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BiTS

Burn-in & Test Strategies Workshop

TM

March 6 - 9, 2016

**Hilton Phoenix / Mesa Hotel
Mesa, Arizona**

Archive- Posters

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Poster
Session

BiTS Workshop 2016 Schedule

Frontiers Day

Monday March 7 - 3:30 pm

Poster Session

"WiGig Test"

Bert Brost – Xcerra

"Re-balling BGA with Gold Plated Copper Spheres, the Need and the SMT Challenges"

Emad Al-Momani, Srikanth Mothukuri, Jack Mumbo - Intel Corporation

"Thermal Test Methodology for Validating Automotive Semiconductor Packages"

Ying Feng Pang, Amy Xia – Intel Corporation

"Insitu 256 Node Resistive Leakage Tester"

Gordon Cowan, Rich Zavala - HighRel, Inc.

RE-BALLING BGA WITH GOLD PLATED COPPER SPHERES, THE NEED AND THE SMT CHALLENGES

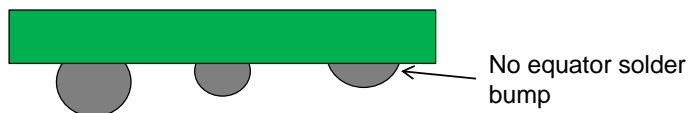
Emad Al-Momani & Jack Mumbo
Intel Corp

Introduction

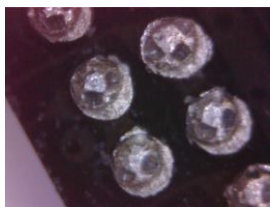
Socketting of current BGA packages have reliability limitations due to oxidation & soft nature of SAC solder. Re-balling with gold plated copper balls resolves some of these issues.

Potential applications includes but not limited to:

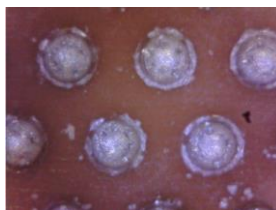
- Enabling gripping type socket technologies for packages with small or bump type solder (no equator)



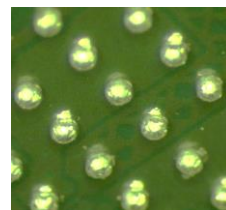
- Improving long term reliability in HVM type BGA sockets where Fretting Corrosion, Intermetallic Formation, Electromigration and creep damages are common at the interface of solder ball to socket's contact pin.



**BGA Balls Damage
Caused by Socket**



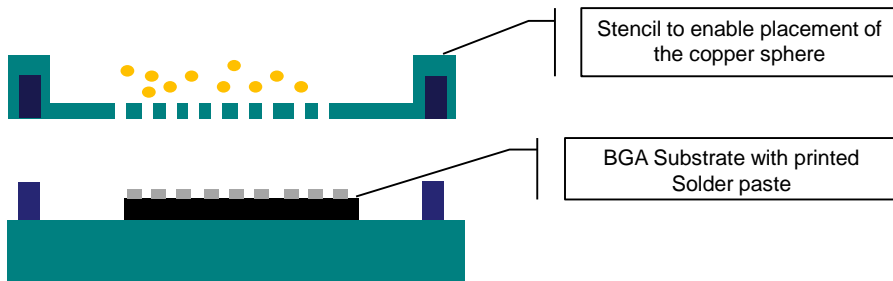
Oxide growth on SAC BGA



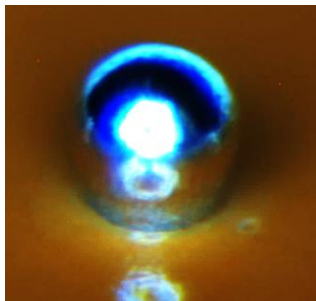
**BGA Balls Gouging
from socket**

Challenges:

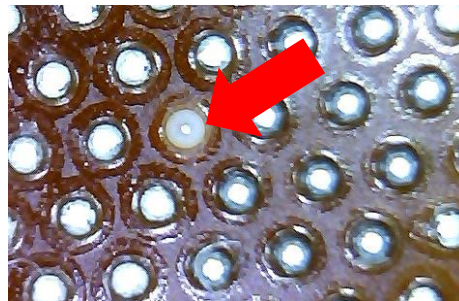
1. Developing a refined Copper Sphere attachment process



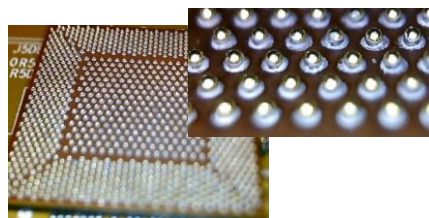
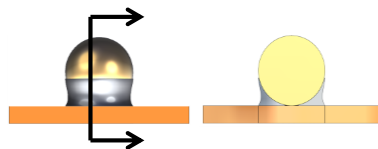
2. Quality of the attached copper spheres:
 - **Solder wicking:** solder should not cover the upper half of the sphere
 - **Missing copper spheres**
 - **Bond strength** of copper spheres to substrate pad



Solder wicking (Cu Sphere completely enveloped with solder)



Cu Sphere bonding to pad is strong enough to peel copper pad on package



Ideal attachment should have a centered sphere on pad with no solder above its equator.

Experiments:

The following table details the factors that were studied and its associated levels. More than thirty different experiments were conducted.

Table 1. Summary of the experimental parameters

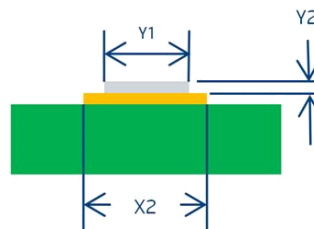
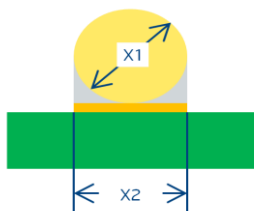
Parameter	Value		
Copper Sphere Diameter (X1)	8	11	13
PCB Pad Diameter (X2)	10 SMD	11 SMD	11 NSMD
Stencil Aperture Diameter (Y1)	3, 4, 5, 6, 7, 8mil		
Stencil Thickness (Y2)	2mil	4mil	
Reflow Device	Oven	SRT	

Solder Paste Volume Calculation:

$$V_{solderpaste} = \left(\frac{X_1}{X_2}\right) \left(\left(\frac{X_2}{2}\right)^2 \left(\frac{X_1}{2}\right) - \frac{X_1^3}{12} \right) \pi$$

$$Y_1 = 2 \sqrt{\left(\frac{V_{solderpaste}}{\pi Y_2}\right)}$$

X1: Copper Sphere Diameter
 X2: Pad diameter
 Y1: Stencil aperture diameter
 Y2: Stencil thickness



Conclusion:

This research highlighted the need for re-balling BGAs with gold plated copper spheres. It summarized the best practices for the sphere attachment processes, including a formula to calculate the amount of solder required to attach a certain size copper sphere while achieving a good quality. The quality was represented by strong enough bonding force and no solder wicking. More details will be the topic of a future publication.