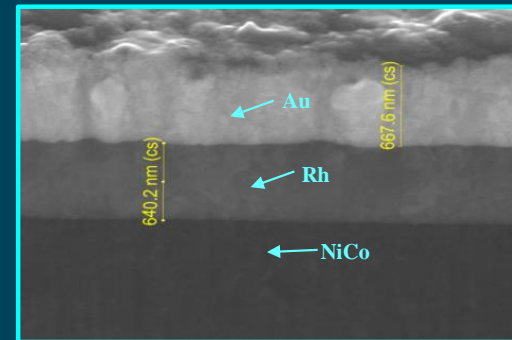
<Au Plating>



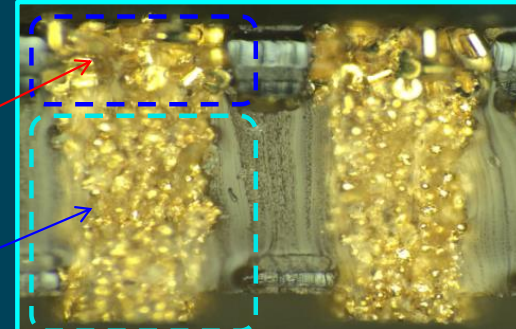
MEMS  
Powder

PCR  
Powder

MRC powder



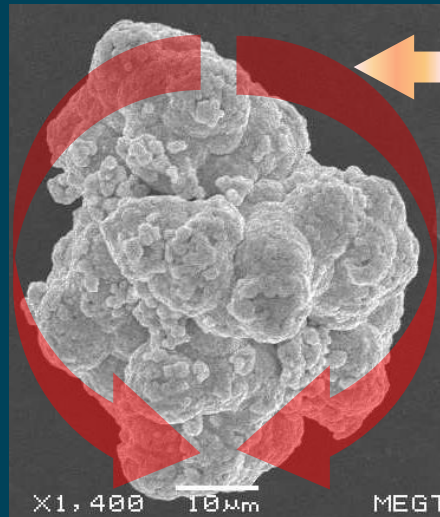
<Rh Plating + Au Plating>



# PCR vs. MRC Comparison

## 3) Cohesion

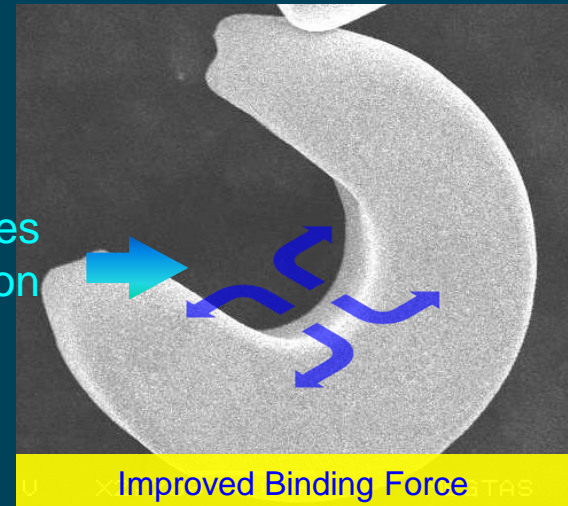
Conventional PCR powder



Silicone Holds  
Conventional  
PCR Powder

Silicone Penetrates  
MRC Powder grip portion

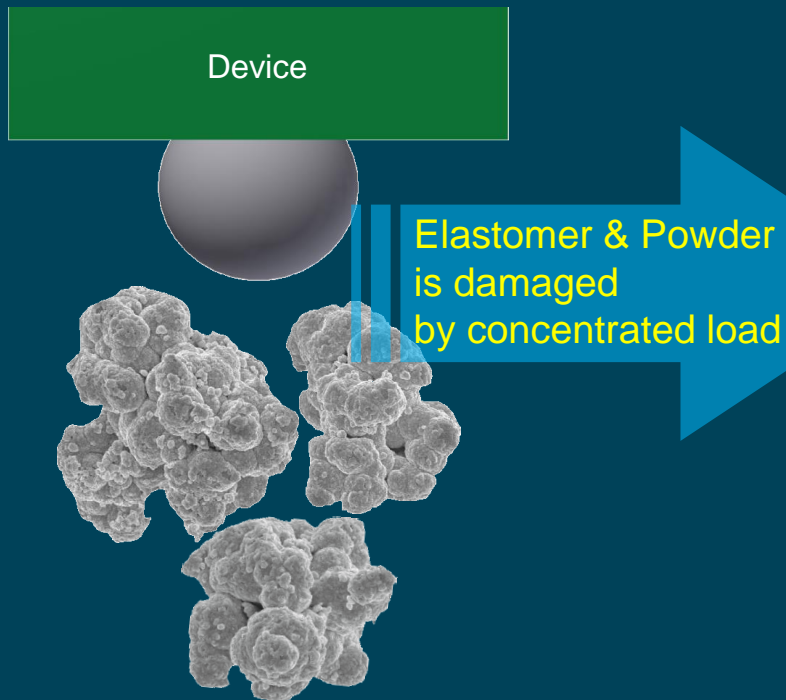
MRC powder



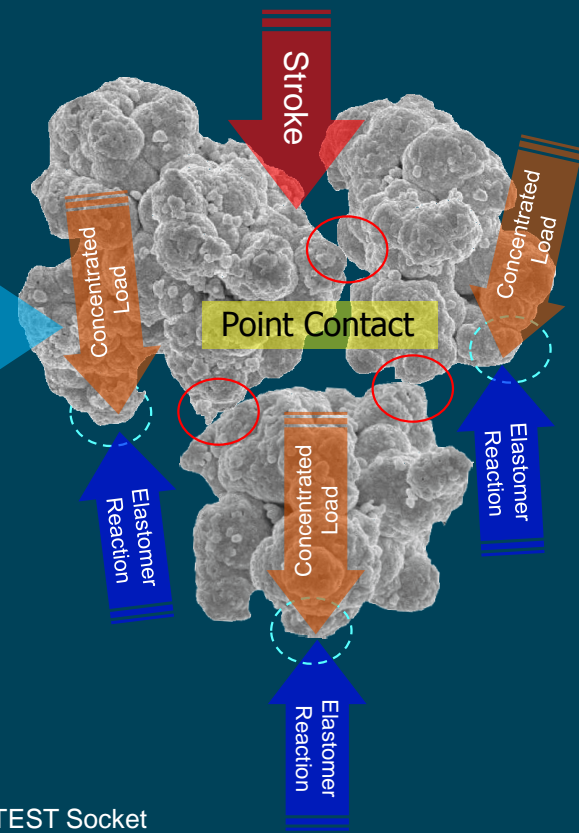
# PCR vs. MRC Comparison

## 4) Contact of Powder (Conventional PCR Powder)

a. Before Device Contact



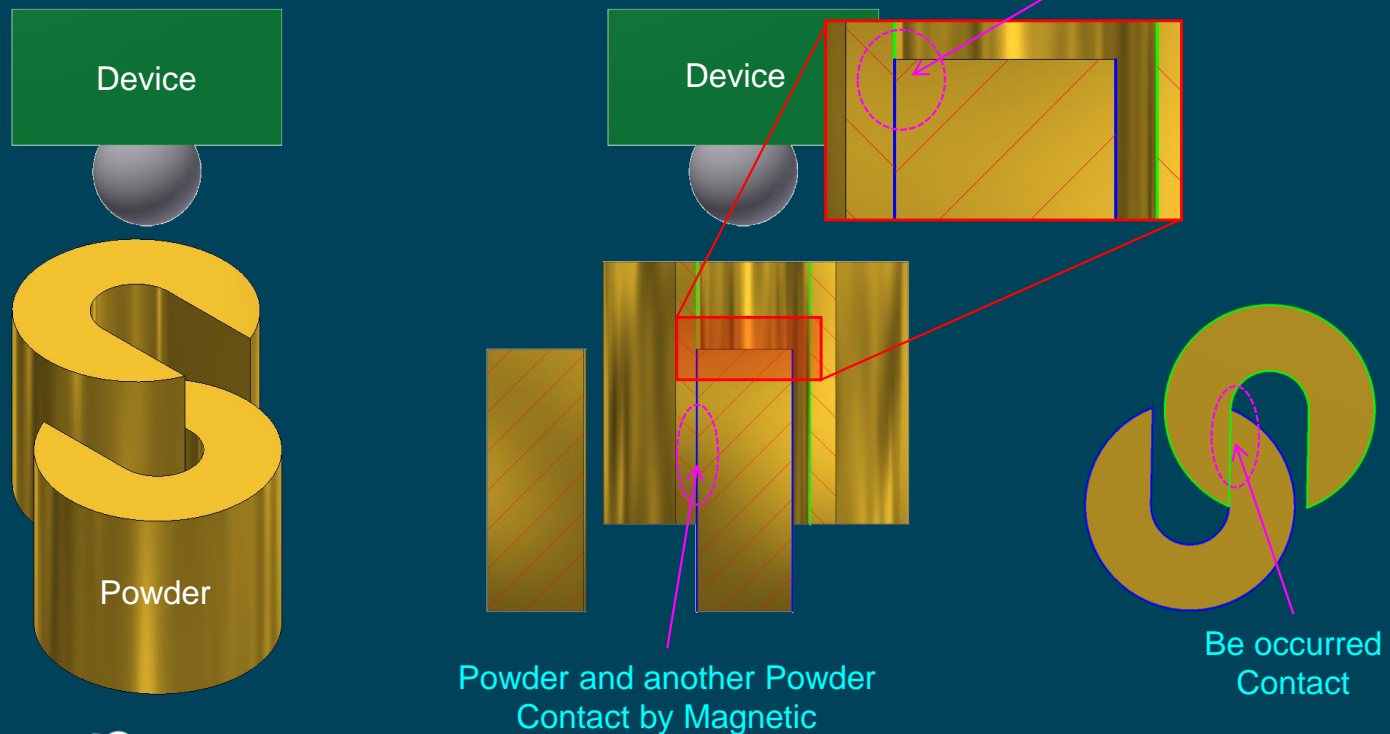
b. After Device Contact



# PCR vs. MRC Comparison

## 5) Contact of Powder (MEMS Powder)

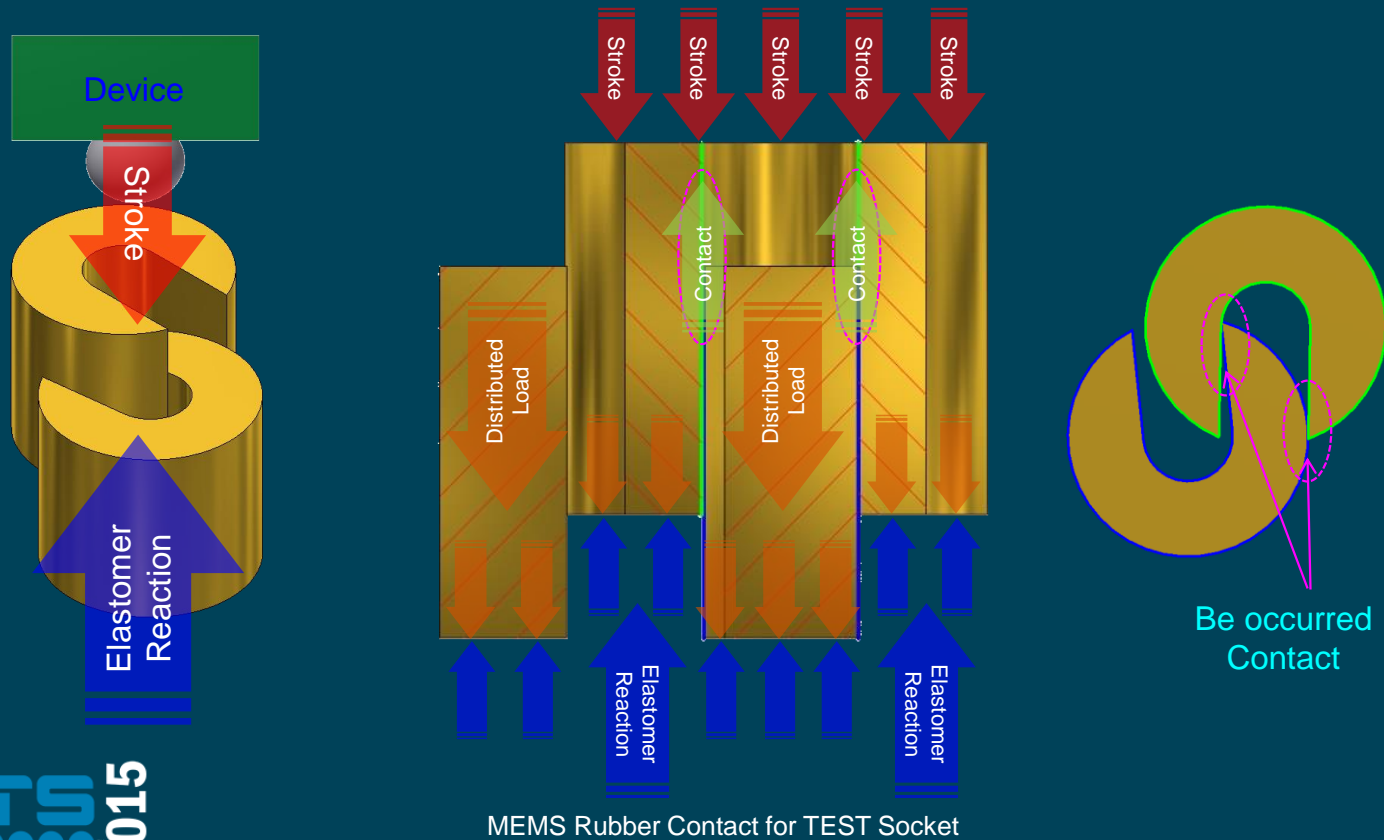
### a. Before Device Contact – Docking Powder



# PCR vs. MRC Comparison

## 5) Contact of Powder (MEMS Powder)

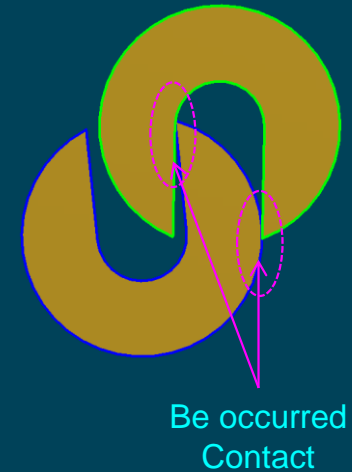
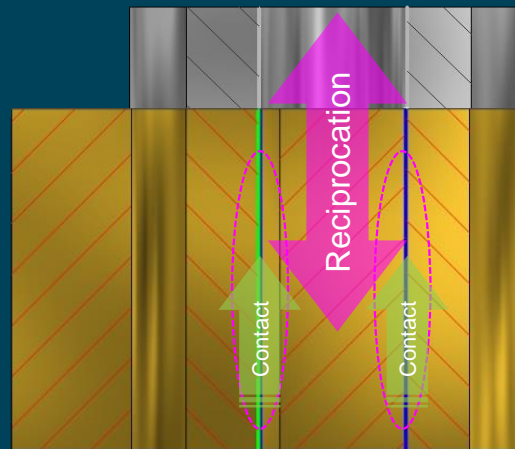
### b. After Device Contact – Reciprocation of Docking Powder



# PCR vs. MRC Comparison

## 5) Contact of Powder (MEMS Powder)

### b. After Device Contact – Reciprocation of Docking Powder

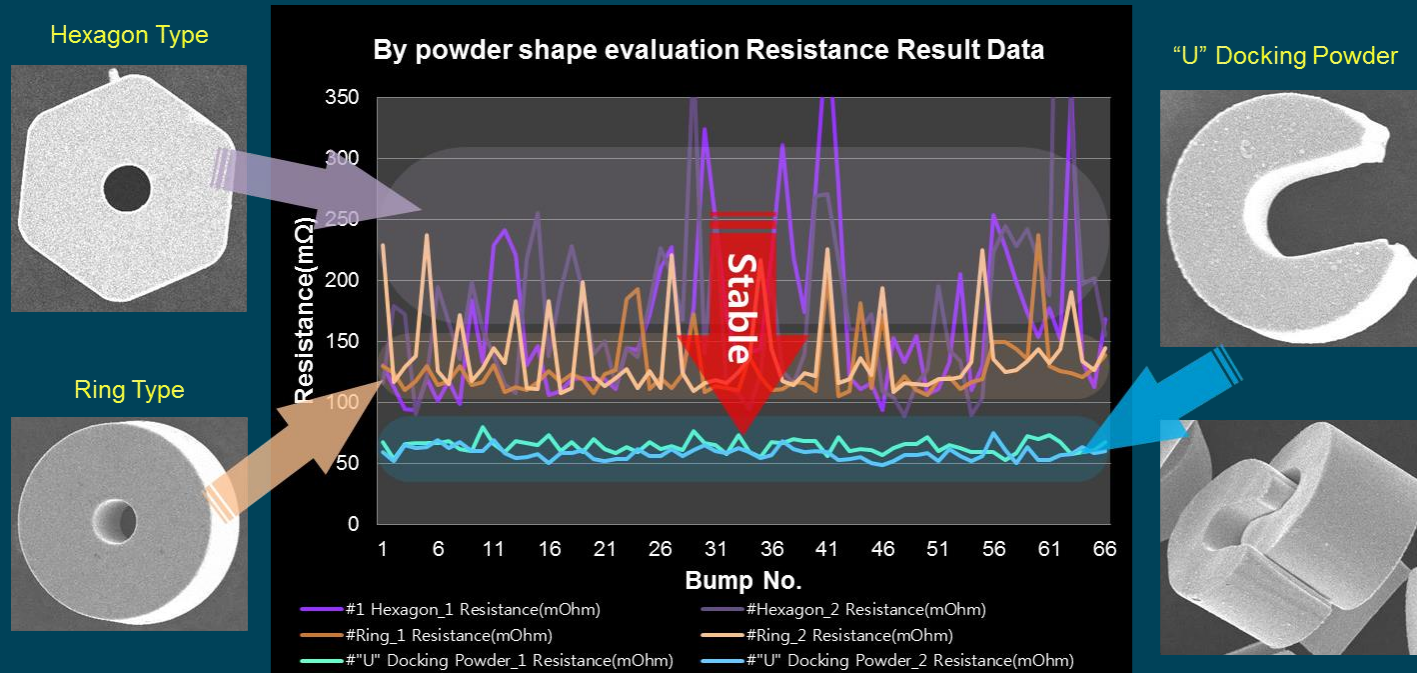




# PCR vs. MRC Comparison

## 6) Resistance Comparison by Powder Structure

### a. Resistance Improvement by Docking Effect



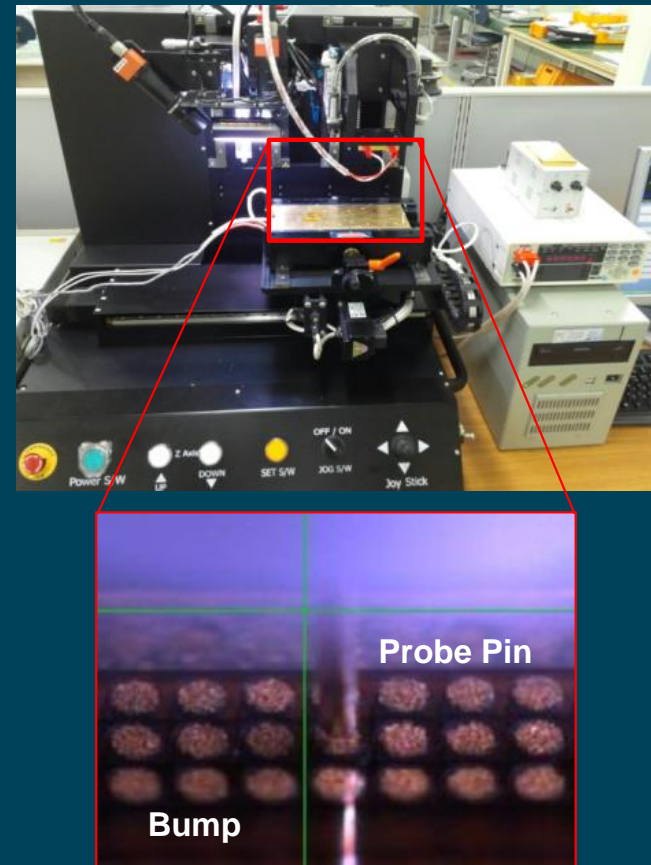


# PCR vs. MRC Comparison

## 7) Contact Lifespan

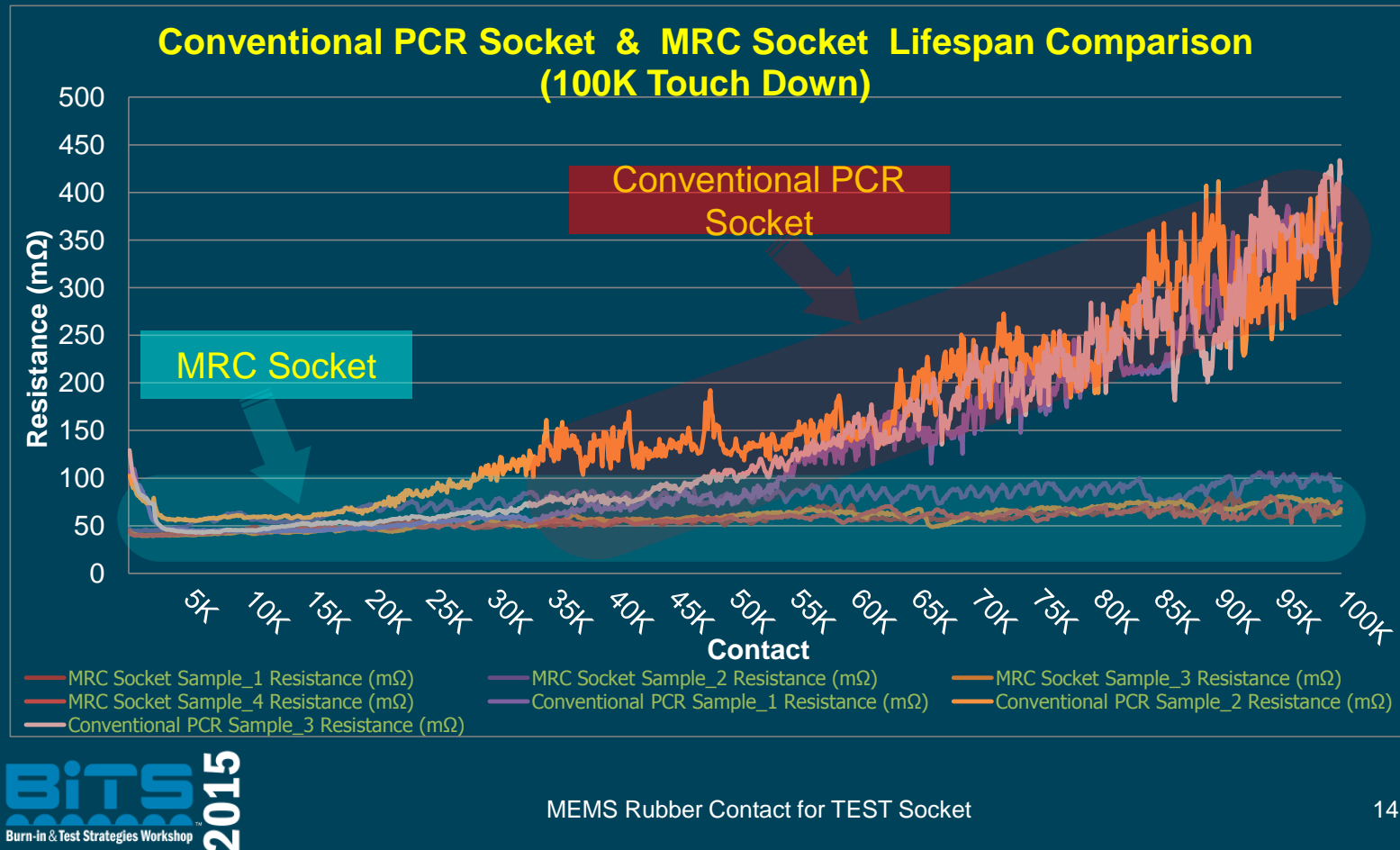
### a. Evaluation Condition

- Tester : TSE IT-490
- Temp : 23°C
- Probe Size :  $\varnothing 0.23\text{mm}$
- Probe Material : BeCu + Plating Au
- Socket : 0.35mm Pitch
- Stroke : 120 $\mu\text{m}$
- Lifespan : Touch Down 100K



# PCR vs. MRC Comparison

## 8) Contact Lifespan



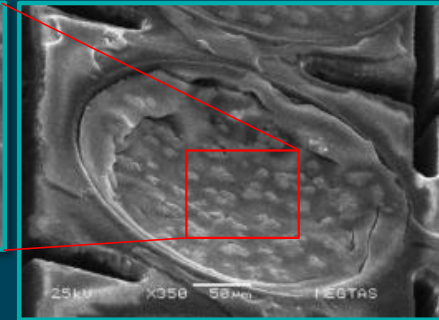
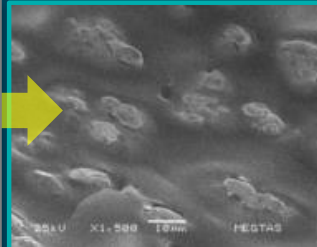
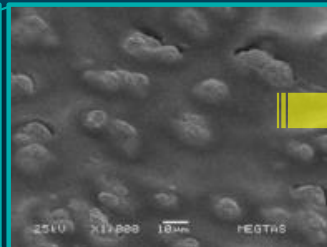
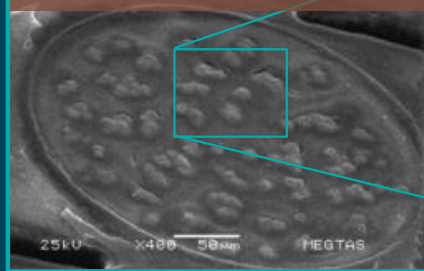
# PCR vs. MRC Comparison

## 9) Durability

Before 100K

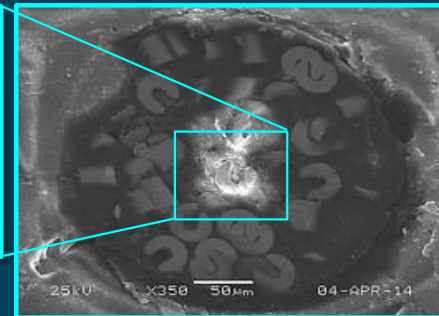
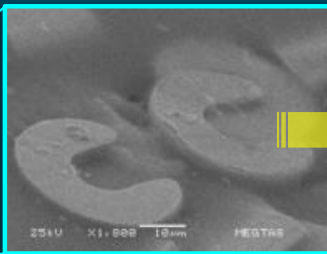
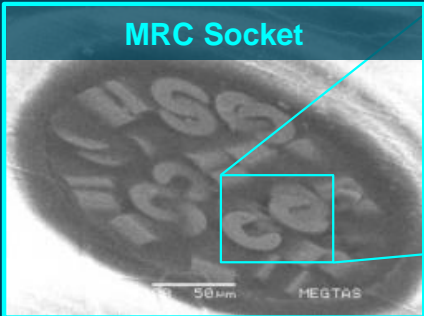
After 100K

Conventional PCR Socket



Depress : 38um

MRC Socket



Depress : 11um

# Evaluation

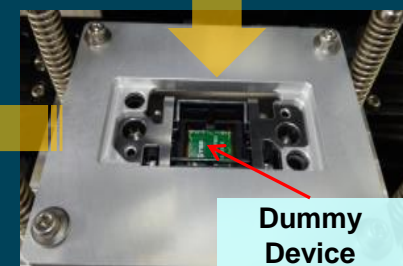
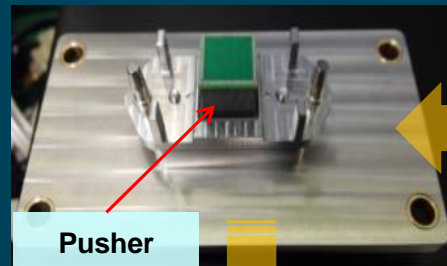
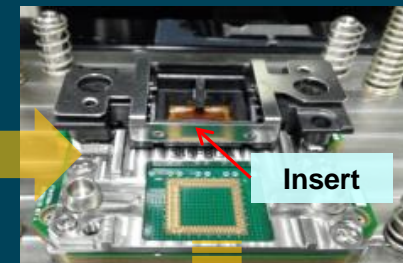
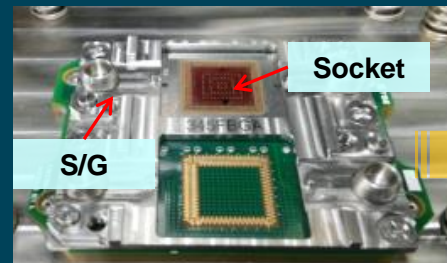
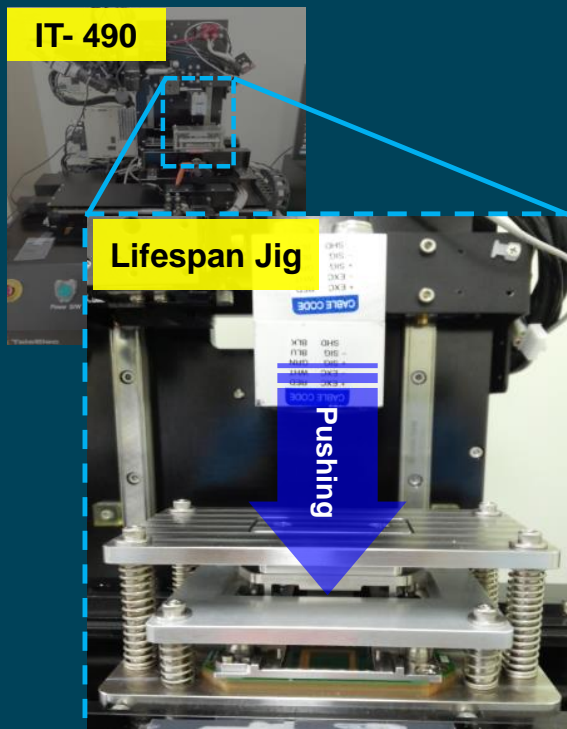
## 1) Lifespan

### a. Evaluation Condition

- Tester : TSE IT-490
  - Temp : 23°C
  - Dummy Device Ball Size :  $\varnothing 0.23\text{mm}$
  - Dummy Device Ball Material : (Pb Free) Sn
  - Socket : 0.35mm Pitch
  - Stroke : 120 $\mu\text{m}$
  - Lifespan : Touch Down 100K
- (Dummy Package was changed whenever after touchdown 10K)

# Evaluation

## Lifespan Jig





# Evaluation

## 2) Lifespan Results

### Durability

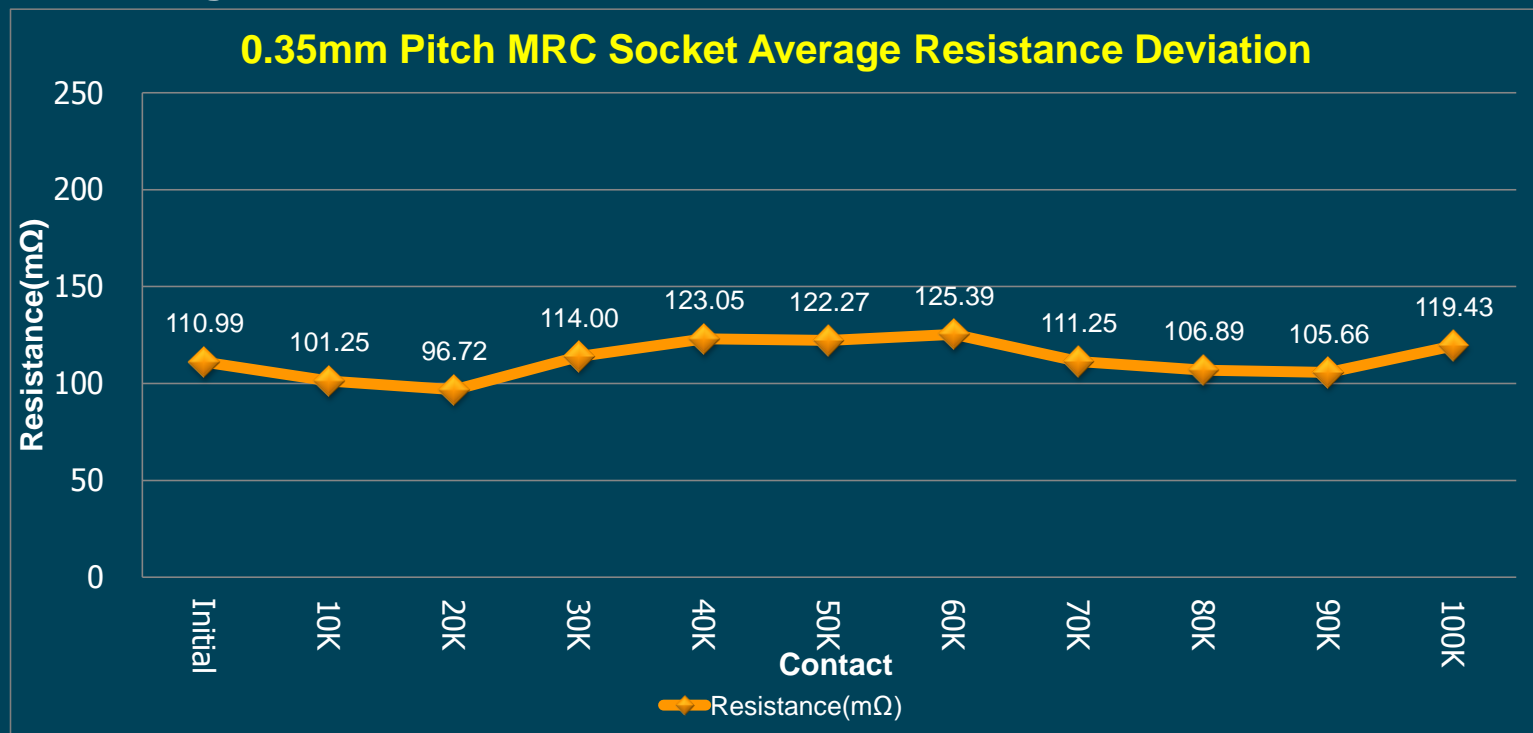


Depress **11um** & AVG Resistance **119.4mΩ**

# Evaluation

## 2) Lifespan Results

### Average Resistance





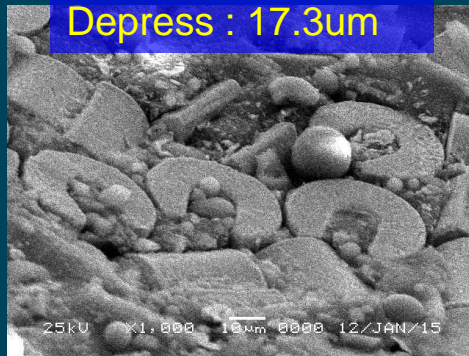
# Evaluation

## 3) Durability at Customer HV Production Site

0.35mm Pitch – 40K



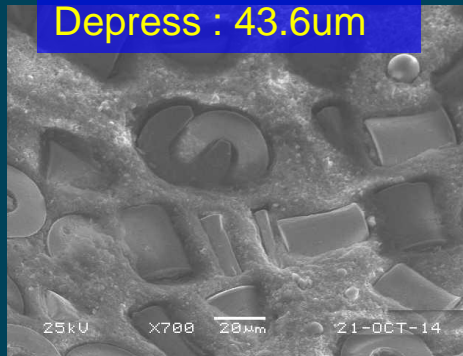
Stroke : 120um  
Depress : 17.3um



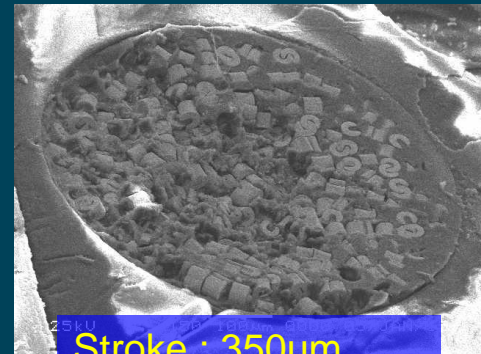
0.8mm Pitch – 100K



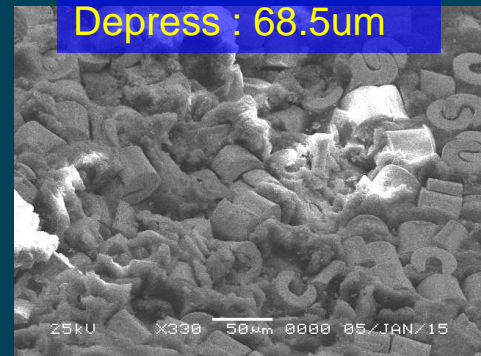
Stroke : 250um  
Depress : 43.6um



1.0mm Pitch – 120K

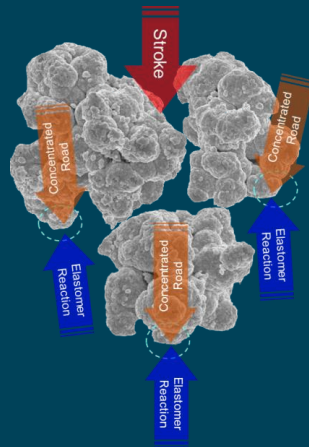


Stroke : 350um  
Depress : 68.5um

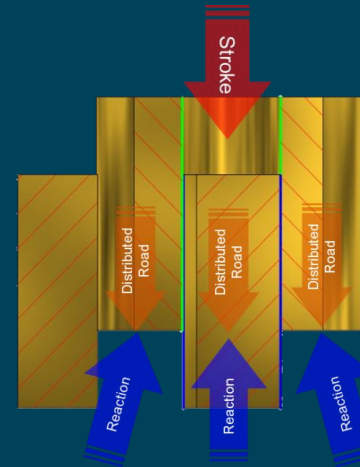


## Conclusion

- Reduced Depression
  - Force distribution on the device & elastomer with uniform shape
  - Prevent damage on powder & elastomer with force distribution
  - Reduced depress by elastomer damage prevention



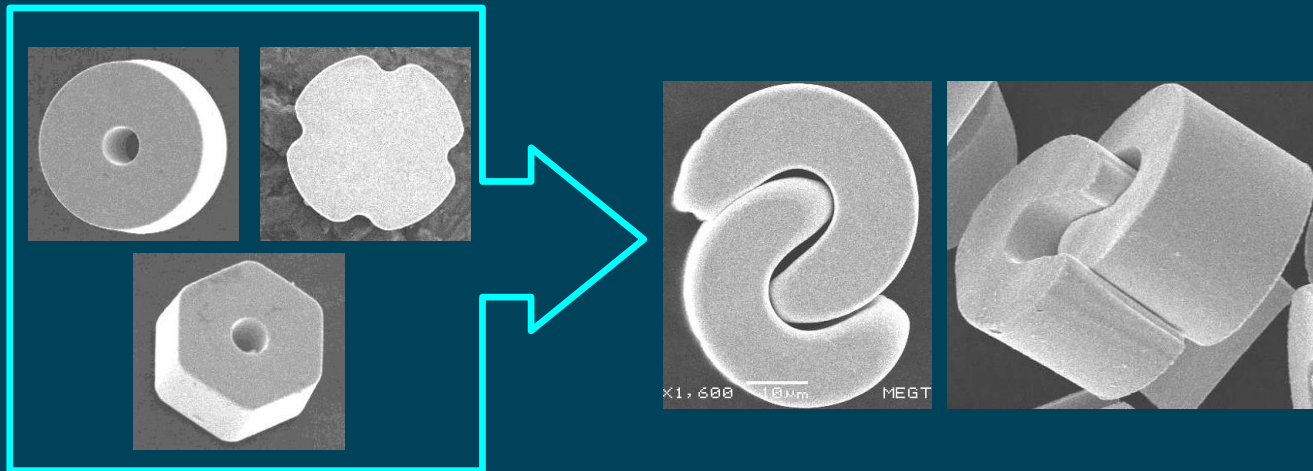
Conventional PCR powder



MRC powder

## Conclusion

- Improved Resistance
  - Stable signal path with a powder docking structure
  - Lower contact resistance with stable signal path
  - Resistance Improvement by increasing plating thickness



## Conclusion

- Improved Lifespan
  - Secure the stroke even though the contact count increase by reducing depress
  - Resistance reliability and uniformity secured between bumps by docking structure
  - Improved lifespan by stable stroke, bump reliability & uniformity