Comprehensive Approach to Control Contact Resistance Instability and Improve First Pass Yield of Bumped Devices

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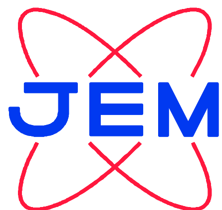
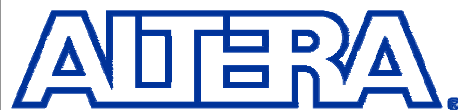




2005 SouthWest Workshop

June 5 to 8, 2005

Overview

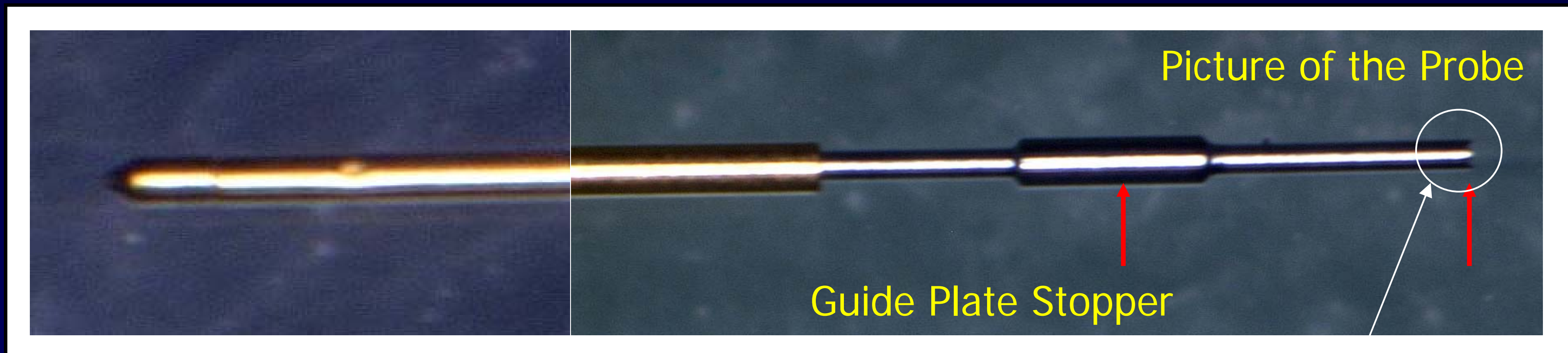
- Introduction
- Objectives / Approach
- Methodology Overview
- Implementation / Characterization
- Summary

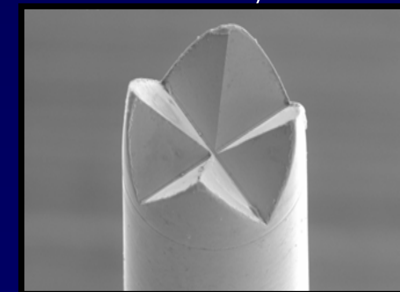
Evaluation Goals

- To determine the initial time zero path resistance of the VS crown probe card, and monitor that same path resistance after various amounts of die had been sorted.
- To compare the performance of current standard VS flat tip technology against the new VS crown tip in terms of wafer yield.

VS-Series Probe (Crown)

- Newly developed spring probe design
- Achieves precise probe position and planarity





Crown Tip Shape

Contact Concept

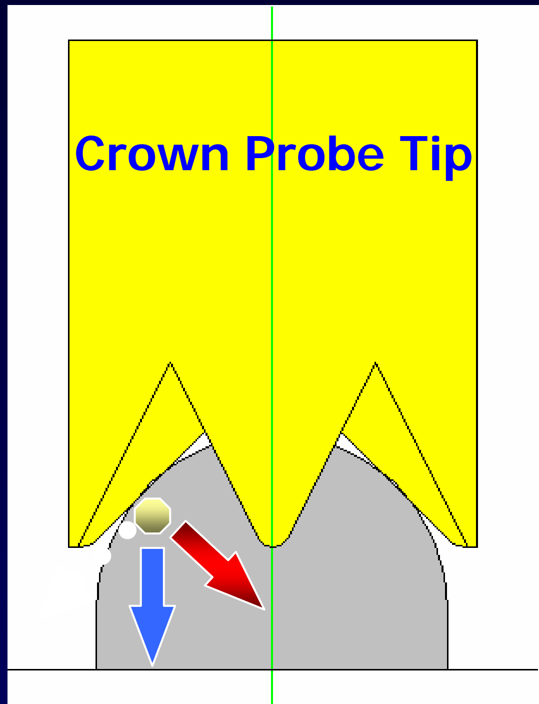
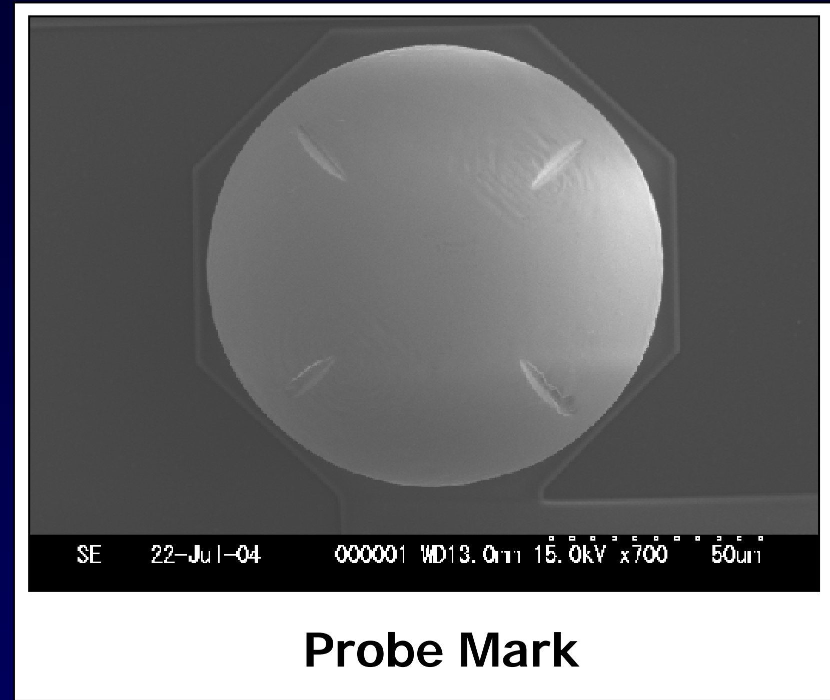
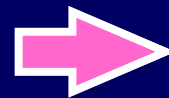


Image of the Contact Point



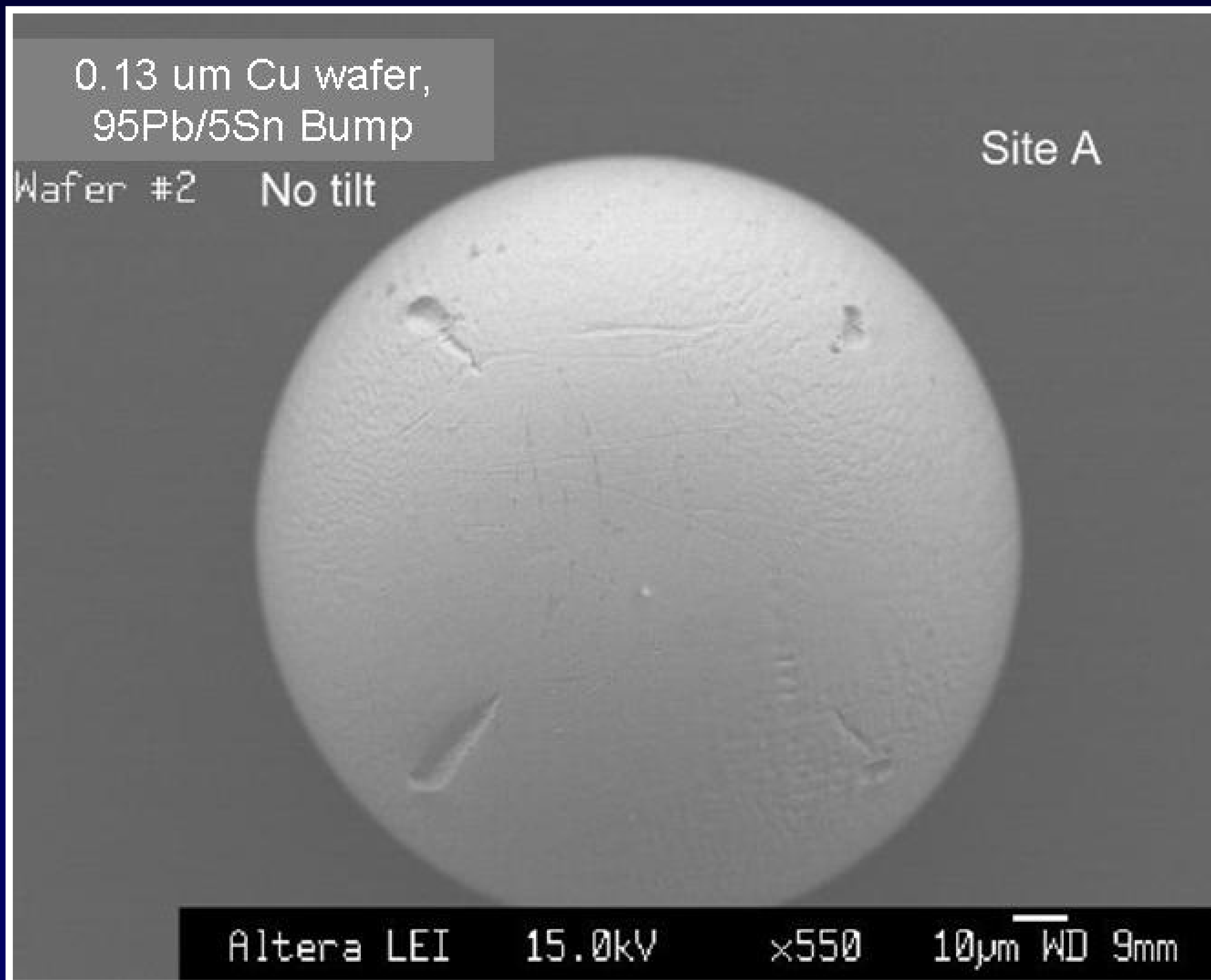
Probe Mark

The ridge of the crown probe tip translates vertical force into radial force.

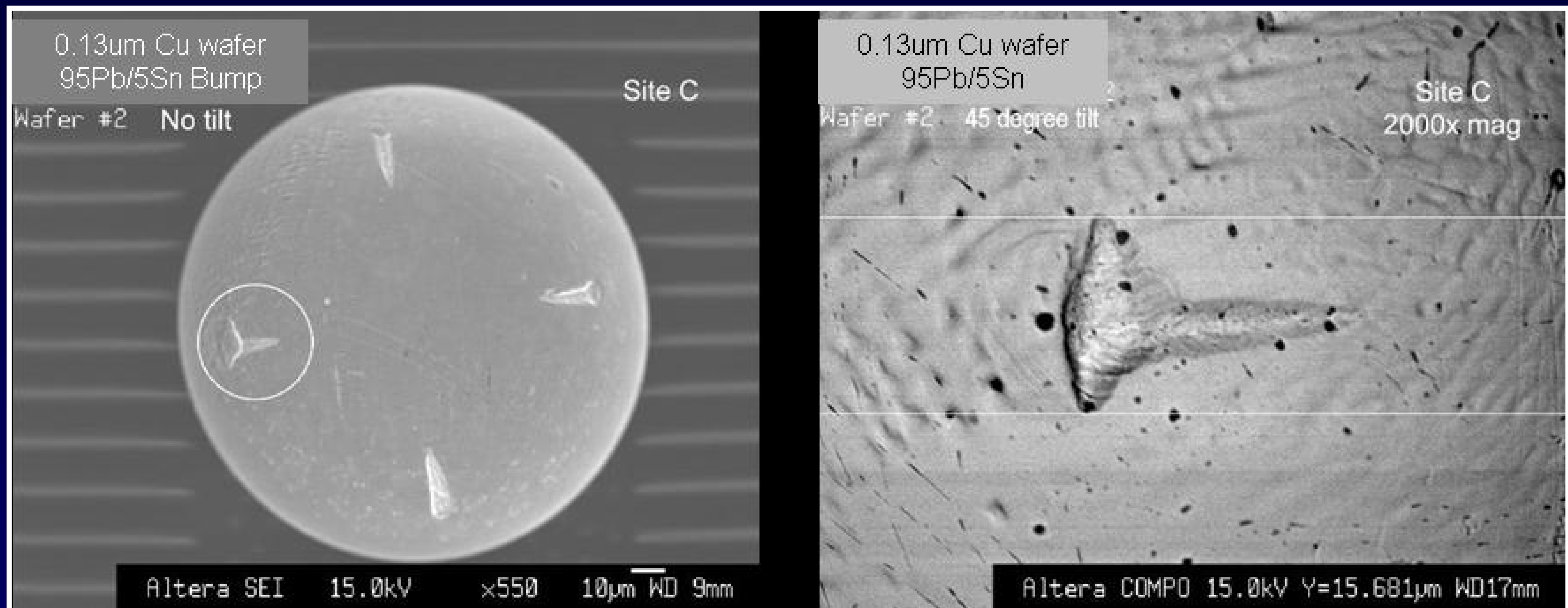


Stable CRES by lower contact force with minimal probe mark.

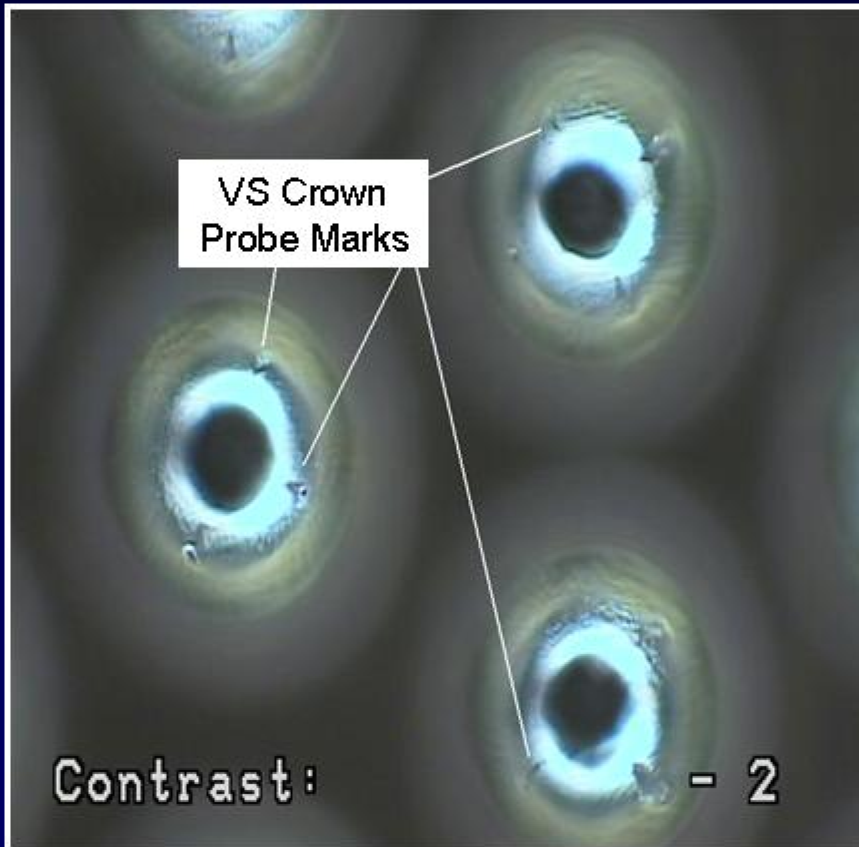
VS Crown Tip Probe Mark Images



VS Crown Tip Probe Mark Images

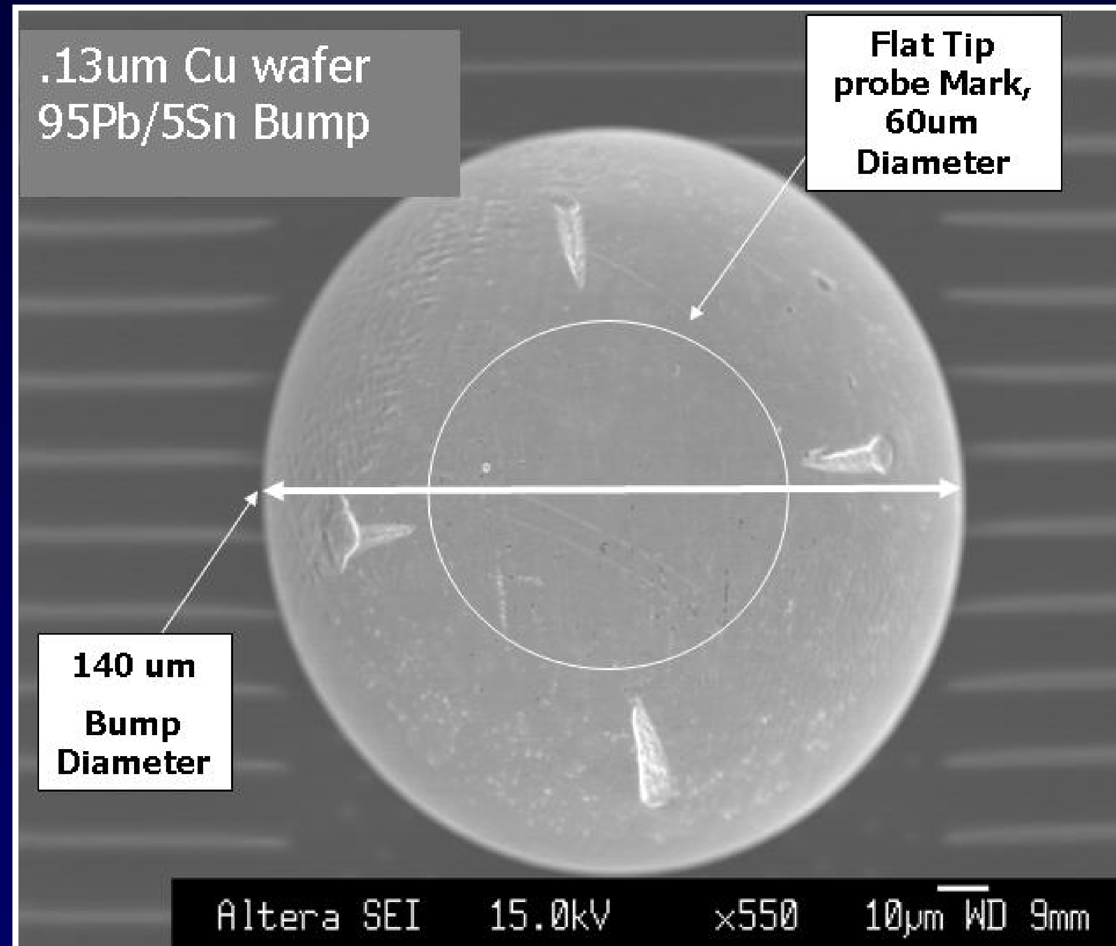


Microscope Images of VS Crown Tip Probe Marks

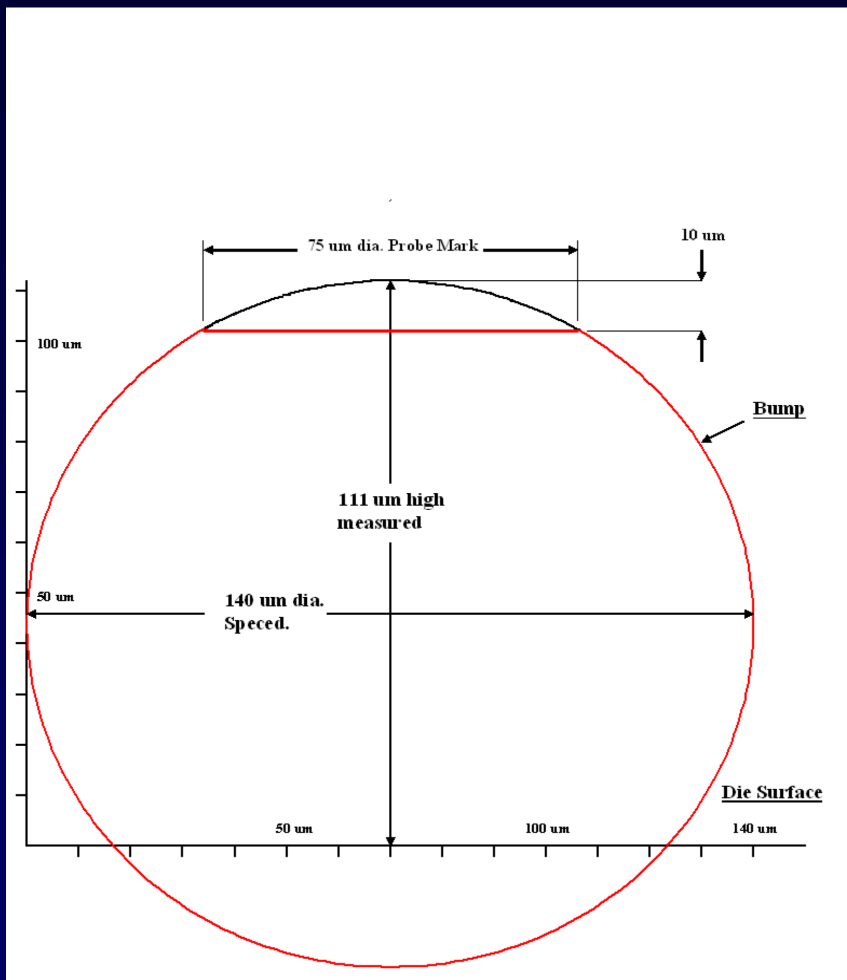


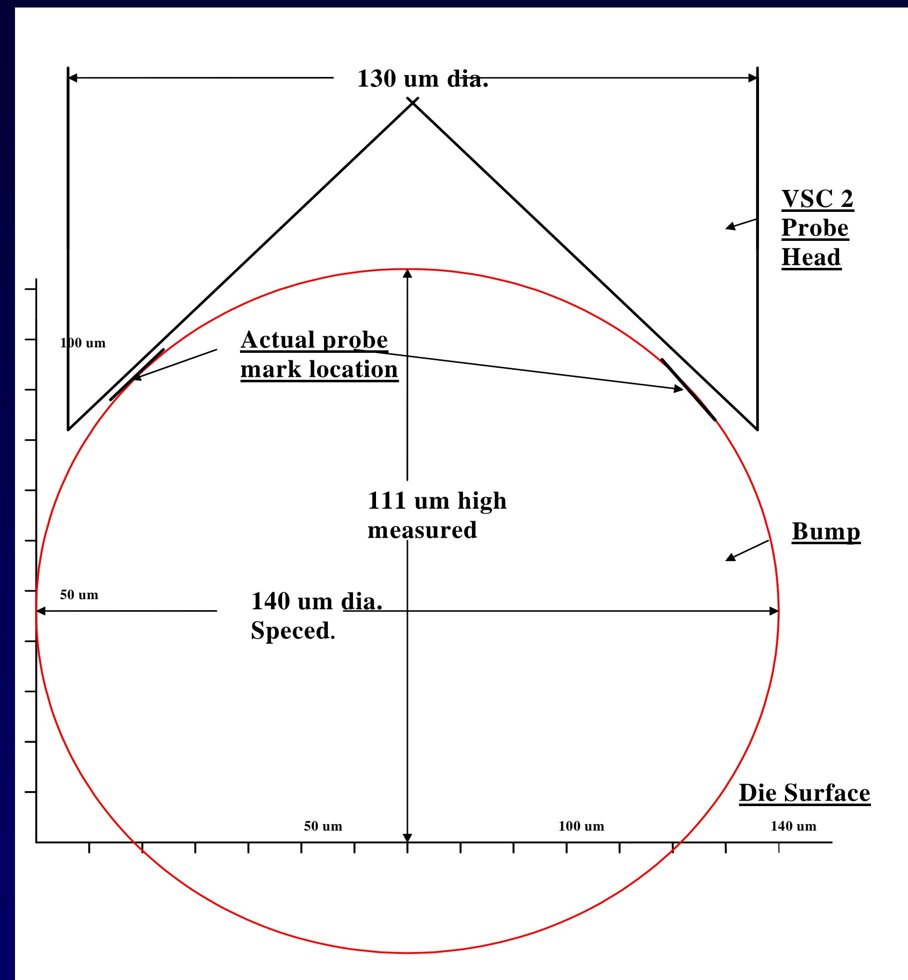
Probe Mark Size Comparison

- Crown Tip Marks vs. Flat Tip Bump Deformation



Side View Comparison Of Probe Marks

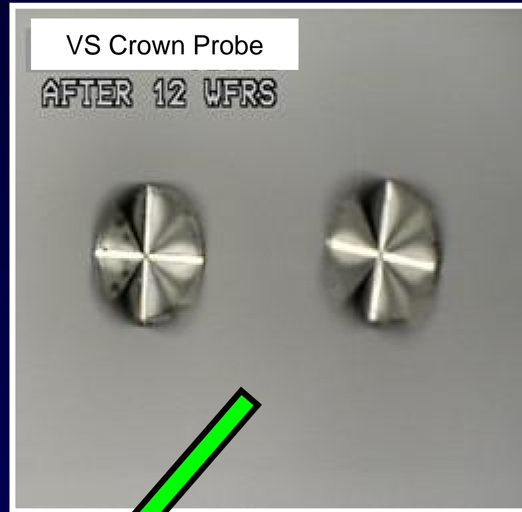


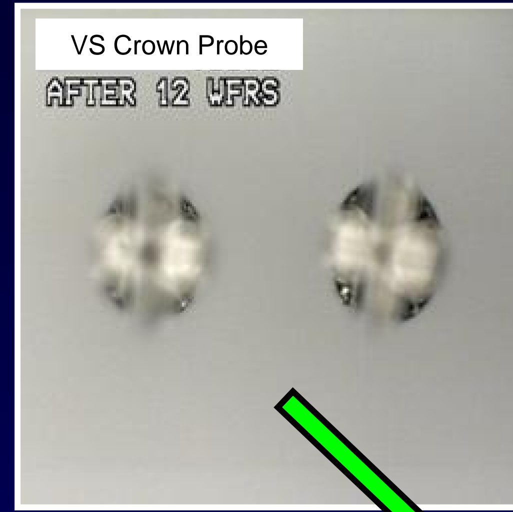


Flat Tip

Crown Tip

VS Crown Probe After Sorting 12 Wafers





Non-destructive on-line cleaning is needed to keep the contact surfaces debris free.

Path Resistance Measurement

- Shorted Probe Card PCB used to zero out the resistance measurements of Test Head and Test Head Cables.
- VS crown tip probe card used to probe a shorted wafer, using 150 um OD.
- Resistance measurements taken at 3 minute intervals, while resting on a die, no Z-up or Z-down in between.
- Zero out resistance measurements subtracted out to acquire actual path resistance.

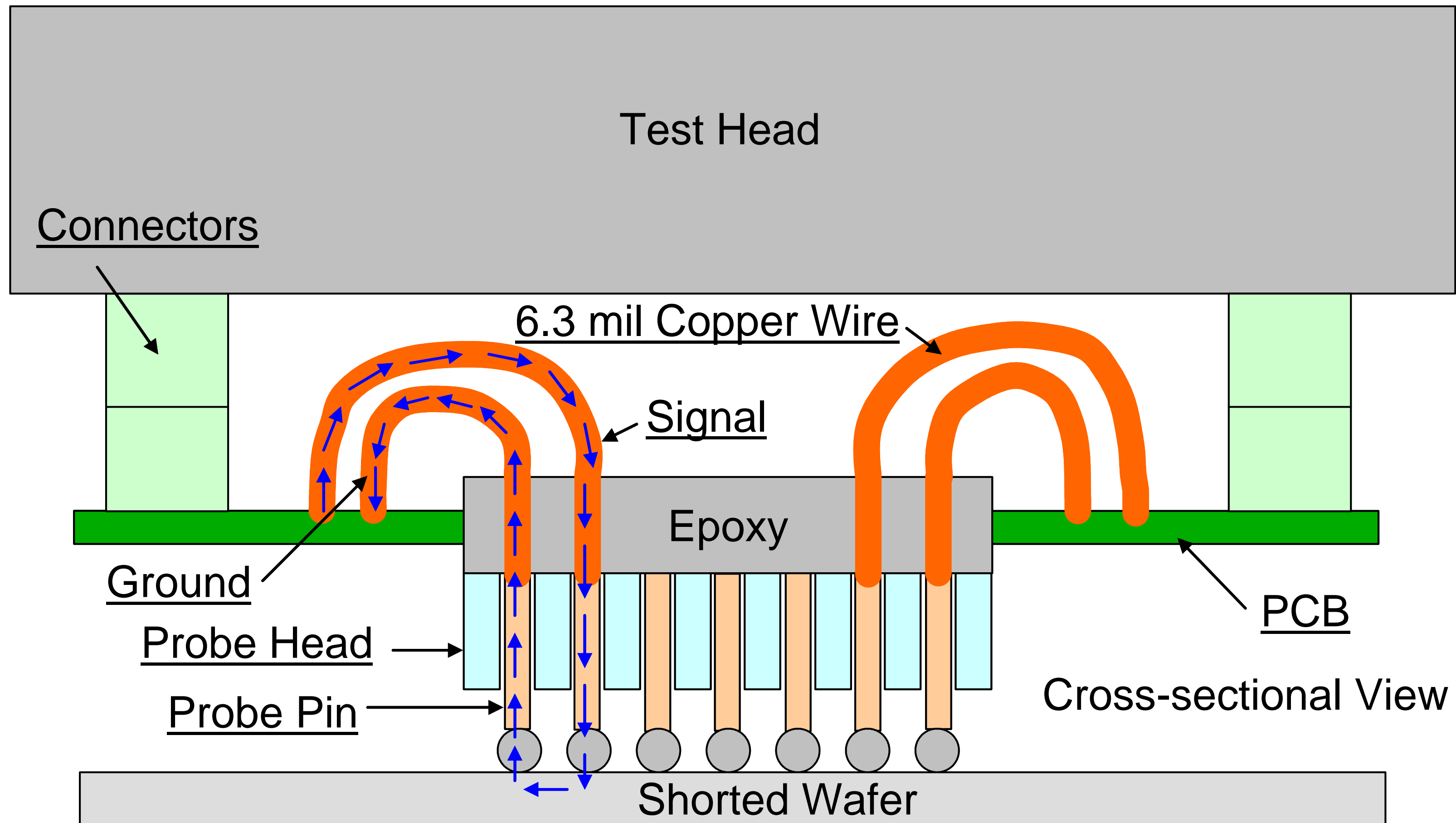
Yield Comparison

- Use VS flat tip and VS crown tip to probe the same wafers.
- Perform selective resort (resorting bad dice only) with both technologies to achieve maximum yield for comparison.
- Inspect VS crown tip probe marks.
- Inspect VS crown tip probes to compare bump residue build-up.
- Measure Planarity and Contact Resistance using PRVX.

Testing Parameters

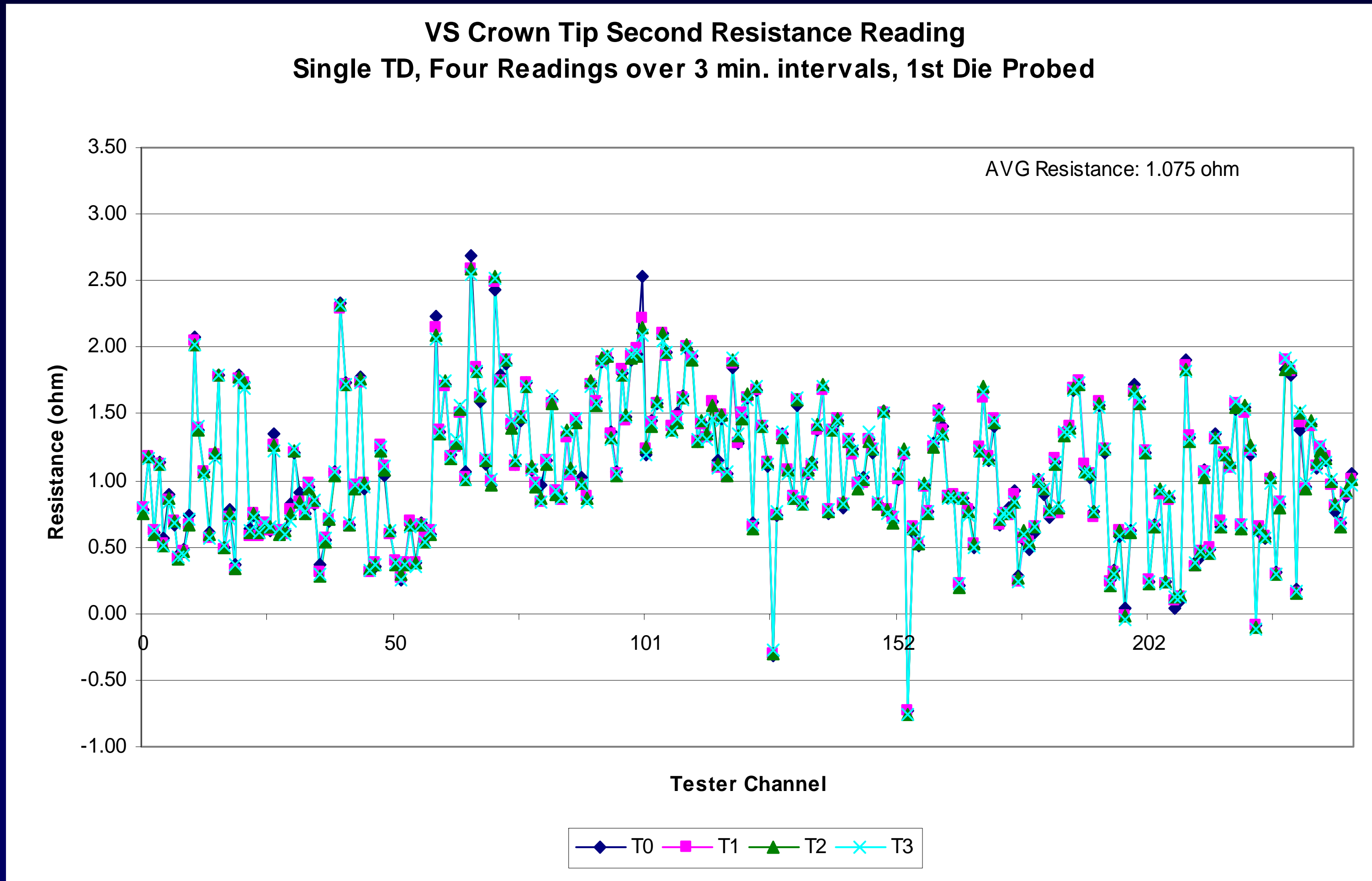
- Same tester and prober used throughout the experiments.
- VS Flat Tip parameters
  - Probing: 175um OD
  - Cleaning: 50um OD, 12 times every 50 dice
    - Cleaning medium – 3M 1um lapping film
- VS Crown Tip parameters
  - Probing: 150um OD
  - Cleaning: 100um OD, once every wafer
    - Cleaning medium – Probe Polish 99, filled cleaning polymer
    - Due to tip shape requirements a lapping film cannot be used

Physical Path Measured for Resistance

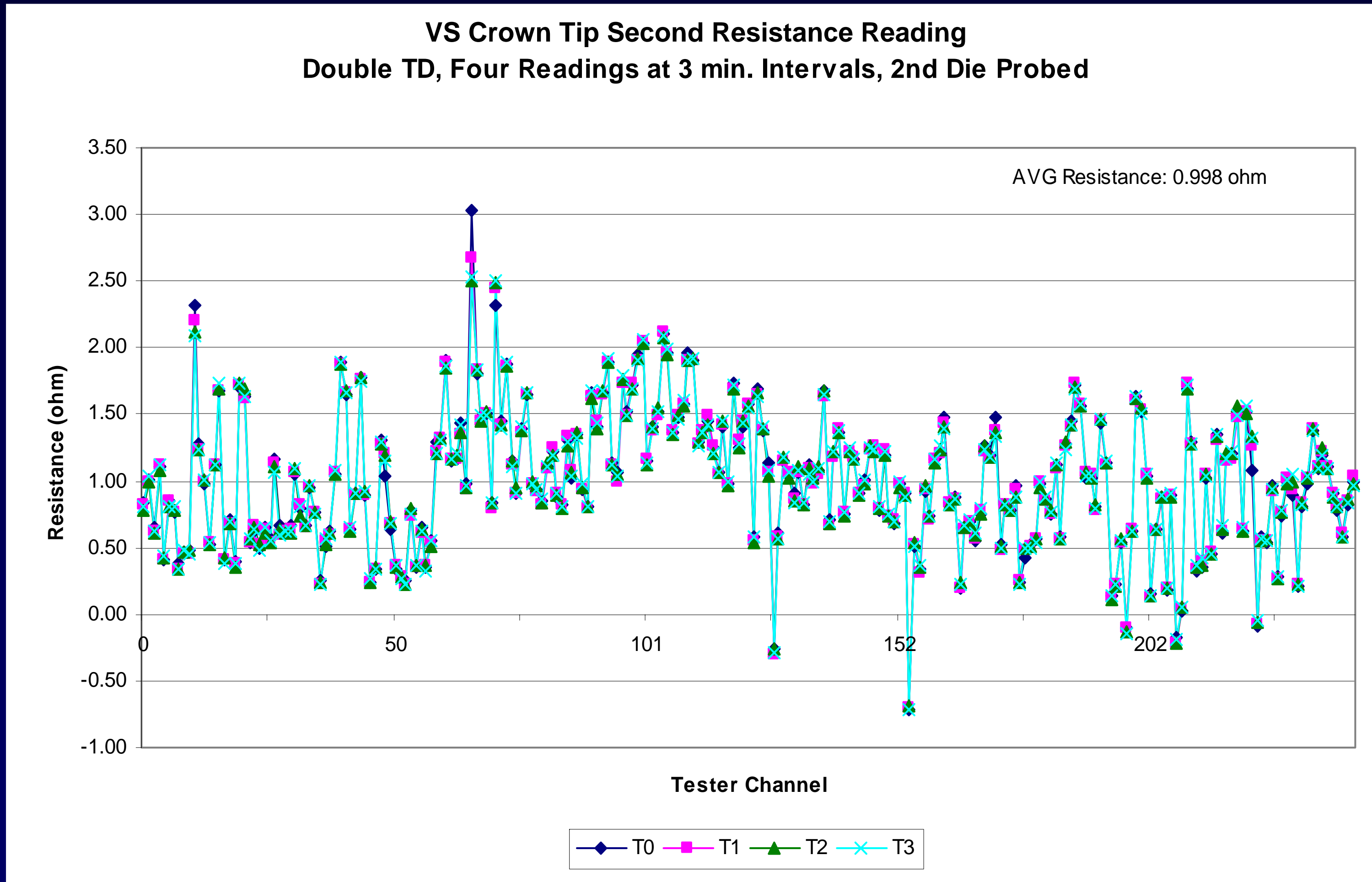


Path Resistance measured outlined by Blue Arrows.

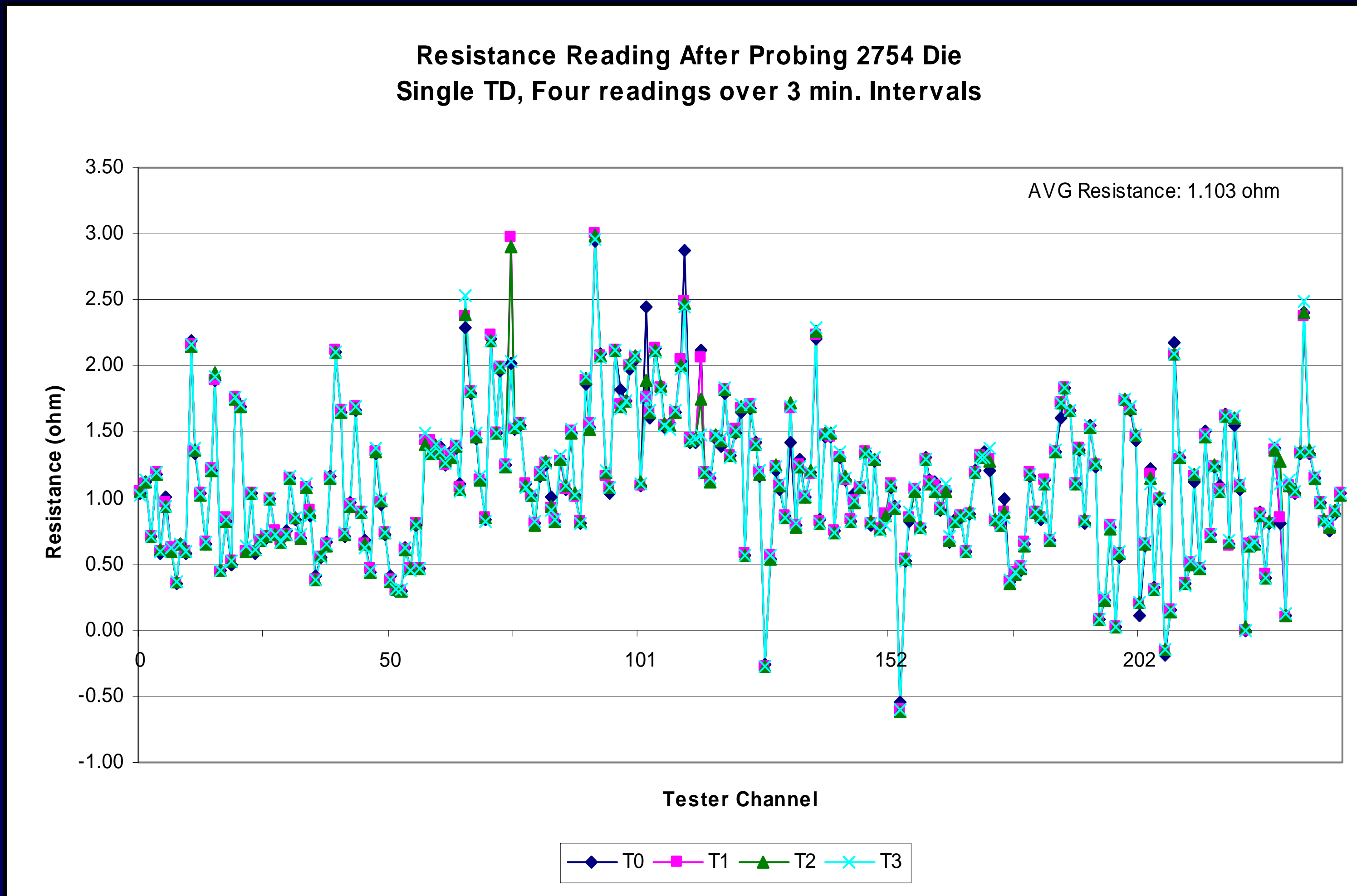
Path Resistance, 1st Die Probed



Path Resistance, 2nd Die Probed

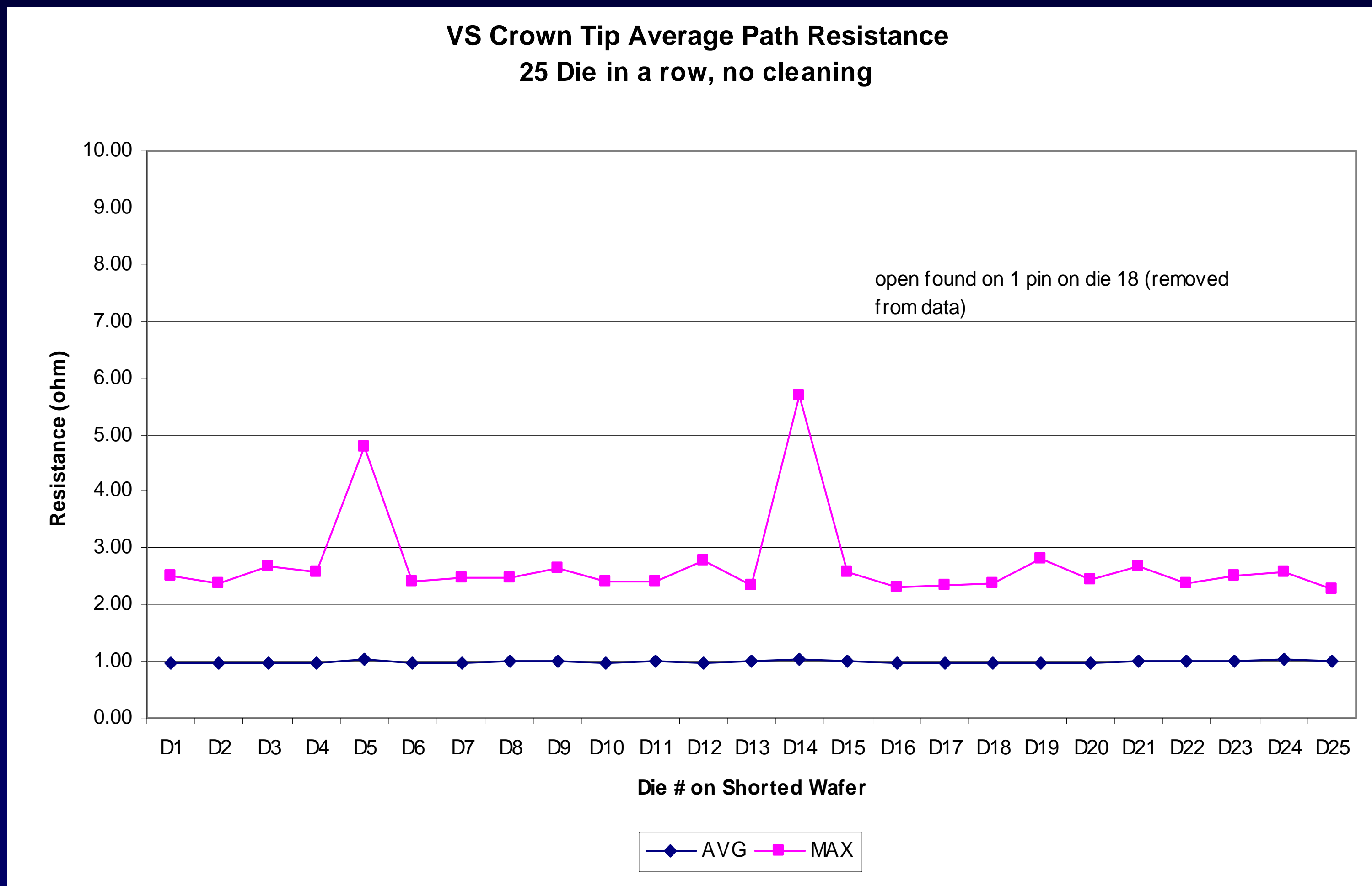


Path Resistance, 2754th Die Probed



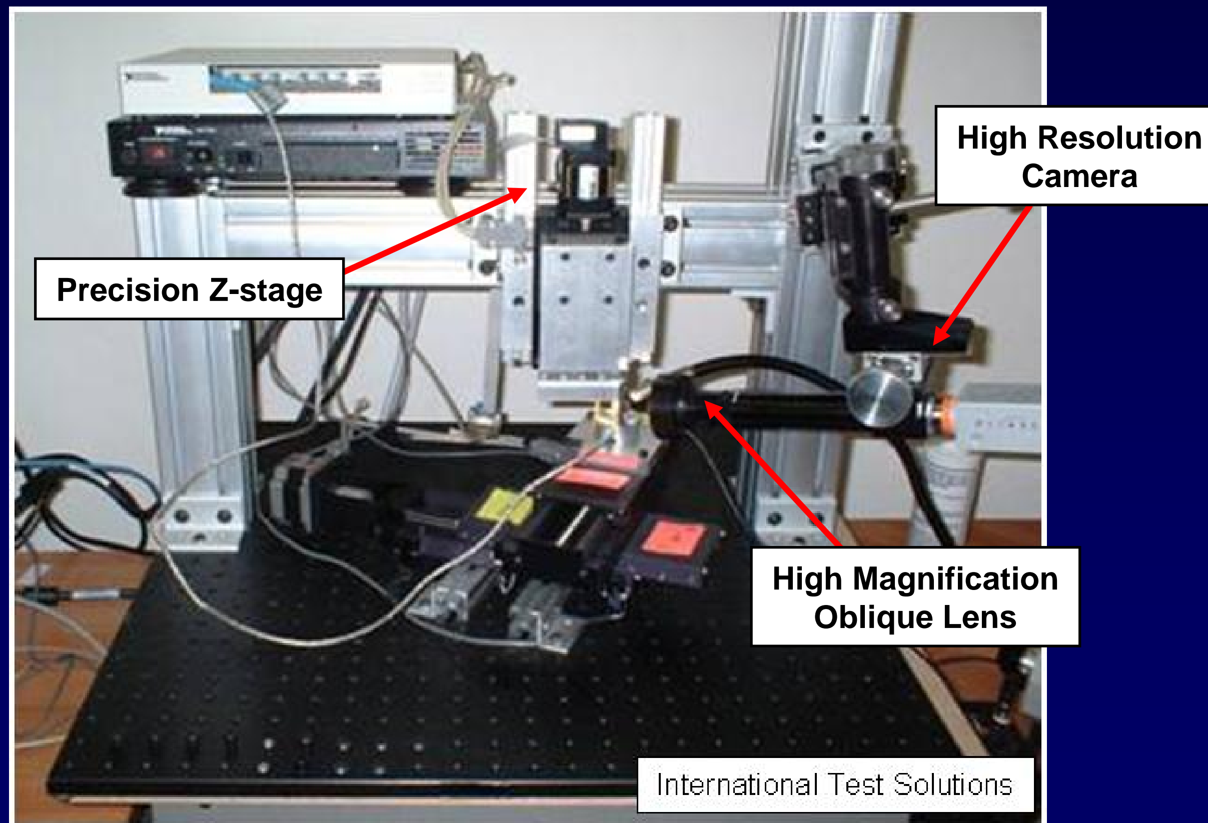
Average Path Resistance

- 25 Die Tested in a row, with no Cleaning



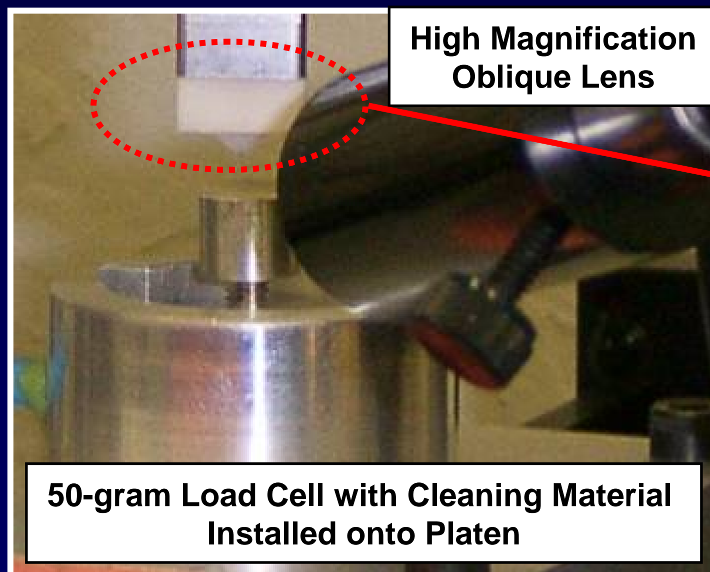
Mechanical Performance Characterization

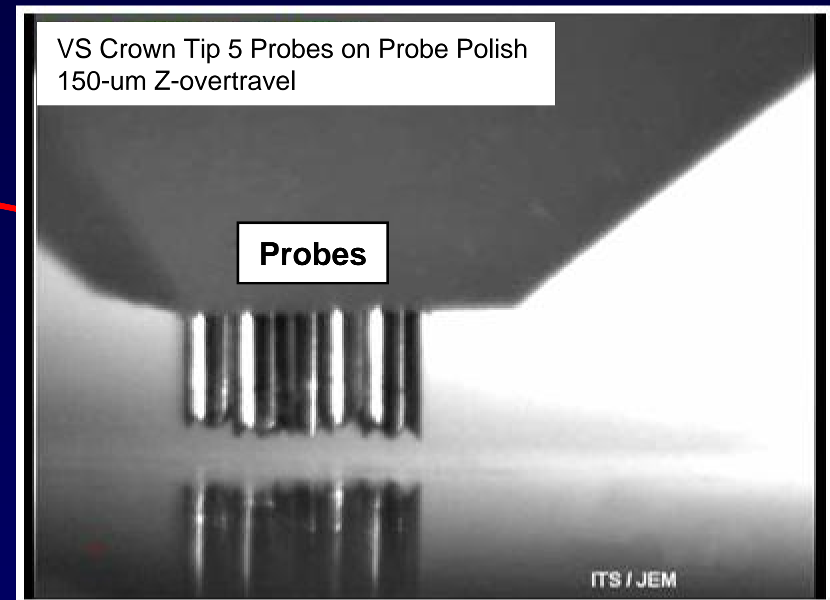
- Bench-top Materials Testing System
  - Assess cleaning material performance.
  - Evaluate applied load characteristics of probe.



Mechanical Performance Characterization

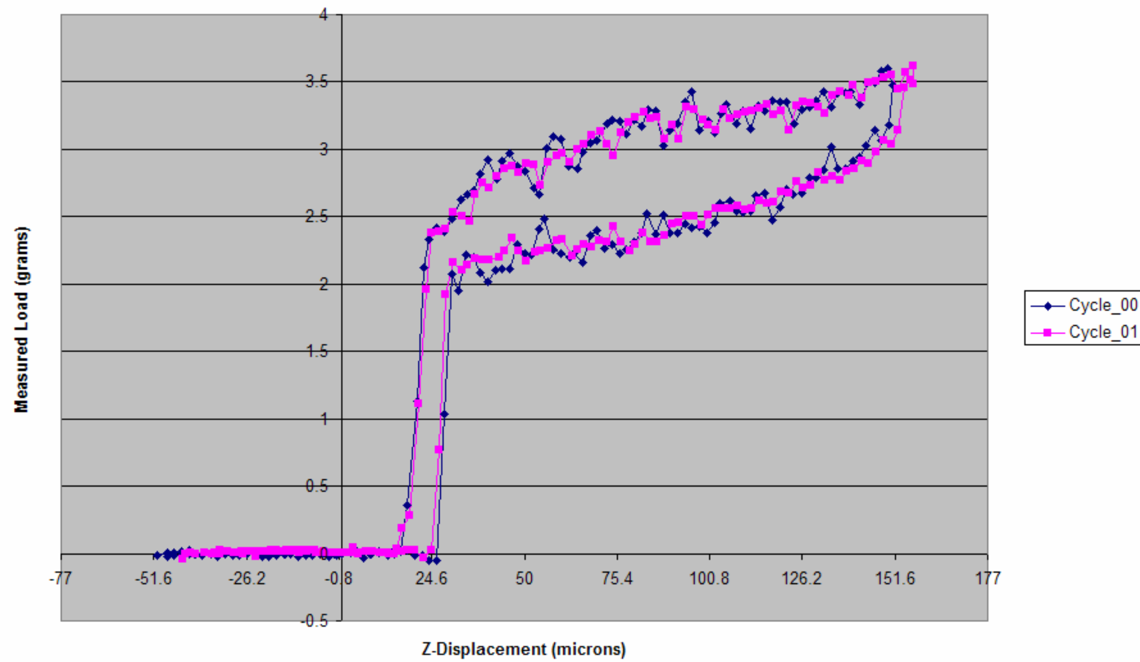
- High resolution and video imaging
- Synchronized load vs. overtravel data acquisition

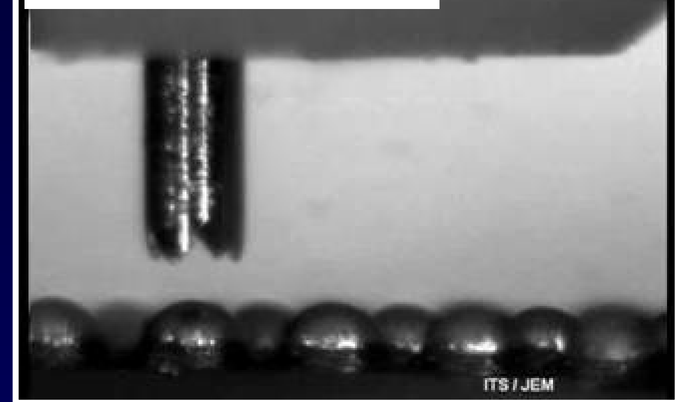


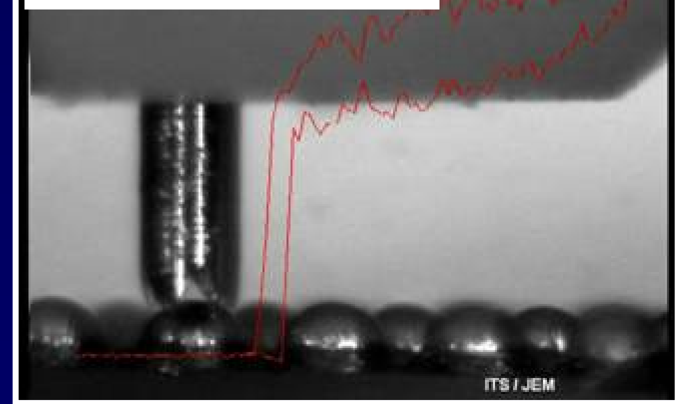


High Magnification and High Resolution Imaging

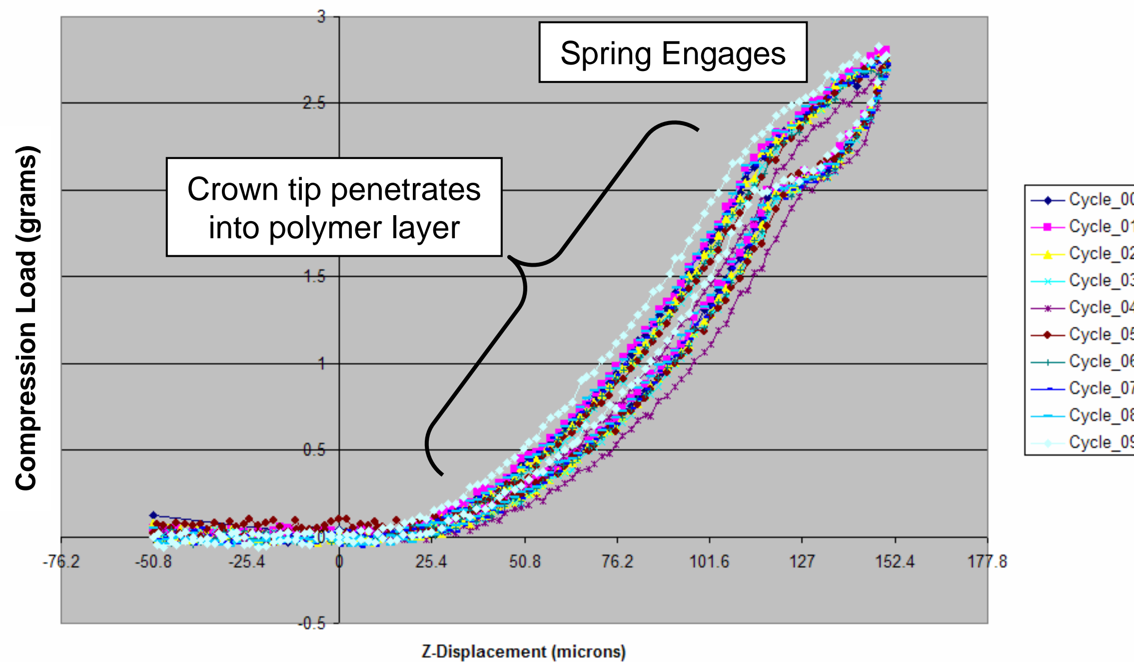
Probe Contact with Bump

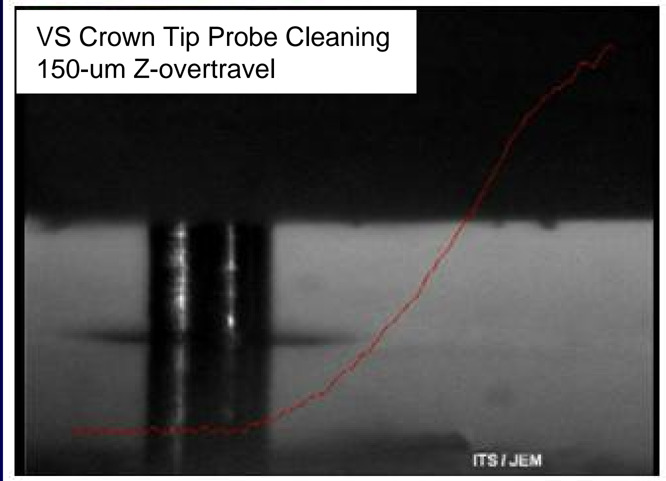


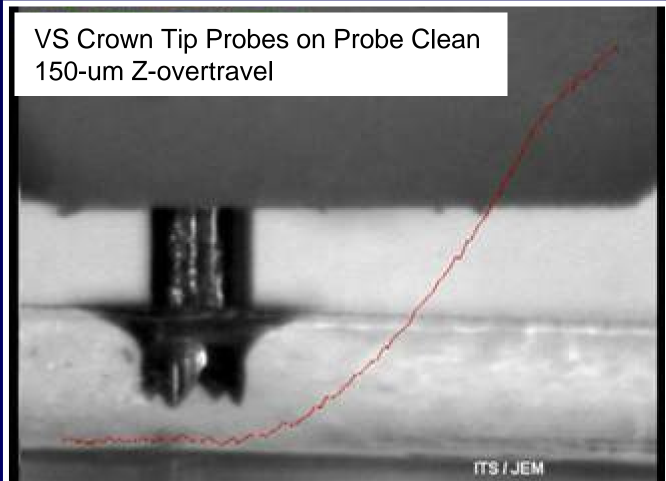




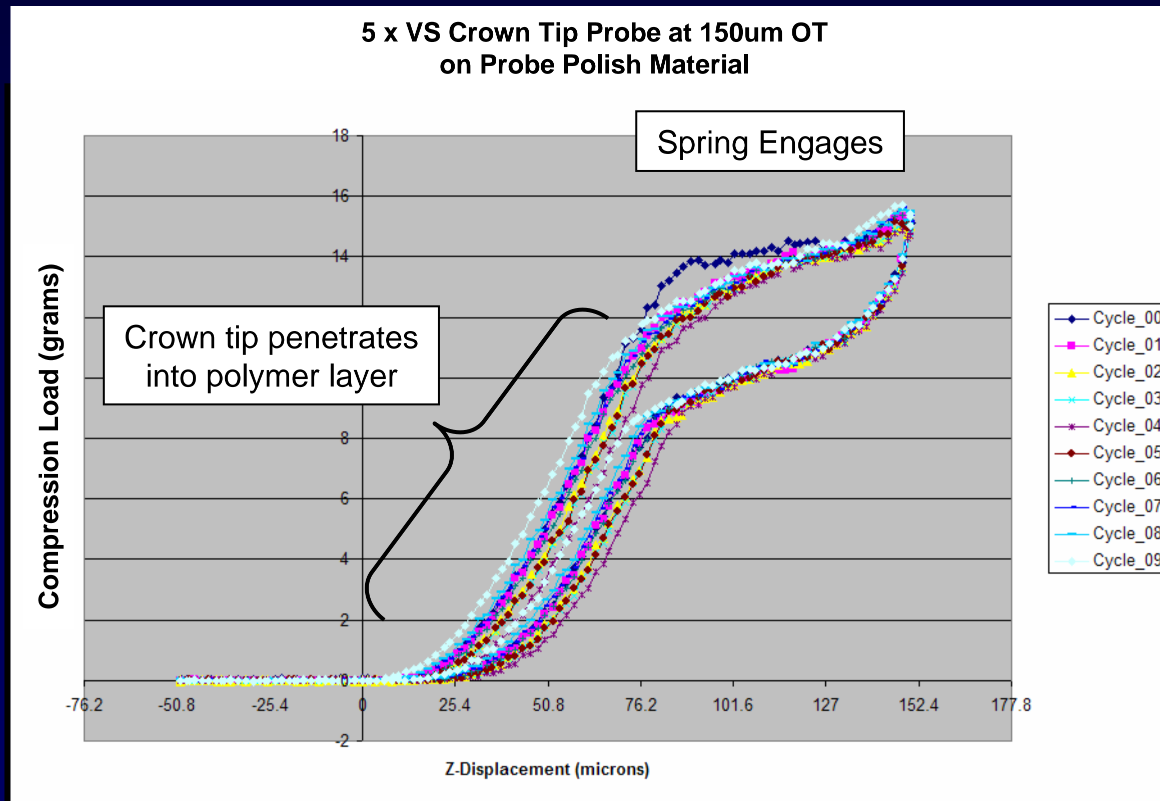
Probe Clean to Visualize Penetration

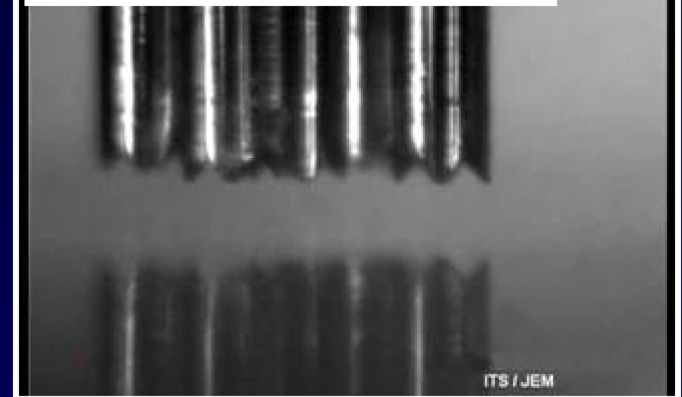


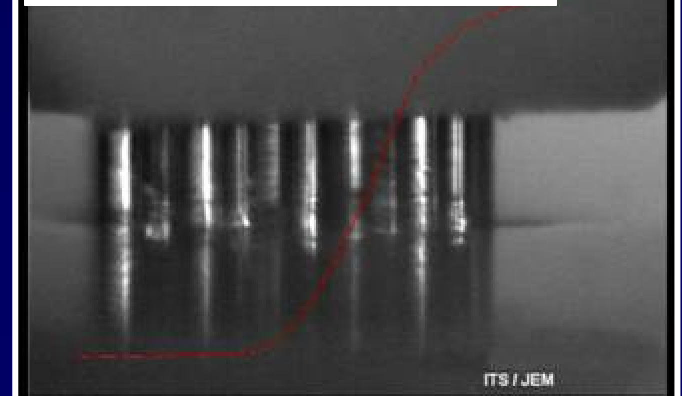




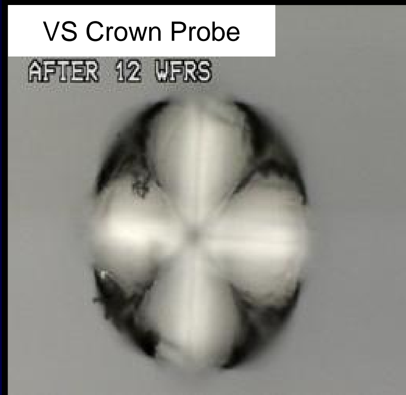
5 Probes on Probe Polish 99

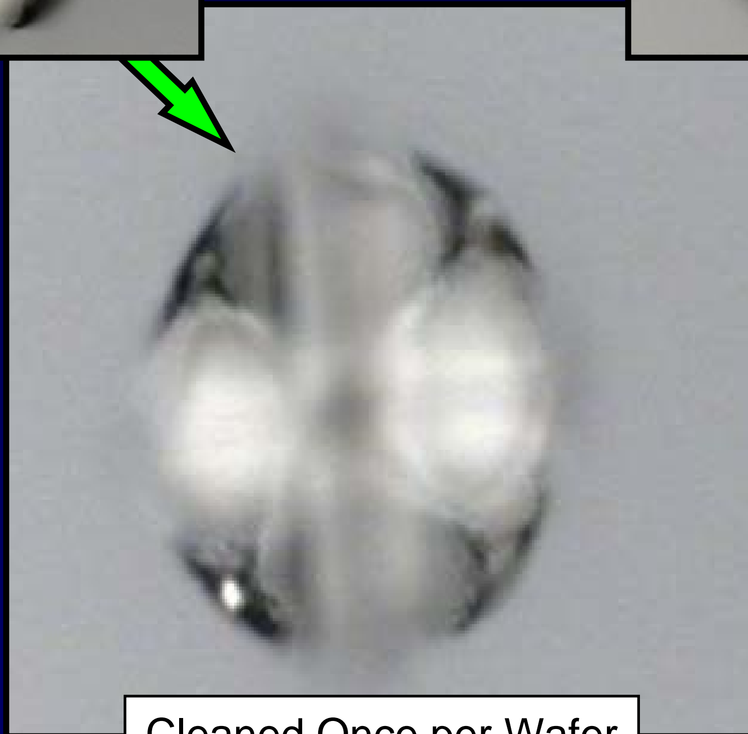




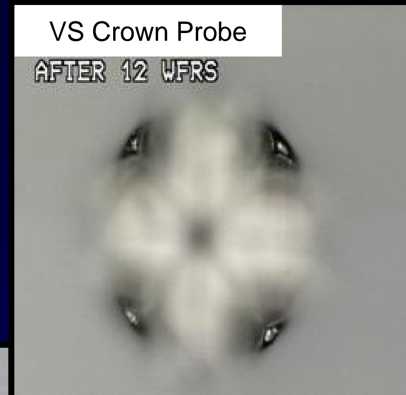


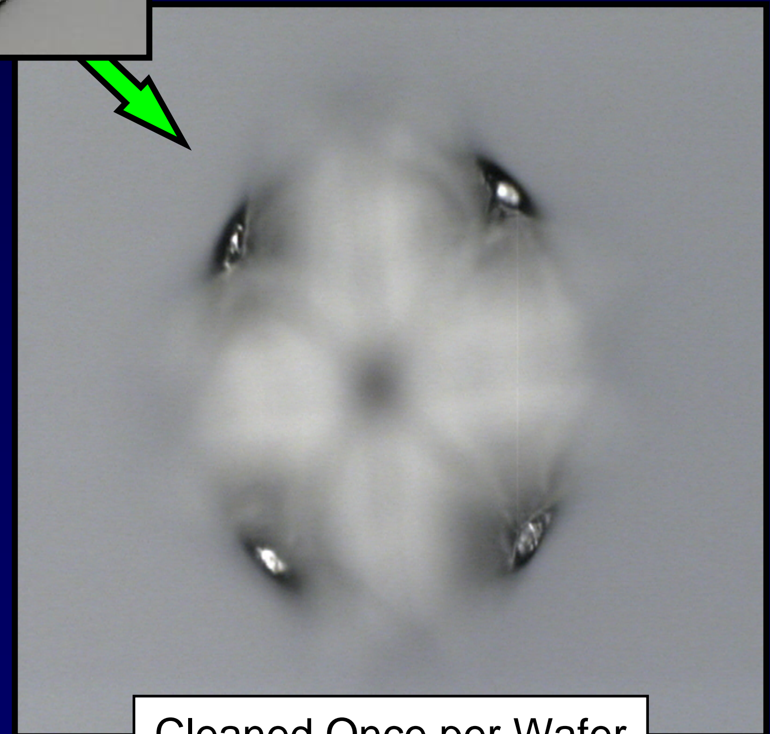
VS Crown Tip Probes After Online Cleaning





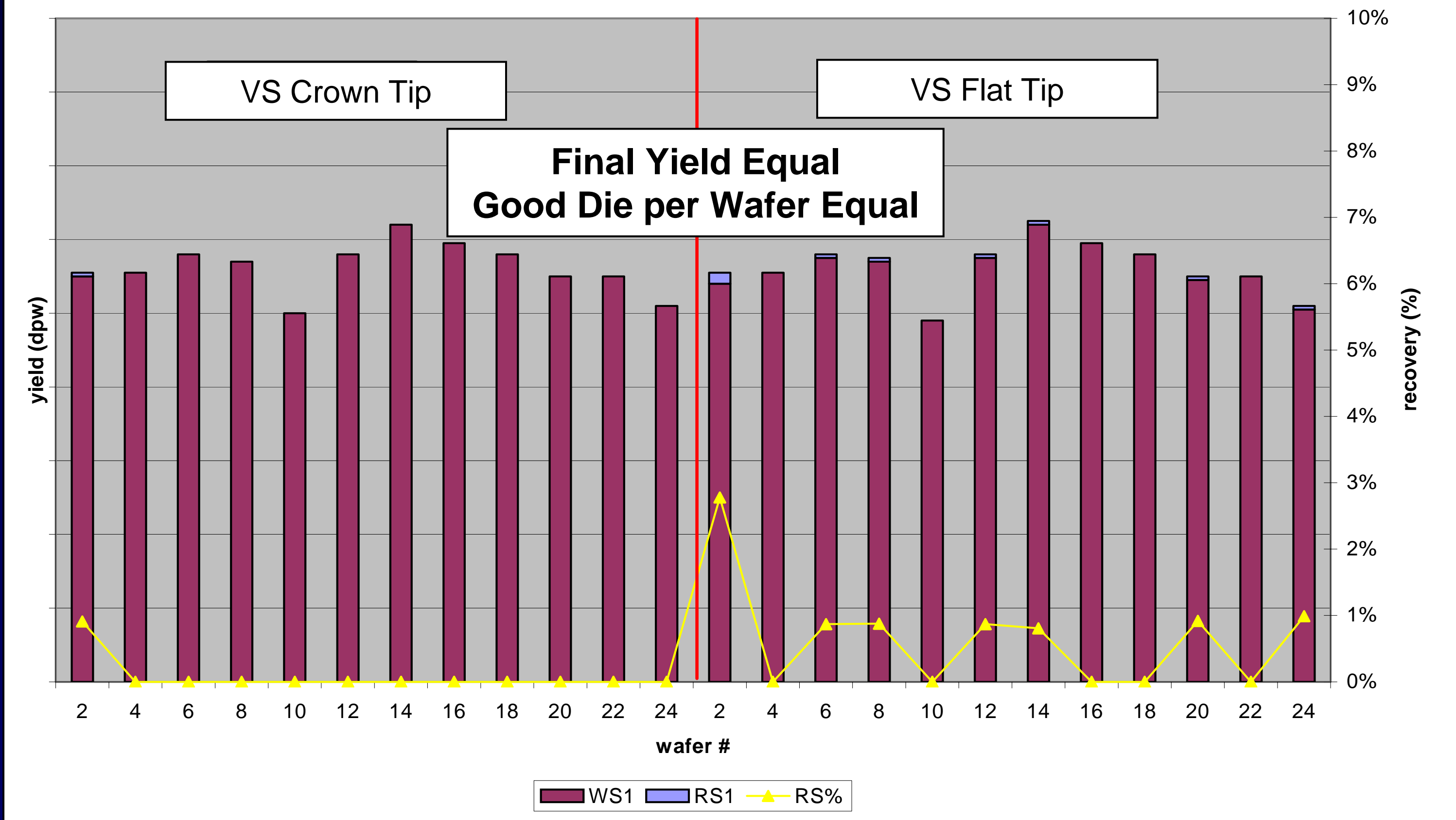
Cleaned Once per Wafer



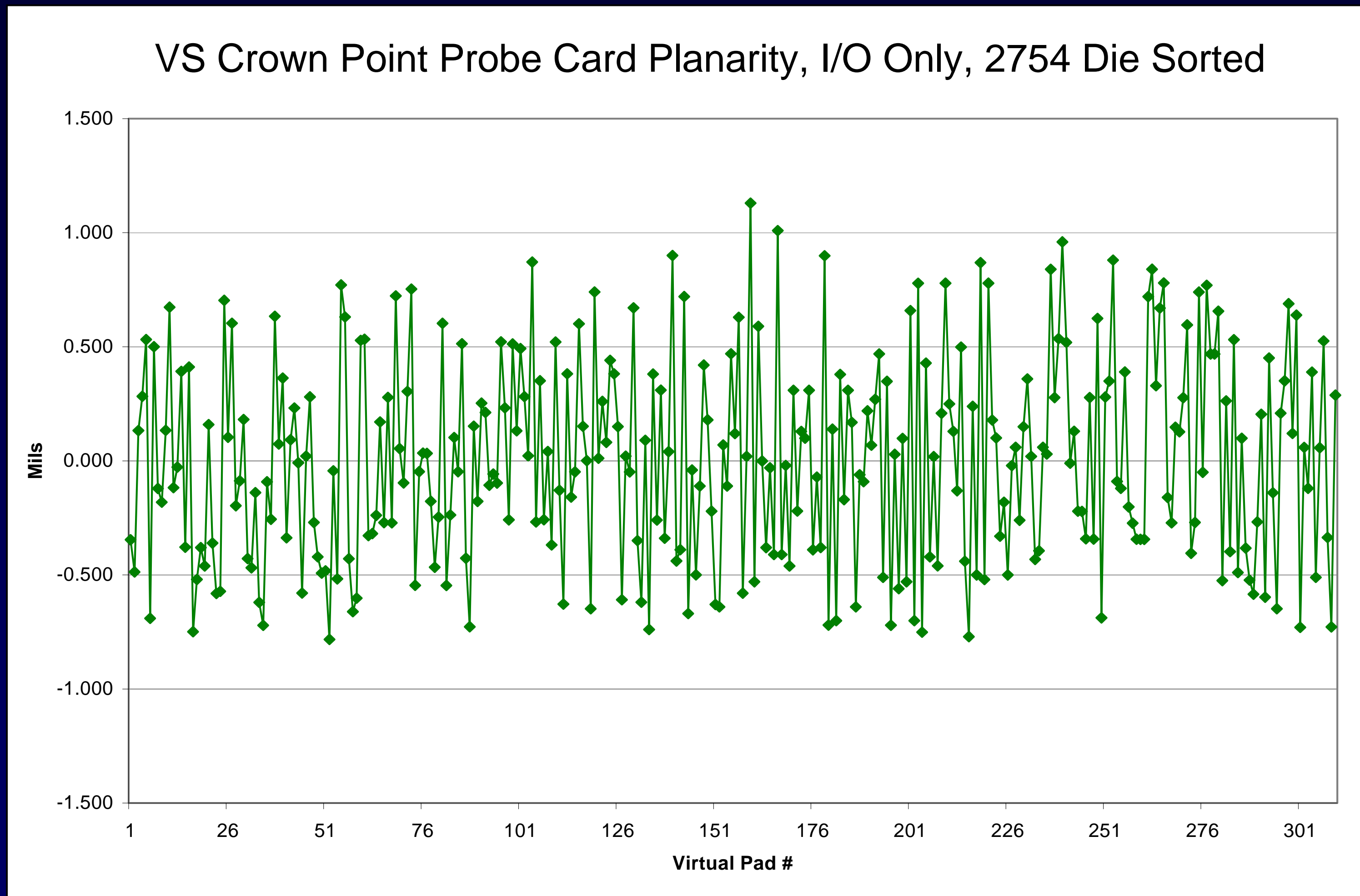


Cleaned Once per Wafer

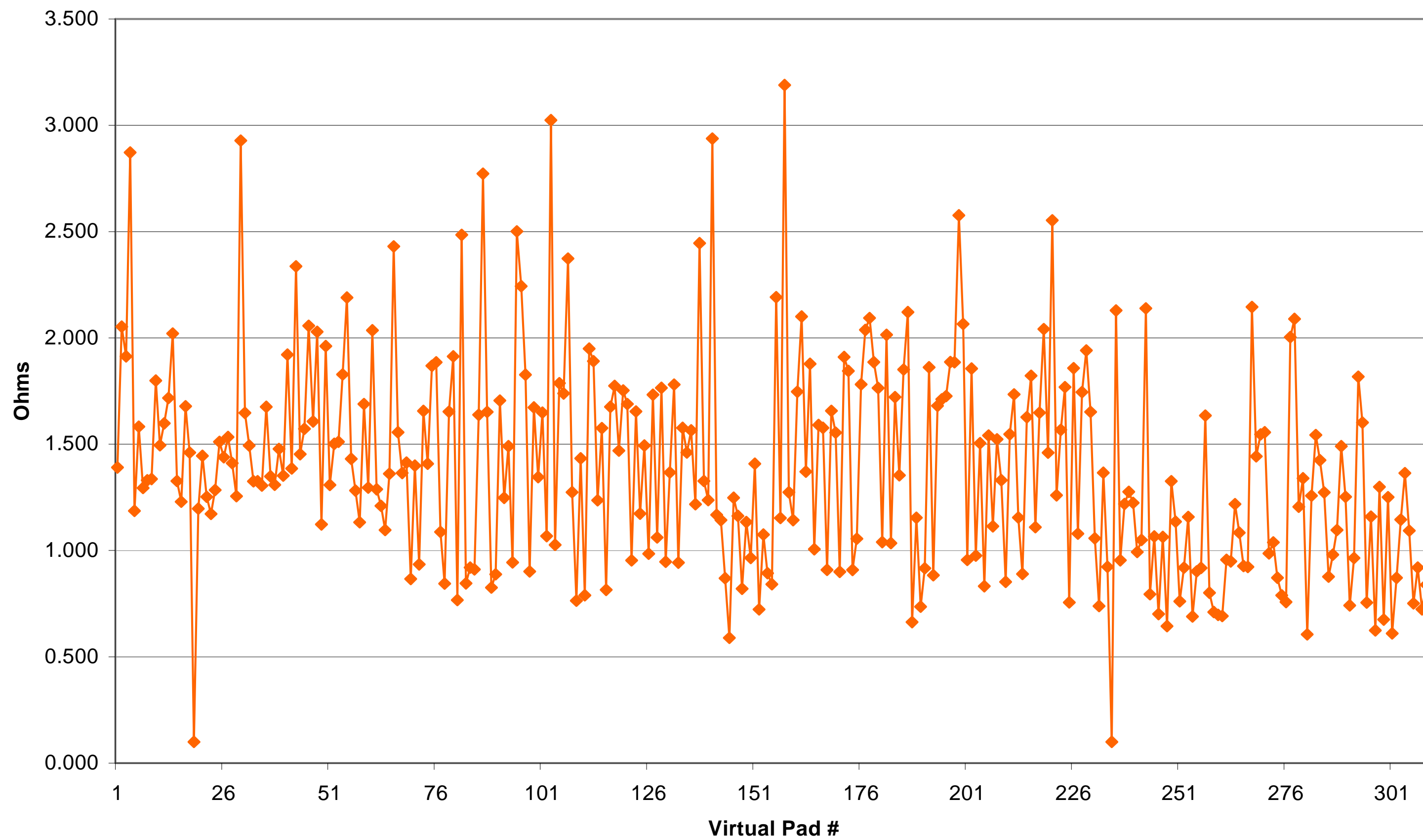
Yield Comparison



Planarity Reading from PRVX



Contact Resistance Reading from PRVX



Summary

- VS crown tip probe path resistance is on the same order as standard VS flat.
- VS crown tip Path Resistance holds stable after 2500+ die sorted and non-destructive cleaning only after each wafer.
- VS crown tip is able to achieve maximum yield at first sort, with lower resort recovery.
- Probe marks generated by VS crown tip show minimal disturbance to the bump structure, compared to VS flat tip and other vertical probing technologies.
- On-line cleaning with Probe Polish 99 was effective in keeping the crown tip clean without affecting the tip geometry in order to maintain consistent yield.
- Planarity remained at +/-1mil after probing 12 wafers.

Acknowledgements

- Patrick Mui – Engineering Manager, JEM-America
- Altera Test Engineering
- JEM-Japan Test Engineering

Thank you for your attention

Questions ???