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High Speed 3D Probe Mark Inspection

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Introduction

- **Implementing a high speed 3D laser scanning technique to enable high throughput measurements of probe mark depths across 100% of the wafer.**
  - Enable monitoring of potential compromises of the integrity of underlying pad materials.
  - Identify probe card excursions
  - Fast probe card requalification
- **Bring a fully automated solution**
- **Close the gap between slow 3D analytical techniques and second order 2D strategies.**

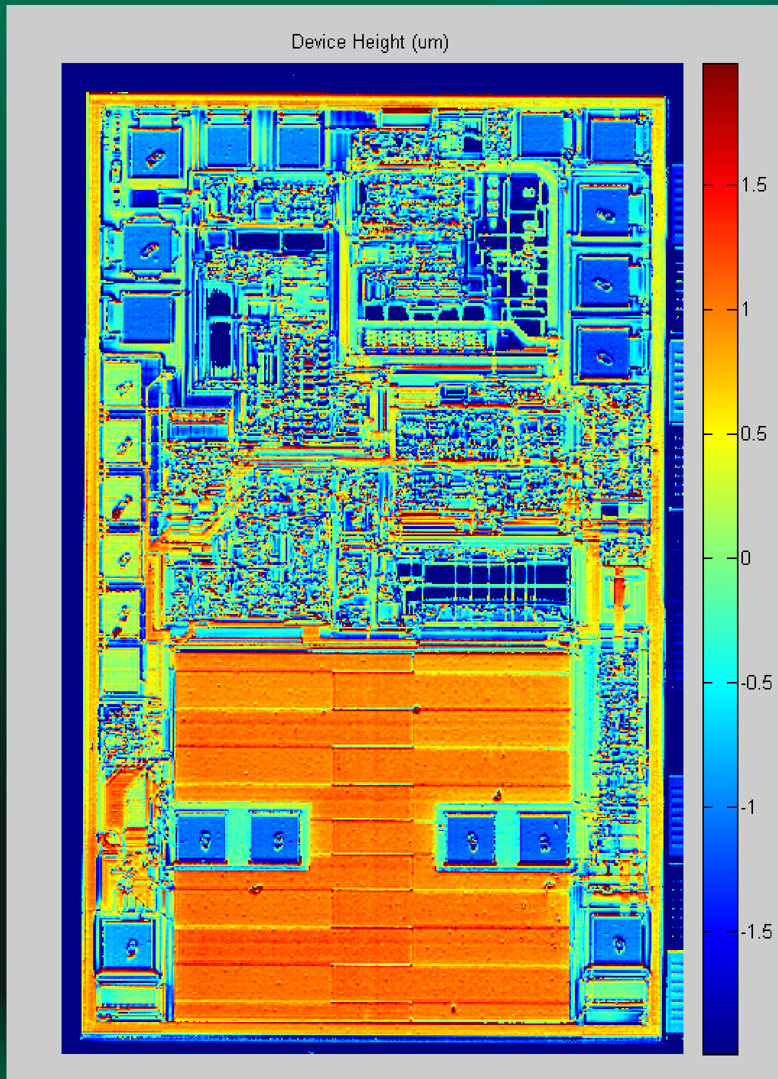
Objective

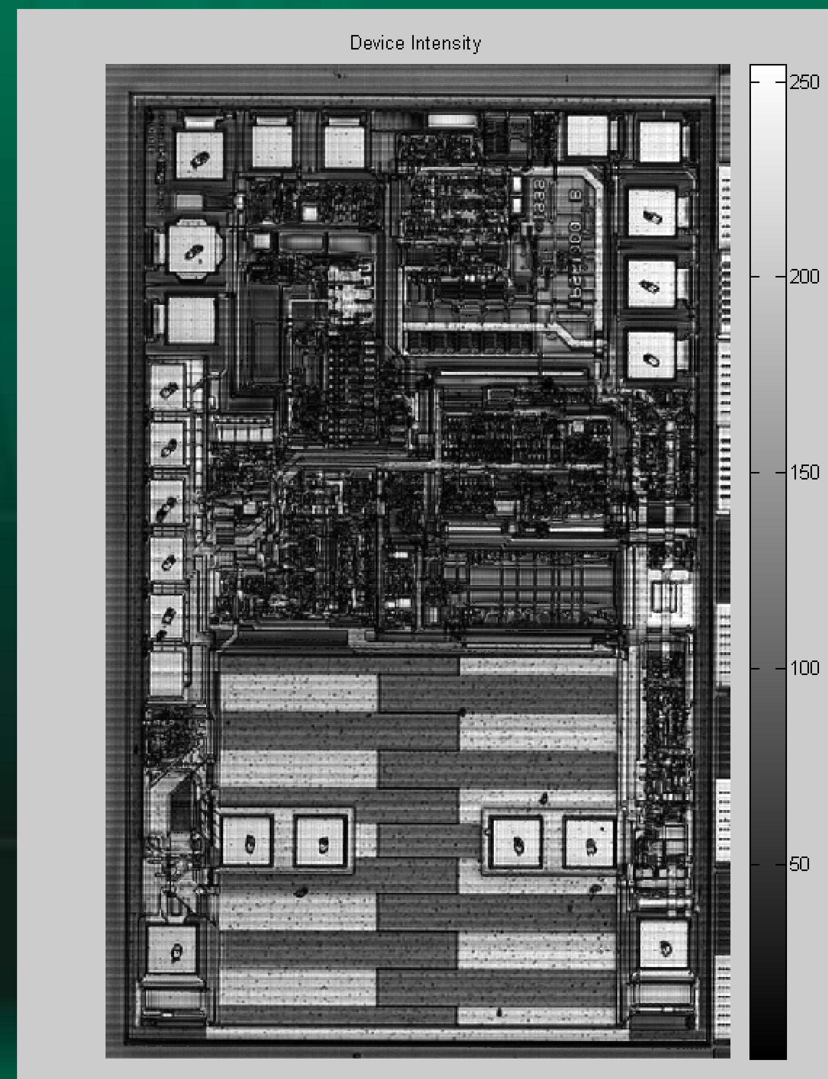
- Apply a 3D scanning laser to a probed wafer to determine the feasibility of high speed depth profiling.
- Determine the scanning resolution requirements to bring consistent results.
- Concentrate on the metrology. Use main stream probing technology early in its touch down life cycle.

3D Laser Measurement Methodology

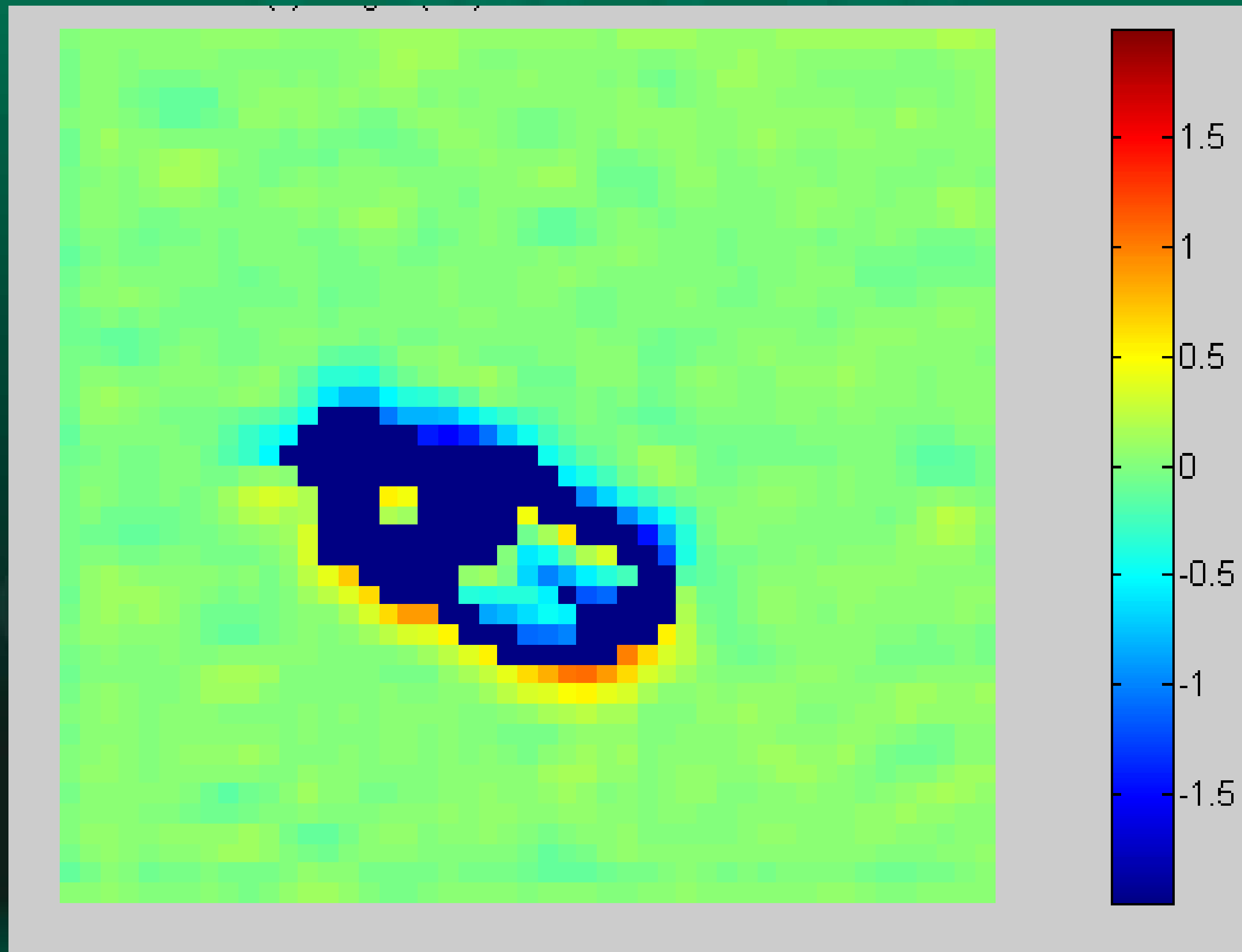
- Laser diode incidences off a Field of View and onto a CIS camera.
- The reflection of several laser lines stacked in the Z axis, parallel to the surface are captured by the CIS.
- Quickly determines Z baseline depth (e.g. bond pad level).
- A relative Z scale is determined across the wafer including probe.

L - 3D Height in Color Scale
R - Intensity Reflection Image

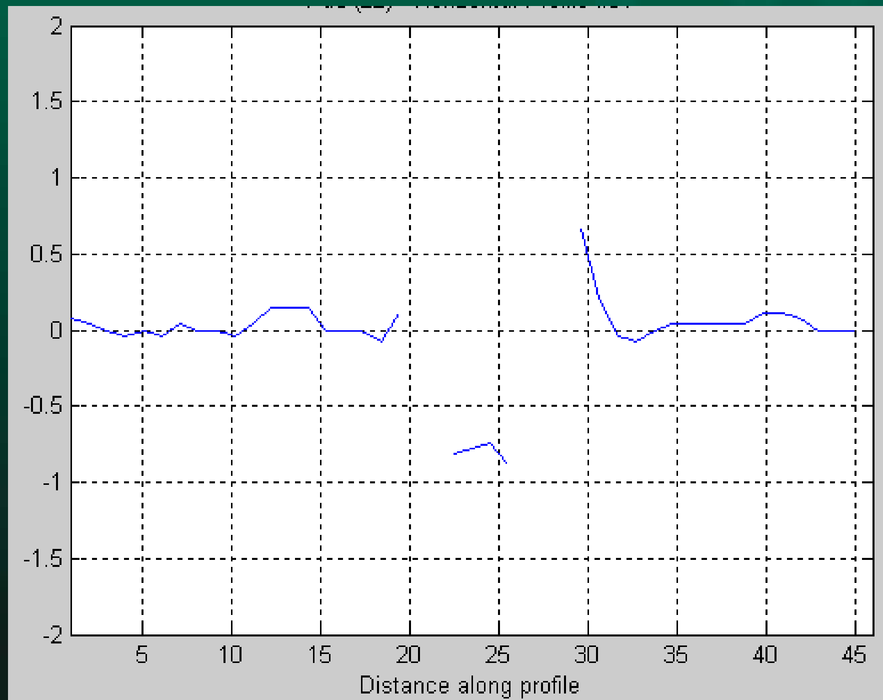


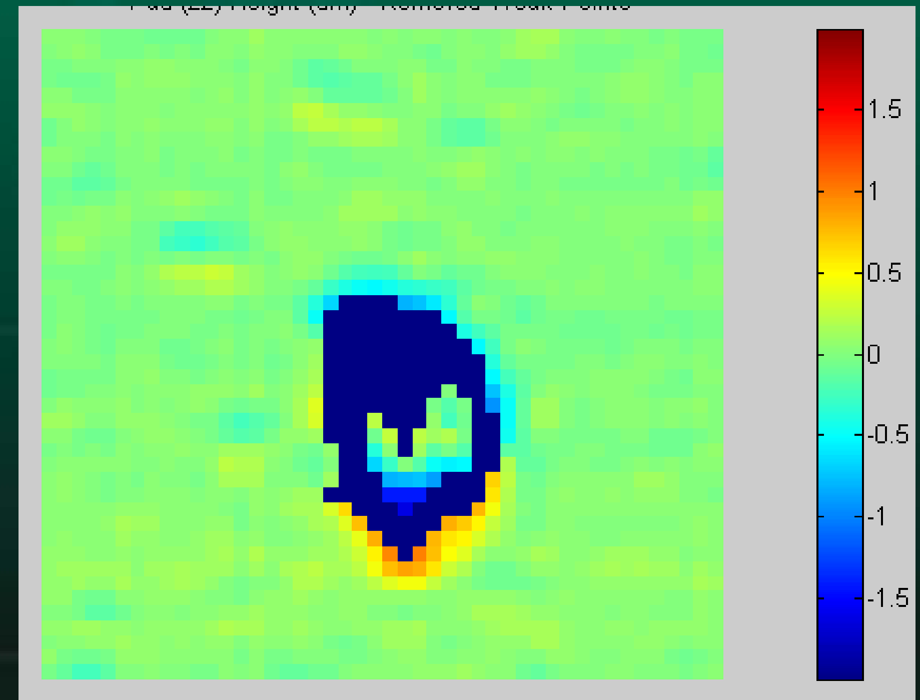


Relative Z Baseline

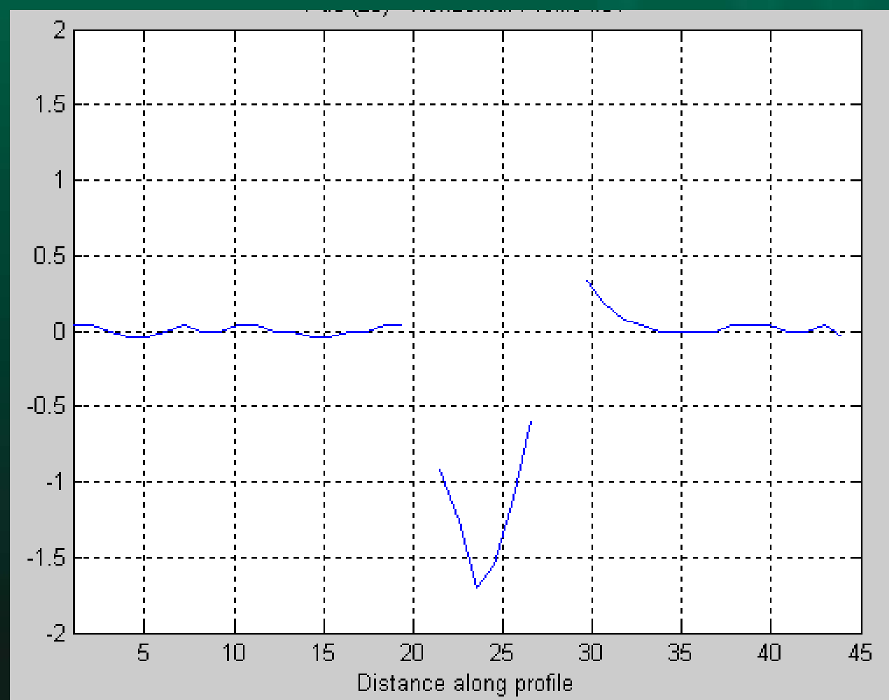


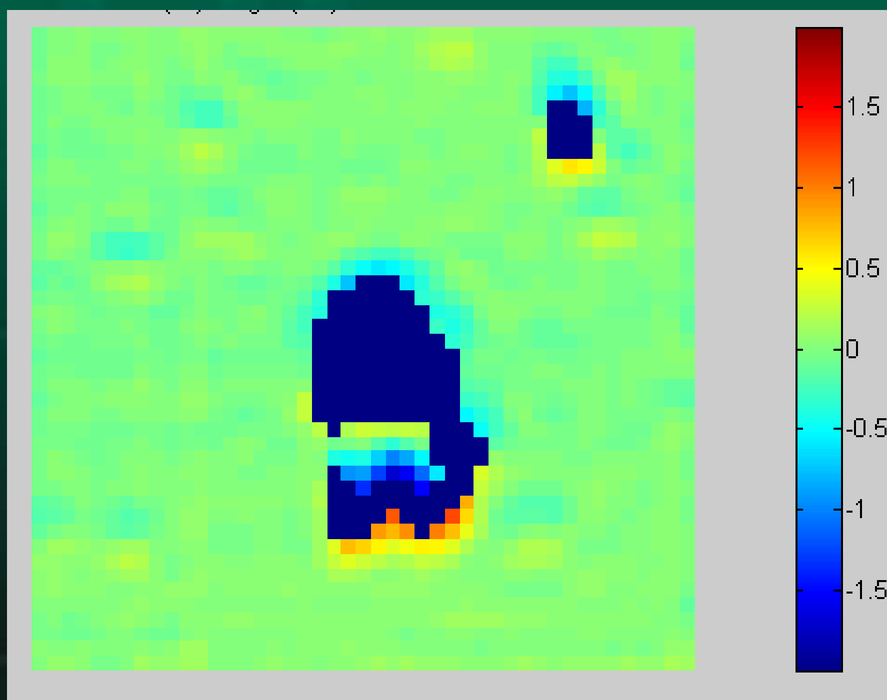
Probe Depth Measurements



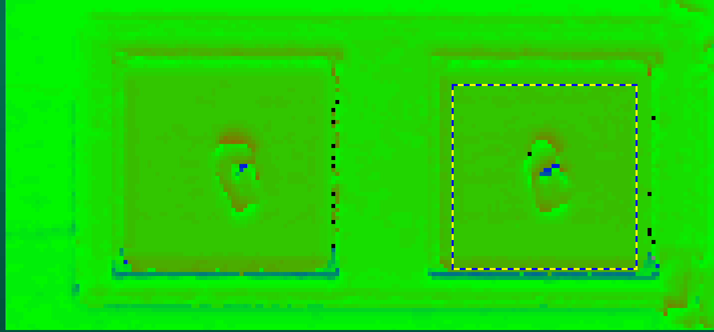


Probe Depth Measurements

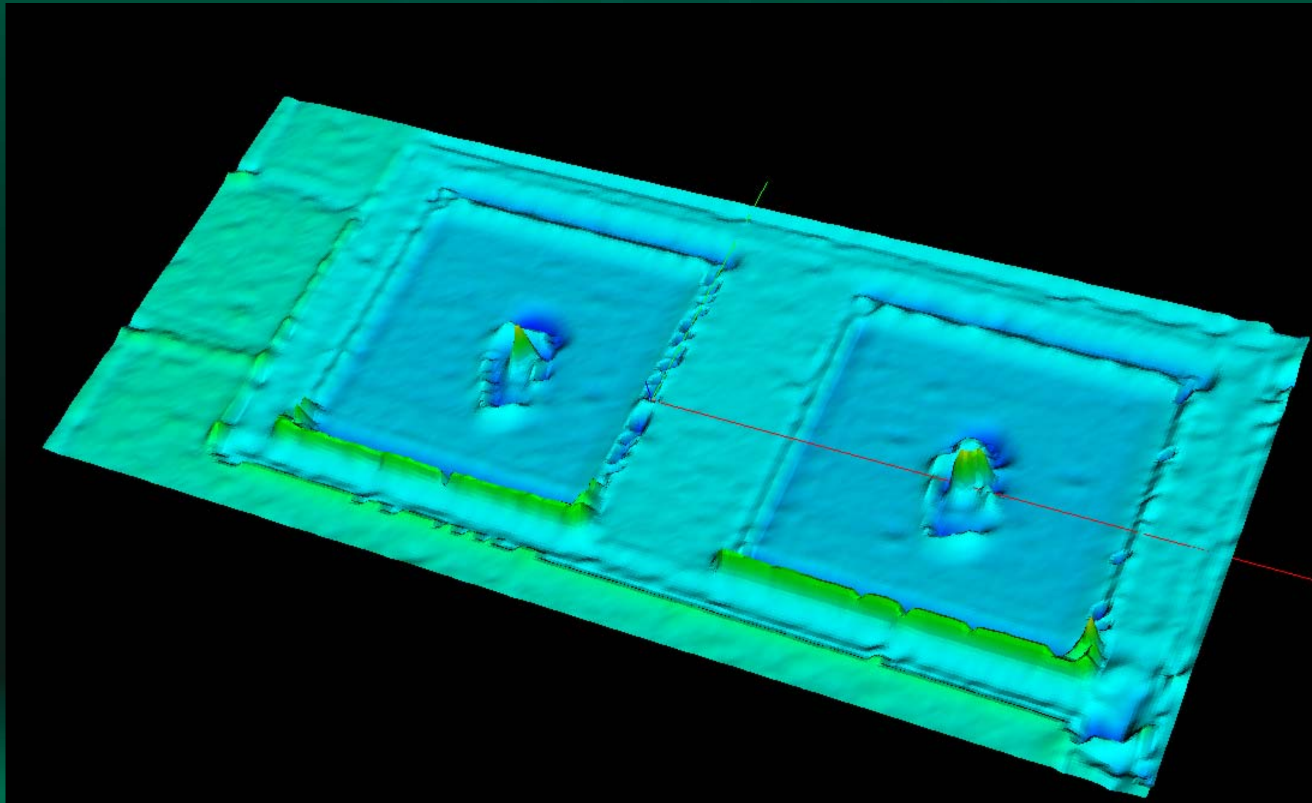




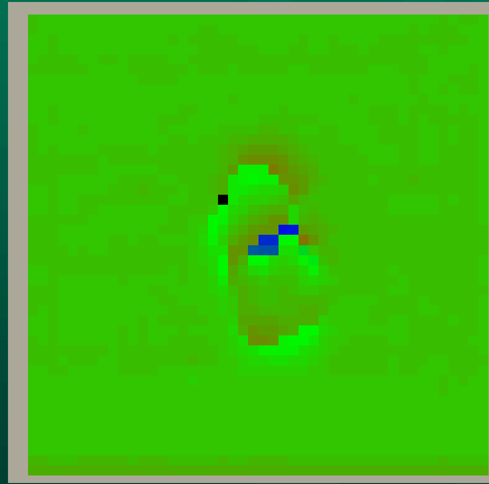
Probe Marks

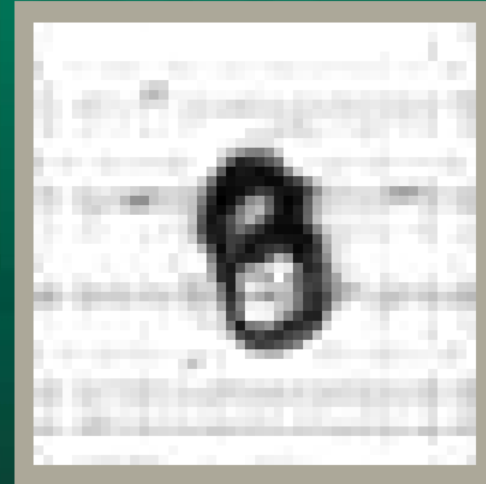


- Raw data:
- X Resolution: 1.96 um/pixel
- Y Resolution: 2 um/line



Probe Marks: Right Pad

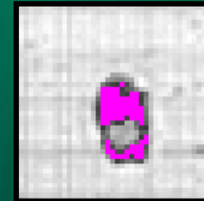


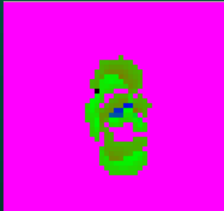


- Height Image (left) and Intensity Image (right)
- A good height pixel has a significant intensity (in intensity image).
- The height position:
  - Pad: ~ between 11.5 and 12.5 um
  - Probe Mark: ~ between 10.7 and 11.5 um
  - High artifacts: greater than 12.8 um
  - Low artifacts: lower than 10.5 um

Probe Marks: Right Pad

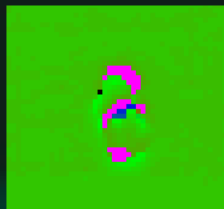
- Pink area on left are pixels that are too high. These fall in weak intensity area (see on right).
- Range: greater than 12.5 um.



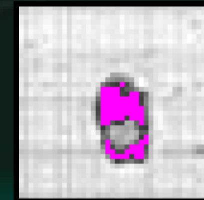


- Pink area on left are the in the Pad height range.
- Range: 11.5 to 12.5 um.

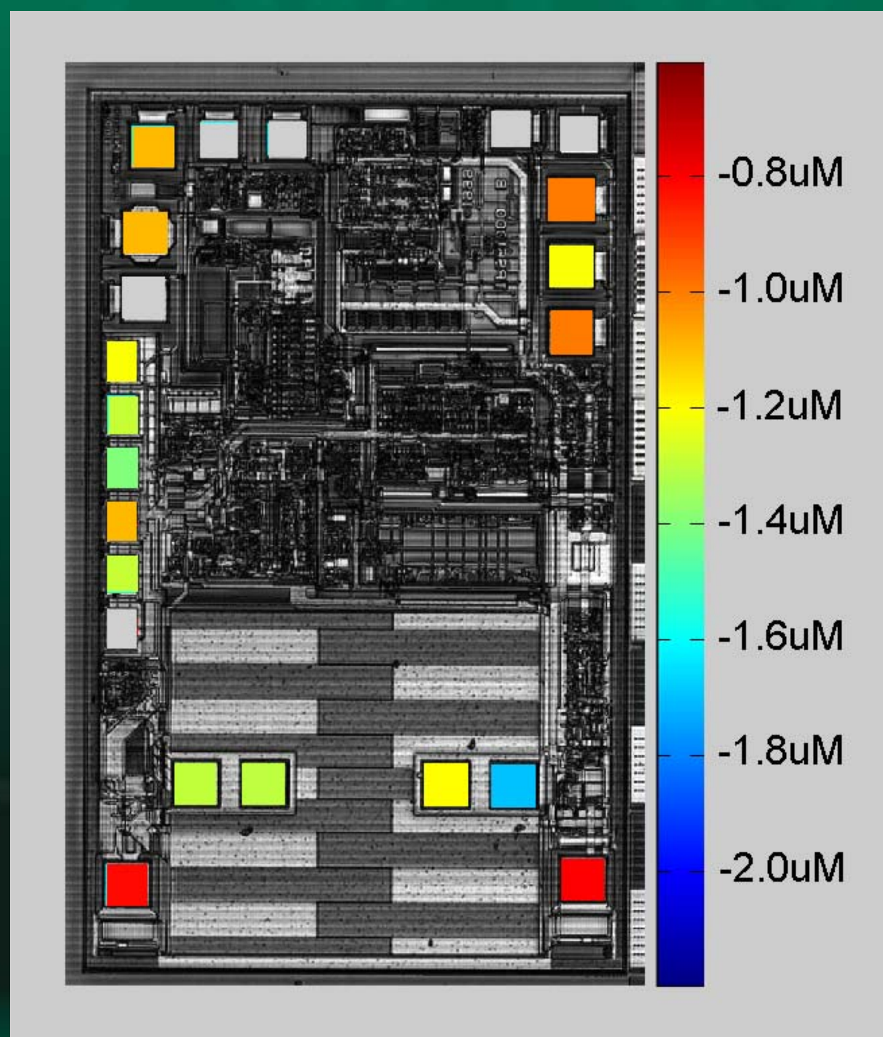
- Pink area on the left are the pixels that we suspect to give the probe mark depth.
- Range: 10.5 to 11.5 um.



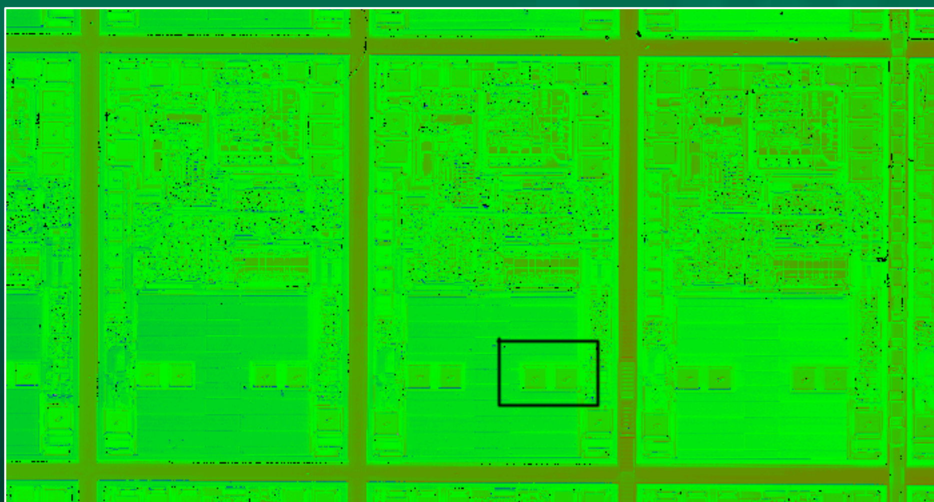
- Pink area on left are pixels that are too low. These fall in weak intensity area (see on right).
- Range: lower than 10.5 um.



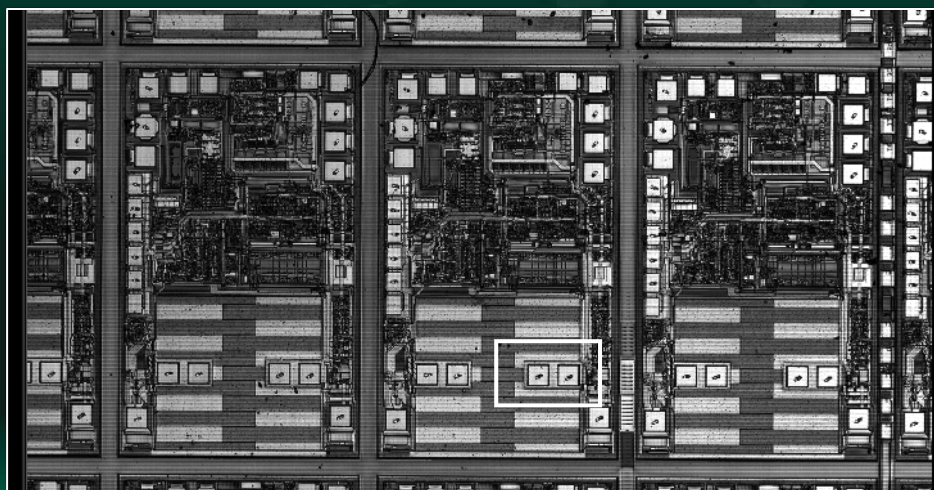
Probe Depths Around Die

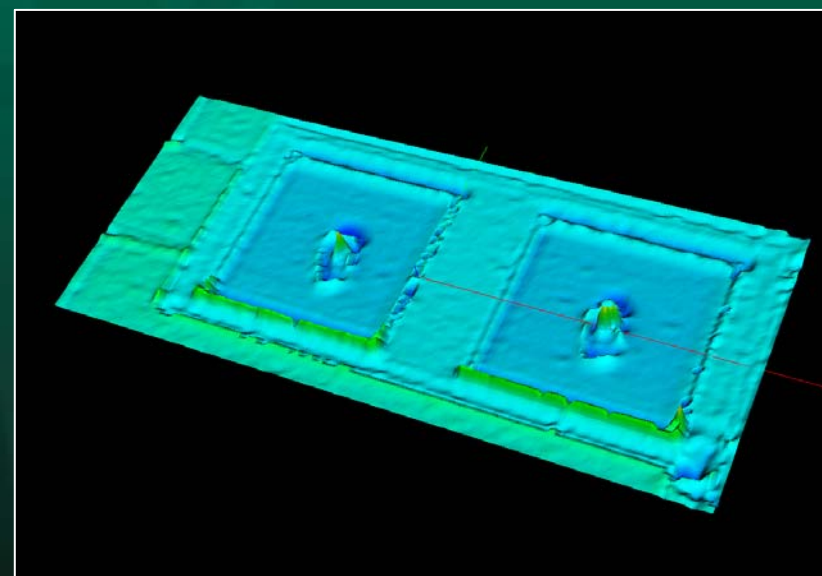


Artifacts Due to Laser Angle



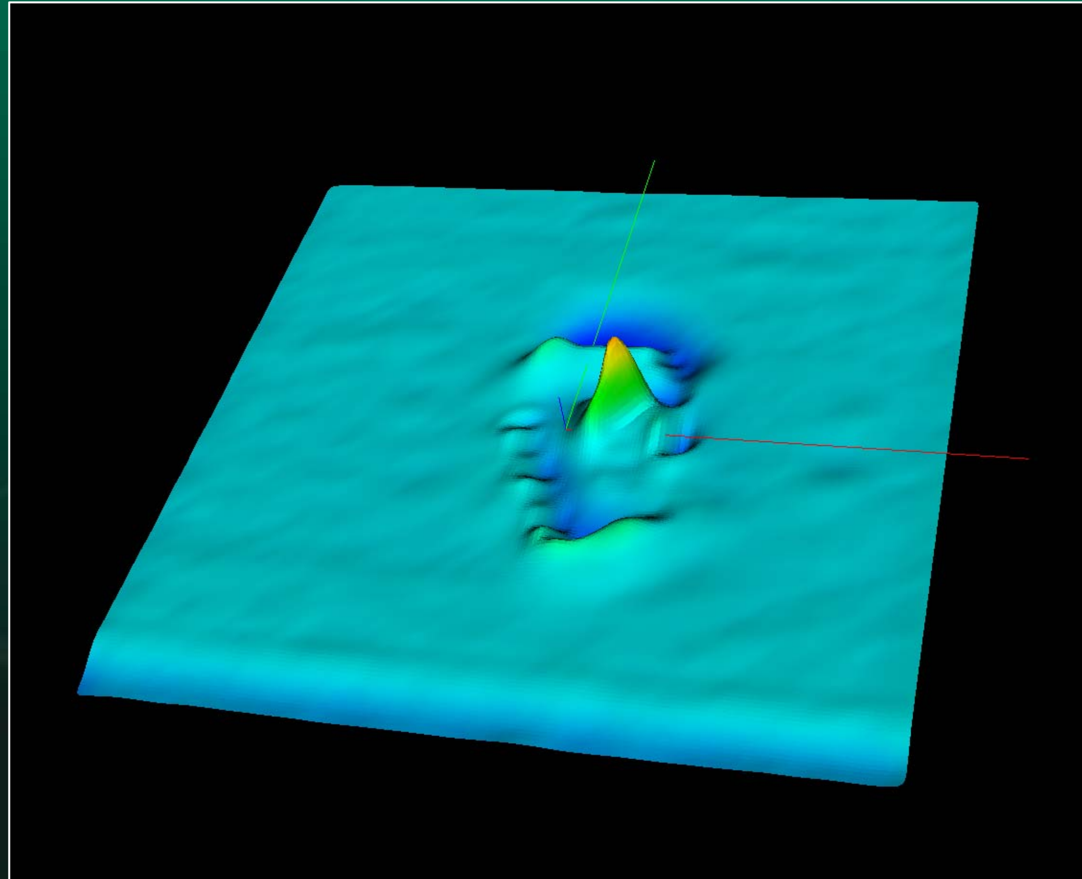
Multiple Die





Selected Pads

Smoothed 3D Profile



Strengths / Weaknesses

- **Relatively believable measurement variation across wafer.**
- **Throughput at presented resolution (4mm swath)**
  - 15 WPH 150mm
  - 8 WPH 200mm
  - 5 WPH 300mm
- **Throughput at 6mm swath (Adequate resolution with presented probe footprint)**
  - 30 WPH 150mm
  - 16 WPH 200mm
  - 10 WPH 300mm
- **Artifacts must be understood**
  - Comparison of Height map to Intensity map

Thank You