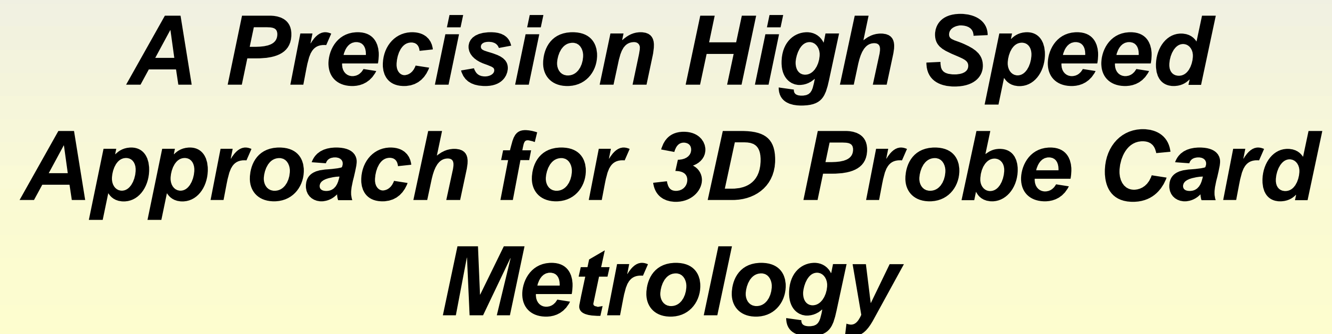


Raymond Kraft, Ph.D.

Applied Precision, LLC

South West Test Workshop
10 June 2002
Long Beach, CA USA

AppliedPrecision
Enabling the world's core technologies

Presentation Agenda

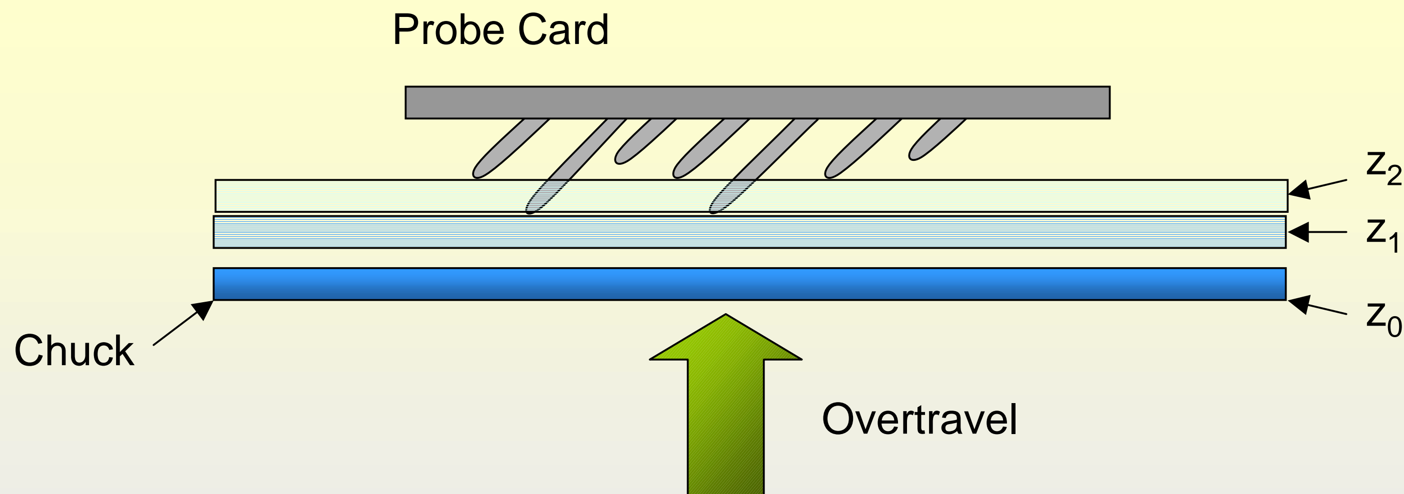
- *Motivation*
- *New 3D Metrology Concept*
- *Benefits*
- *Summary*

Motivation

- Ever increasing need to test more devices simultaneously
- Probe card pin counts and loads increasing
  - Advanced Technology Cards with 5,000 – 10,000 probes
- Accuracy
  - Increased loads impact structural deflection and degrade accuracy
  - Tighter probe pitch and smaller pads require higher accuracy
- Test Time
  - Need to keep test times acceptable
  - Minutes, not hours

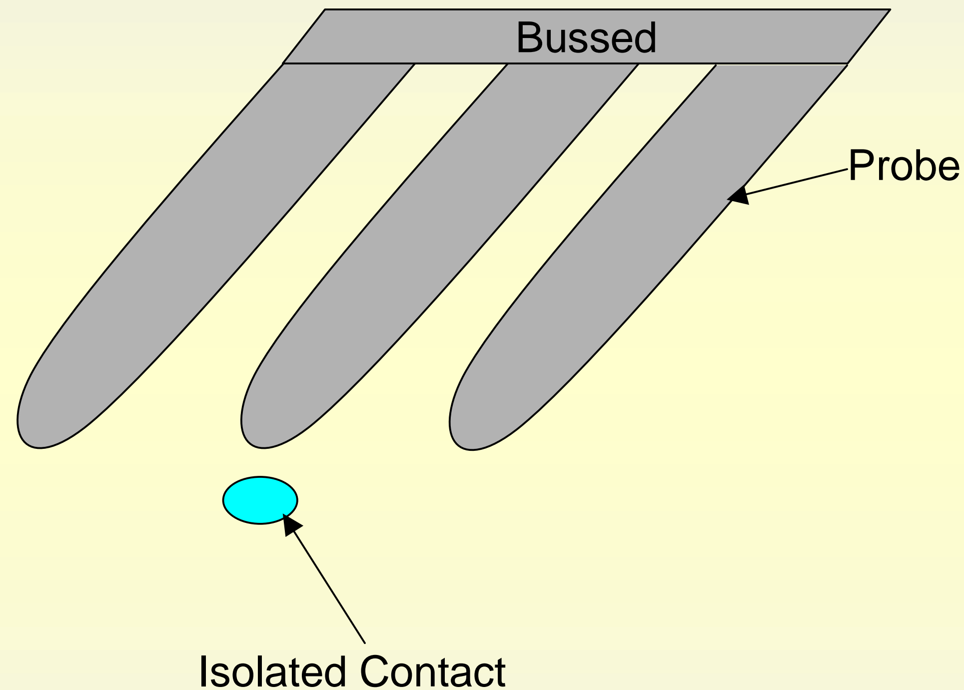
Motivation: Test Times

- Electrical Planarity: Non-Bussed Probes
  - Scan chuck in Z
  - Fast planarity measurement (electrical switching)
  - Accurate



Motivation: Test Times

- Electrical Planarity of Bussed Probes



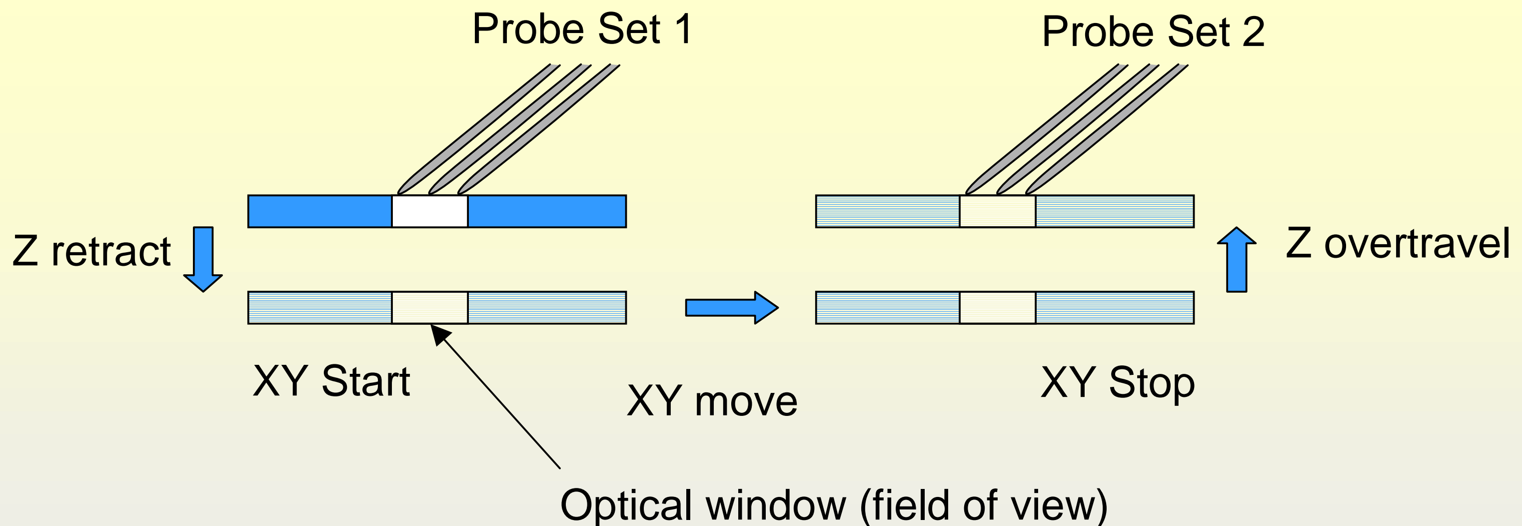
Each bussed probe individually driven to isolated contact

Motivation: Test Times

- Electrical Planarity of Bussed Probe Issues
  - Time consuming for advanced technology cards with large numbers of bussed probes
    - XY move and Z moves required for each bussed probe
    - Z moves can be time consuming to achieve desired accuracy
  - Isolated contact can accumulate dirt/debris
  - Issues with compatibility of probe pitch with isolated contact size

Motivation: Test Times

- Optical Probe Alignment Issues
  - Alignment at overtravel requires large number of touchdowns – one for each field of view
  - Start/Stop motion between fields of view also time consuming



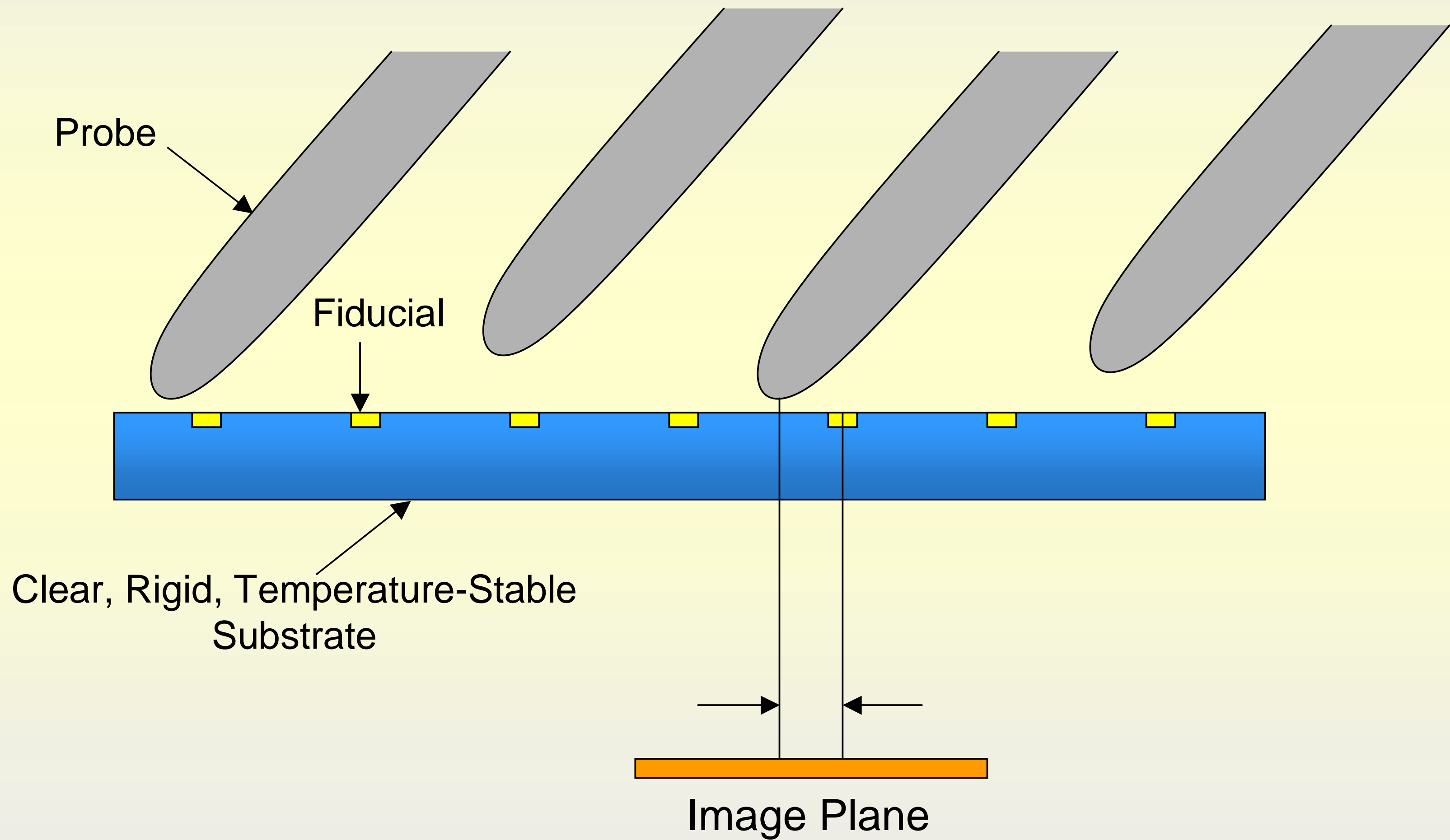
Motivation: Accuracy&Repeatability

- Performance affected by:
  - Stage accuracy/repeatability
  - Temperature induced issues
  - Deflection under load
  - Abbe Error

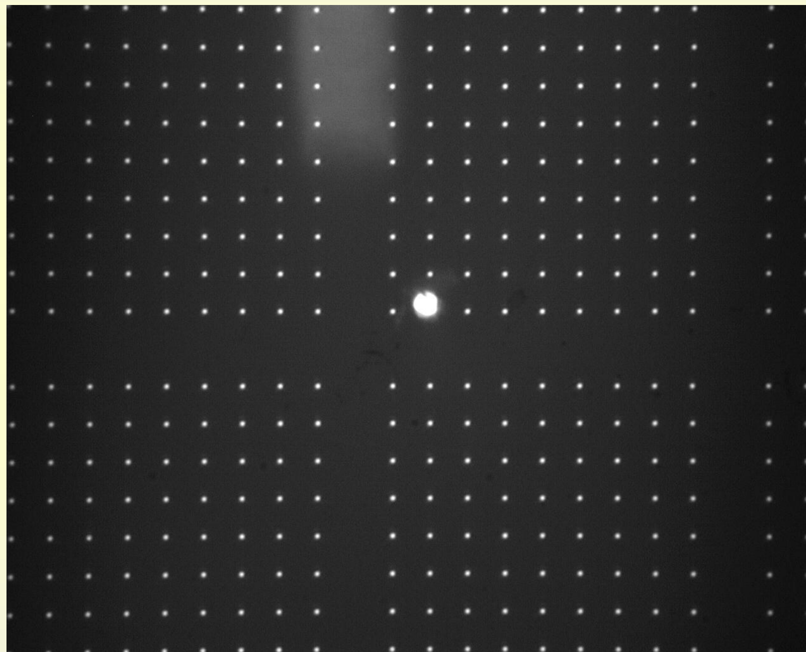
3D Metrology Concept

- 3D Optical Comparative Metrology (3D-OCM)
- Fully Optical Metrology
  - Colocate measurement standard and probes
  - Measure probe locations relative to NIST traceable measurement standard (fiducial marks)
    - Produced by photolithography process
  - Compute planarity and alignment from measurements
  - Multiple patents pending

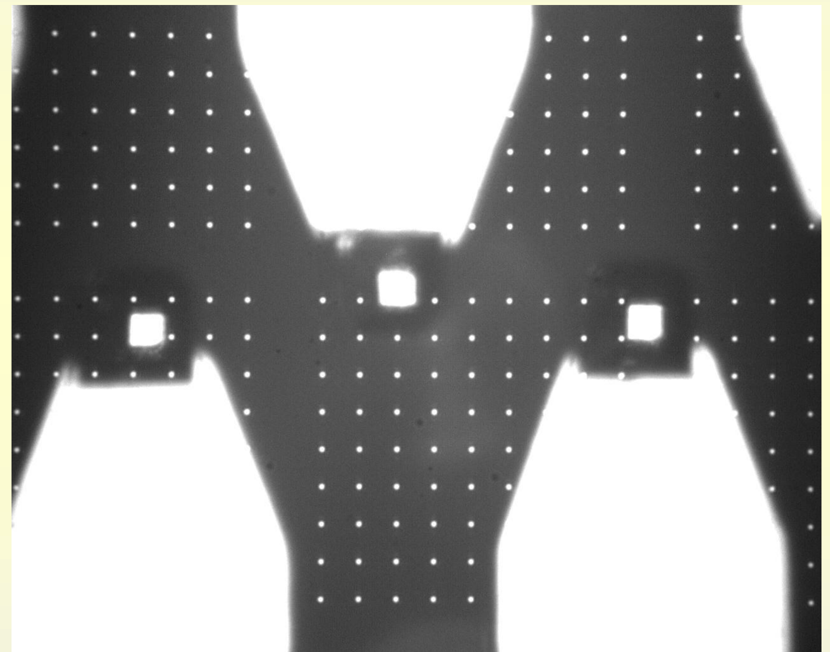
3D-OCM: Concept Elements



3D-OCM: Example Probe Images



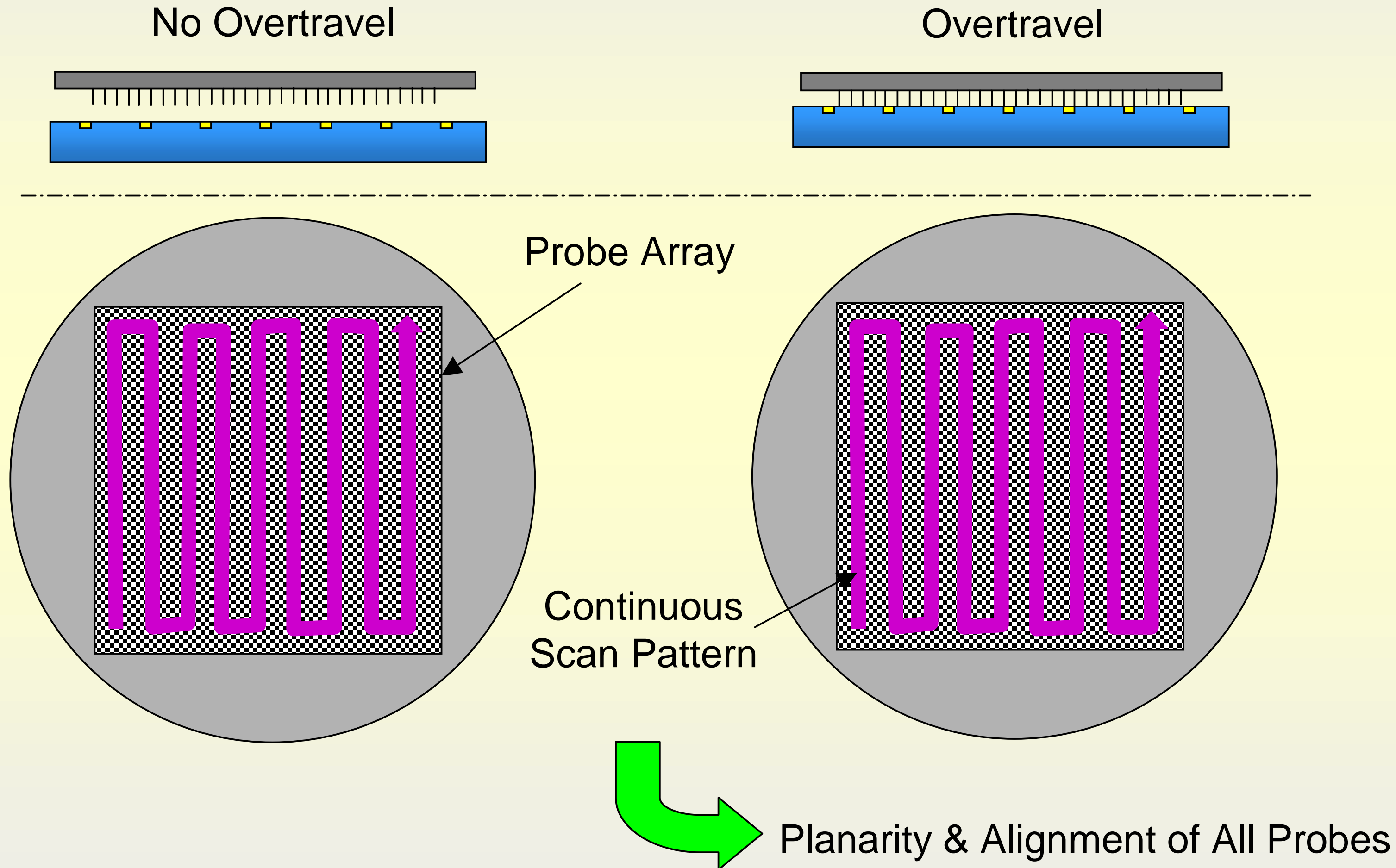
Cantilever



MicroSpring™
Probe card courtesy of FormFactor

3D-OCM: Continuous Scan

- Continuous One-Touch Scan



3D-OCM: Benefits

- ***ACCURACY & REPEATABILITY***
  - Measurement INDEPENDENT of stage accuracy
  - Virtually no Abbe error
  - Based on NIST traceable standard
  - Highly insensitive to temperature variation
    - Proprietary substrate design

3D-OCM: Benefits

- ***Machine to machine correlation***
  - Afforded by Common NIST traceable standard
  - Improved Gage R&R results
- ***One-touch scan***
  - Continuous scan of ALL probes ⇒ planarity and alignment
    - No distinction between bussed and unbussed probes
  - Reduced probe wear

3D-OCM: Benefits

- *SPEED*
  - Fast continuous motion scan of ALL probes
    - Non-bussed and bussed
  - Measure multiple probes at available image capture rate
  - Example: @ 30 FPS
    - 2,000 probes in < 2 minutes
    - 10,000 probes in < 10 minutes
  - Better than order of magnitude faster than current technology

Summary

- Wafer test roadmap demands faster, more accurate metrology
- 3D Optical Comparative Metrology offers significant advantages over current metrology for Advanced Probe Cards
  - Greater accuracy
  - Higher degree of repeatability and reproducibility
  - >1 order of magnitude improvement in speed

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