Semiconductor Wafer
Test Workshop-2007

Parallel Sort Process and its Challenges

Sabita Roy Intel Corp.
Warren Crippen Intel Corp.
Sean McClure Intel Corp.
Sayed Mobin Intel Corp.

June 2007

OBJECTIVE

Share learning on initial development of 2 DUT (by-2) parallel probing process utilizing Wedge Buckling Beam probe card technology on Copper Bumps

OUTLINE

- Introduction
- Technical issues discovered in developing the first 2 DUT probing process with Wedge Buckling Beam (WBB) on Cu Bumps
- Characterizing the issues from the observed effect
- Addressing the challenges
- Conclusions

☞ INTRODUCTION

INTRODUCTION

Motivations for parallel sort →

(i) Sorting multiple dice simultaneously;
Improves through put efficiency compared to a single DUT

(ii) Lower total cost compared to single sort testing

Goal→ Establish a by-2/Cu/WBB solution

Prior technology delivered probing process for by-2/FBB on PbSn bumps

by-2 sort on WBB/Cu bump is a new probing process with associated challenges

Initial Development Uncovered Key Challenges

- ❖ Docking consistency of probe card to prober
- ❖ Site to site discrepancies in in-line path resistance
- ❖ Rapid degradation of probe tips → short SIU lifetimes

☞ Understanding/Characterizing the Challenges

Docking Consistency

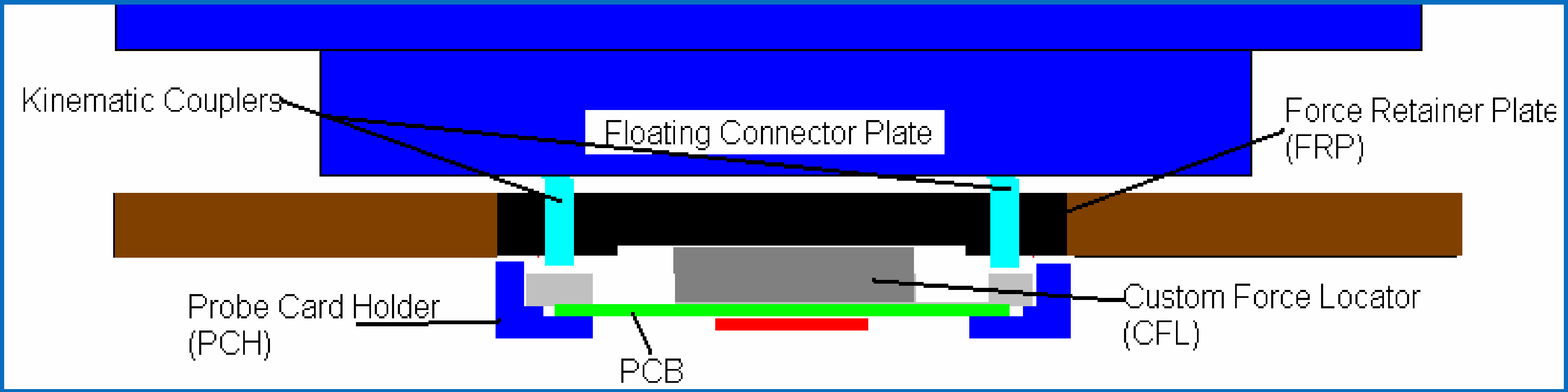


Fig.1- Schematic of the interface of Test Head, FRP and CFL

- Force Retainer Plate (FRP) controls system deflection
- Custom Force Locator (CFL) controls contact of SIU to prober
- Good, consistent contact is a function of controlled Contact between FRP and CFL
- Alignment of FRP and CFL setup are each controlled independently

Worst Case Scenarios:

Inconsistent docking leads to inconsistent planarity across the probe field. This can lead to differences in site to site sort performance

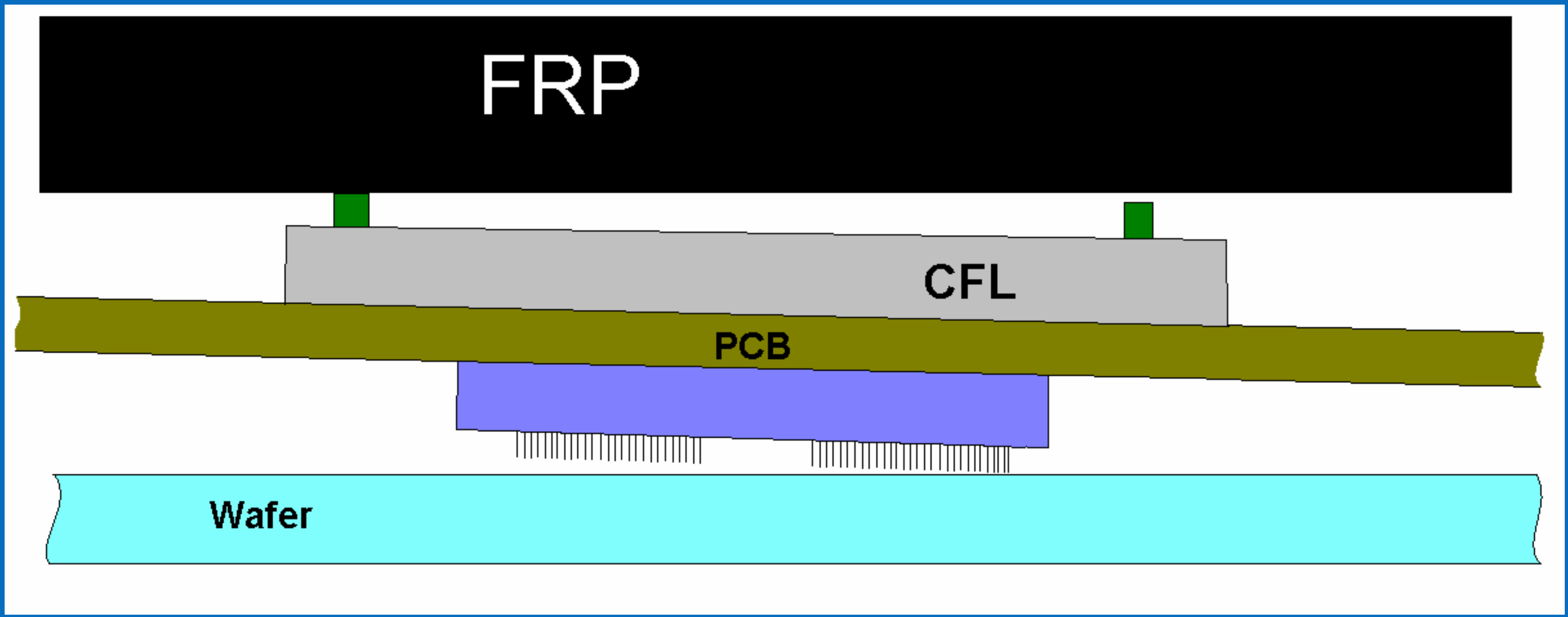
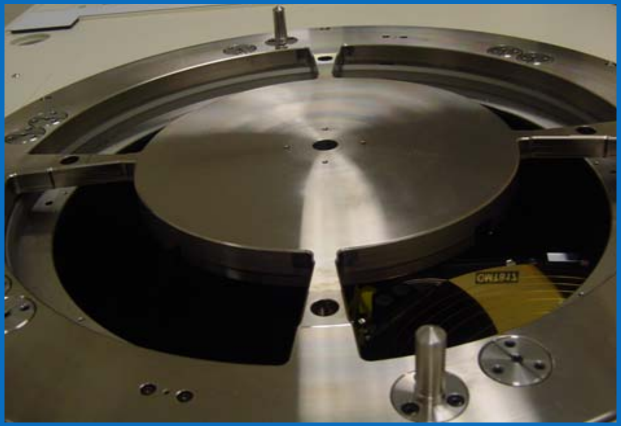
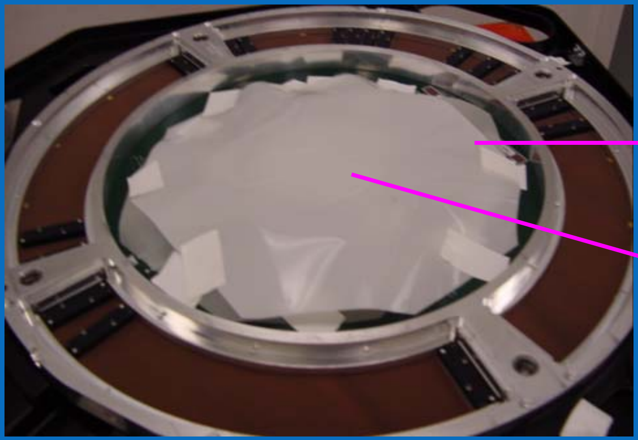


Fig.2- Inconsistent CFL to FRP Contact

Characterization of Contact Quality between CFL and FRP

- ❖ **Determining quality of contact**
  - ❖ **Conducted pressure paper experiment**
  - ❖ **Under normal docking condition**
  - ❖ **Evaluated paper color change**
  - ❖ **Light color → poor contact; deep color → good contact**



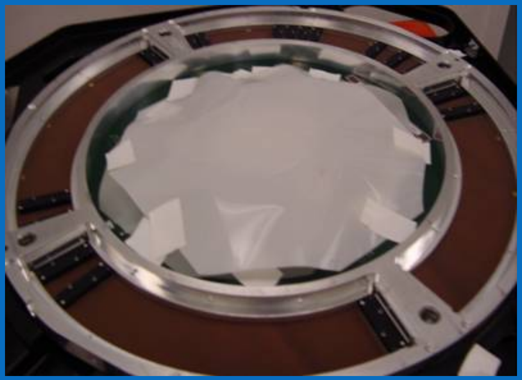


Pressure Paper

CFL covered by the pressure paper

Fig.3- Contact between CFL and FRP

Pressure Paper Study – Determination Contact Quality

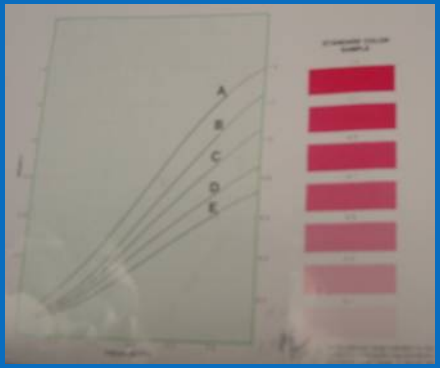


a) No-contact → Pressure paper attached with CFL

b) Good Contact→ Red dots = good quality contact between FRP/CFL

C) Uneven contact→ Red incomplete dots

d) Poor Contact→ No dots = no contact



e) Pressure paper calibration curves

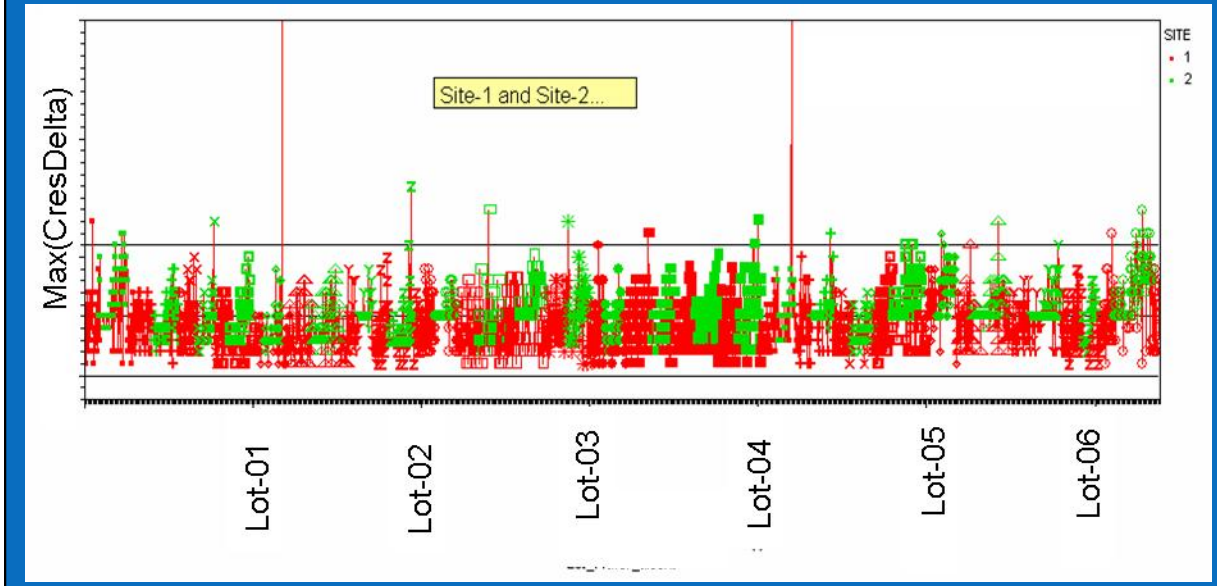
Initial Development Uncovered Key Challenges

√ Docking consistency of probe card to prober

NEXT- Site to site discrepancies in in-line path resistance

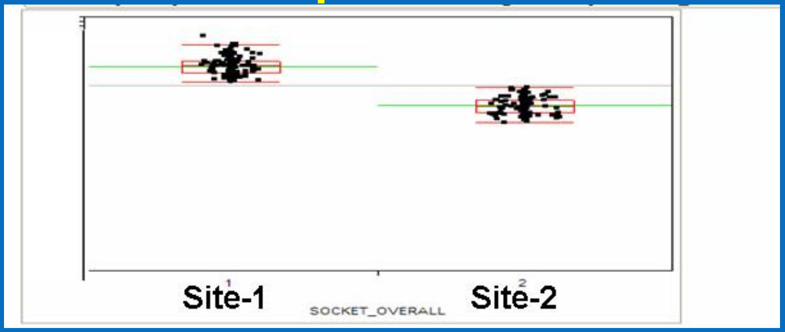
Rapid degradation of probe tips → short SIU lifetimes

Site to Site Difference in Path Resistance



•Max Cres delta between sites ~15 - 20%

Die average Cres distribution – product X



Die average Cres distribution – Test Vehicle Y

•Normalized max delta (TV material) is ~15 - 20%

•Site to site routing path length difference is a fraction (~ 8%)

•Discrepancy is not fully understood yet

Initial Development Uncovered Key Challenges

√ Docking consistency of probe card to prober

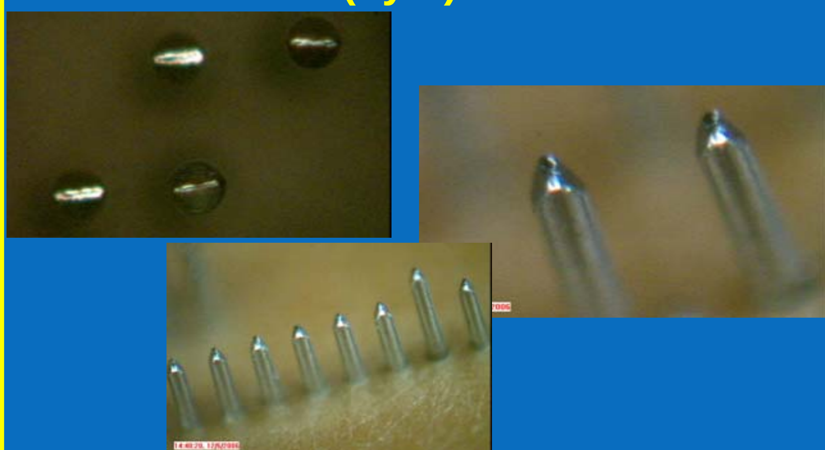
√ Site to site discrepancies in in-line path resistance

NEXT- Rapid degradation of probe tips → short SIU lifetimes

Rapid degradation of Probe tip for Parallel Sort

- ❖ Significant Probe tip degradation→ life time is about order of magnitude less for by-2 sort
- ❖ Minimal Probe tip degradation for by-1 sort

Parallel Sort (by-2): WBB



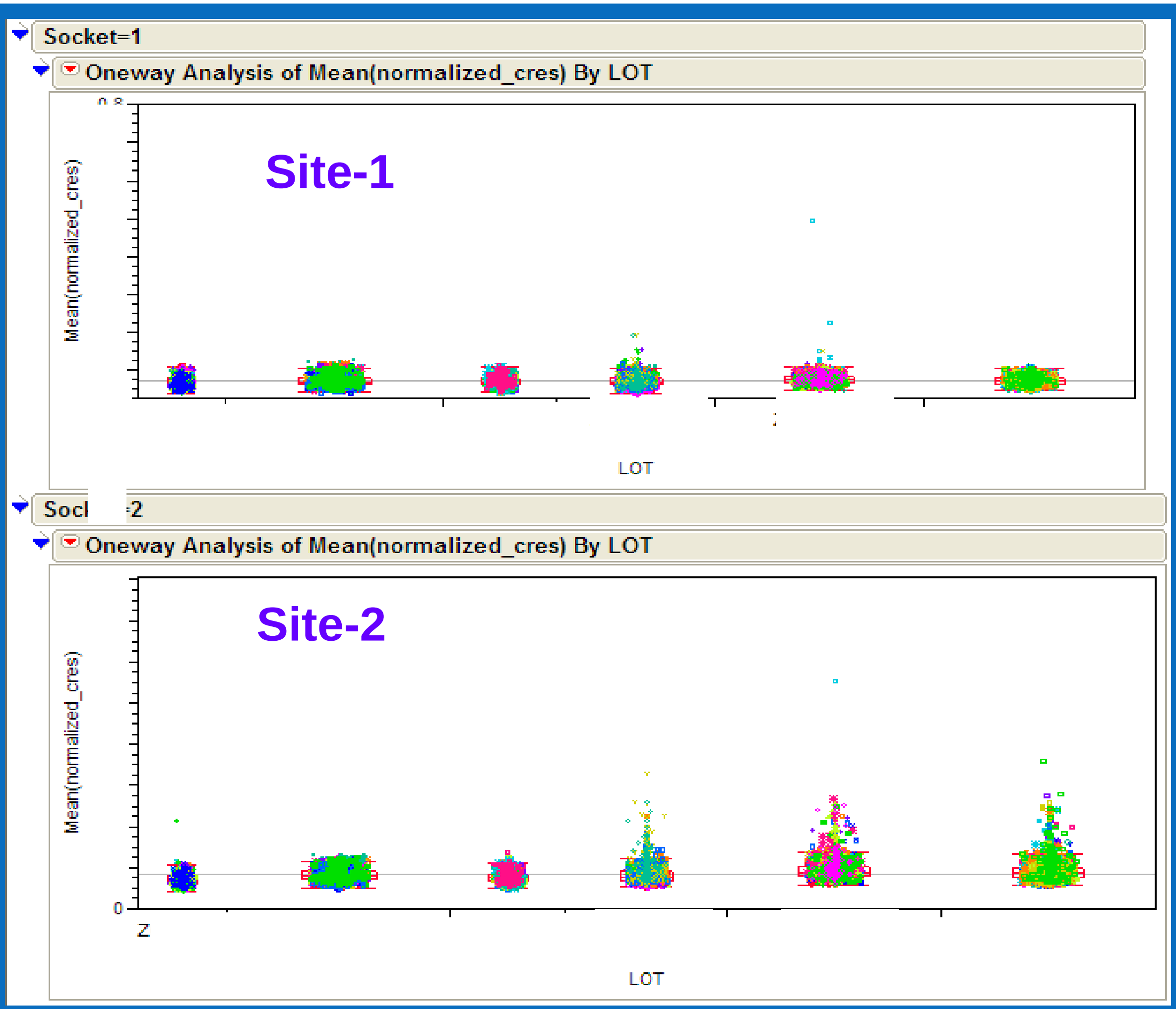
Site-2 Tip image from by-2 parallel sort

Single Sort (by-1): WBB

Tip image from by-1 sort

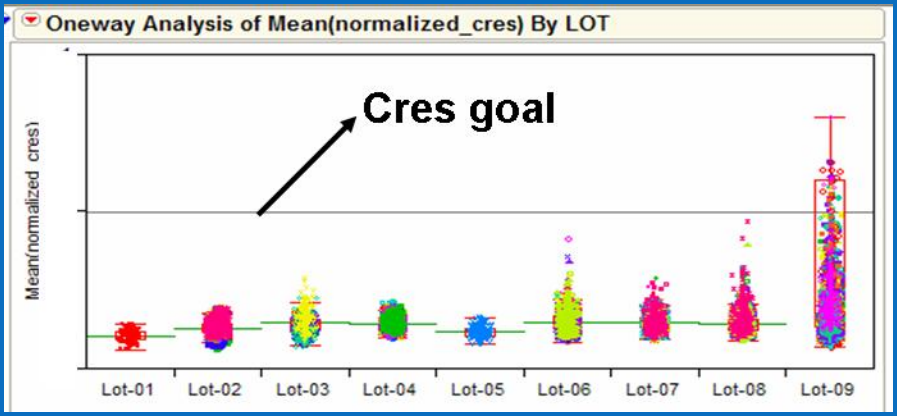
Site Level Break out of Cres

- Cres started increasing only at site-2
- Overall Cres increases due to increased Cres of Site-2

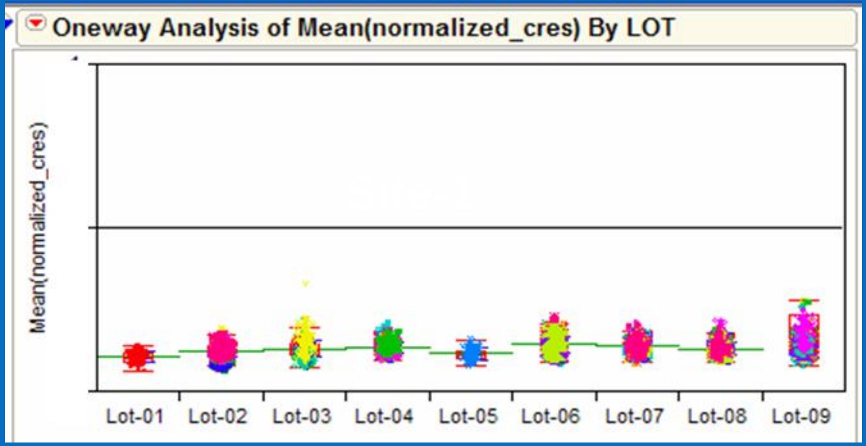


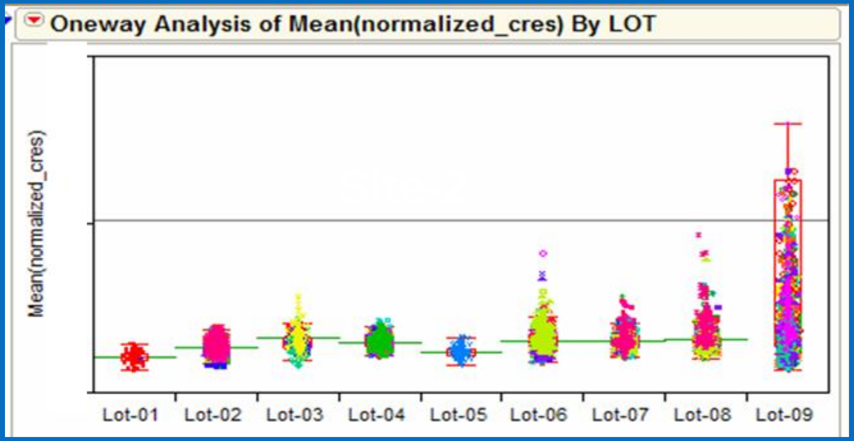
Die average Cres distribution on Cu bump (TV wafer)

Probe Card Expires due to Increased Cres



Die average Cres distribution on Cu bump





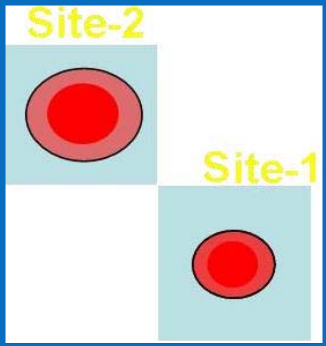
Site level die average Cres distribution

- Life time order of magnitude less → exceeds Cres goal
- High Cres at Site-2 → shorter SIU lifetime

Potential Resolutions of the Challenges

Challenges – (i) Site to site discrepancies in in-line path resistance
(ii) Life time Degradation

- FEA was used to select an improved probe head design
  - This demonstrates resolution of probe tip degradation
  - Cres was also shown to be improved
- This analysis was validated via experimentation



Schematic of Z deflection for site-1/site-2

Contour plot illustrates differences in Z deflection between site-1 and site-2

Potential Resolutions of the Challenges

Challenge -- Docking consistency of probe card to prober

- **Insuring specifications for both FRP and CFL are compatible so that even in worst case material condition, contact is of sufficient quality to insure good sort**

CONCLUSIONS

- Major challenges of parallel sort on WBB/Cu bump discussed
- Docking consistency can be achieved by consistent specifications between CFL and FRP
- Site to site difference of in-line path resistance and life time to be validated with improved design