Achieving Low Contact Resistance on Aluminum Using Pyramid Probe Tips with Microscrub™ Technology

SWTW 1999

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Pyramid Probe’s New Facility (Formerly Etec Building)

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Outline

1. Industry Requirements
2. Microscrub Technology Operation
3. Current Implementation
4. Sematech/Sandia Evaluation
5. Lucent Evaluation
6. Intel Evaluation
7. Summary
Industry Requirements

- Contact resistance reliably less than 1.0 ohm
- Minimize pad damage
- Minimize scrub for small bond pads and fine pitch
- Minimal cleaning and maintenance
- DESIGN REQUIREMENT: Uniform scrub independent of position on the probe
Microscrub Tip with Integral Beam
Microscrub Principles of Operation

- Integral beam
- Offset forces
- Compliant backing
- Rotational moment
- Uniform scrub for all probe tips
Initial Microscrub Implementation (1996)
Typical Initial Contact Resistance Results (1996)

Contact Resistance during Life Test

Minimum
Maximum

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Current Microscrub Implementation (1998)

- Smaller tips (30 >> 15 microns)
- Taller tips (30 >> 60 microns)
- Less probe force (20 >> 10 grams)
- Engineering DOE parameters:
  - Independent variables: Beam length, thickness, tip height, tip diameter, elastomer durometer, thickness, force per tip
  - Indicators: Contact resistance, compliance, interaction with wafer contamination
Pyramid Probe Tips with MEMs Process
Evaluation at Sandia

- Same set up as SWTW ‘98 Sematech cantilever probe data
  - Three point Kelvin
  - HP 4062
  - EG 4090
  - Sematech funded facility
- No cleaning
- Stepped off wafer multiple times
Pyramid Probe Contact Resistance from Sandia Lifetest (@ 85 C)

Lifetest at Sandia on a blank aluminum wafer
(5 mil overtravel at 85 C)

Touchdowns (x 1000)
(box plot without tails comparative to data shown at SWTW '98 page 24)

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Conventional Cantilever Probe Card
Contact Resistance (@ 85°C)

Tier 1 Contact Resistance on Wafer
(3-mil overtravel at 85°C)

- 5-mil Tungsten Probes
- 5-mil Tungsten-Rhenium Probes

Contact Resistance (ohm)

0  10  20  30  40

0  100  200  300  400

Touchdowns (x 1000)

Tungsten-Rhenium Probes on Stepping Pattern Leading Edge
Tungsten Probes on Stepping Pattern Leading Edge

SEMATECH
Advanced Probing Systems, Inc.

Applied Precision, Inc.
Sandia National Labs

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Comparison of Cantilever (@ 30 C) vs. Pyramid (@ 85 C)

Lifetest at Sandia on a blank aluminum wafer
(5 mil overtravel at 85 C)

Touchdowns (x 1000)
(box plot without tails comparative to data shown at SWTW '98 page 24)

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Lucent Evaluation: 200K Cycles With No Cleaning
Typical Pyramid Probe and Cantilever Marks
Single Pyramid Mark SEM
One Cantilever, Two Pyramid Scrub Marks

One Cantilever and two Pyramid Probe scrub marks from Sandia Labs test wafer

X - one division = one micron
Y - one division = one micron
Z - height (microns)
Intel Multi-DUT FlashRAM
Multi-DUT Testing of FlashRAM

- 2 X 5 Multi-DUT probe layout for FlashRam devices
- 500 I/O
- 25 mm square
Standard Internal Infant Lifetest
Acknowledgements

- NIST/ATP, DARPA, Sandia Labs, Sematech
- Rey Rincon, Phil Seitzer, Dave Unzicker, Khe Ting
- About 30 Cascade team members
Summary

- This is the first time Membrane probes have published excellent contact resistance and life test results on aluminum
- Small contacts and small scrub distance drastically reduce pad damage and allow smaller pads
- Uniformly engineered consistent Microscrub is the magic that makes it work
- Microscrub contact structure is compatible with fine pitch, array, multitest and high frequency applications