Spartan Technical Bulletin

Pad Evaluation for Prime Si/Sapphire CMP

SPARTAN FELT COMPANY

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NOTE: Spartan Stock Removal Pads meet the industry standard for stock removal, flatness and generated surface finish requirements.

All stock removal pads are manufactured in the USA using green technology.

Custom pad diameters and thickness are available with Pressure Sensitive Adhesives (PSA) to meet your application requirements.

These pads tested (on silicon) can be also be employed for sapphire and silicon carbide applications with process adjustements on the polishing machine being used with different slurry compositions.

SCOPE OF WORK

- Two Spartan "*Stock Removal*" Pads were evaluated for CMP of prime 200mm Si/Sapphire wafers
- Each pad is broken in with 10 minutes of pad conditioning and 20 minutes of polish with a filler silicon wafer prior to collecting monitor data
- Three wafers were then tested for removal rate and TTV, with defectivity and surface roughness being measured on the final wafer
- Wafers are buffed on the final platen with a soft pad and go through OnTrak double-sided PVA brush scrub prior to collecting roughness and defectivity measurements.

TOOLS AND CONSUMABLES

Tools: →

- IPEC 472 with Standard 200mm Carrier
- OnTrak Synergy PVA Brush Scrubber
- SurfScan 6220 Surface Analysis System
- Atomic Force Microscope
- ADE UltraGage 9500

Consumables: →

- Primary platen: two stock removal pads (AMG-5 and OMNI Gray-B) with diamond conditioning disk and diluted Mazin slurry
- Final platen: Soft pad with finishing Si slurry
- OnTrak dedicated PVA brushes with SC-1 cleaning chemistry

PAD TEST RESULTS

Polish Pad	Removal Rate (um/min)				Surface Roughness Ra (A)			Post-CMP LPD
	Run 1	Run 2	Run 3	Average	Center	Edge	Average	
Spartan Pad AMG-5	0.98	0.88	1.00	0.95	1.80	1.17	1.49	34
Spartan Pad OMNI Pad	0.98	0.98	1.02	0.99	2.56	1.29	1.93	41

- Overall, the data suggests that the two Spartan Pads tested are industry standard
- Final surface roughness of the silicon wafer on the two pads was below 2A Ra on average defectivity was less than 50 LPD at 0.2um and greater sizes on prime silicon

WAFER TOTAL THICKNESS VARIATION (TTV, um)

- Wafer TTV stayed within normal ranges for each run on each pad type

Polish Pad	Total Thickness Variation Pre/Post CMP (um)					
	Pre-Run1	Post-Run1	Pre-Run2	Post-Run2	Pre-Run3	Post-Run3
Spartan Pad AMG-5	3.27	3.65	3.65	3.63	1.24	1.84
Spartan Pad OMNI Pad	1.84	3.25	3.25	2.67	1.06	1.58

SUMMARY

- Silicon wafers averaged 0.95um/min on Spartan AMG-5 Pad , and 0.99um/min on Spartan OMNI Pad
  - In general, the final TTV depends on many factors besides the pad, e.g. incoming TTV, slurry, process conditions, etc.

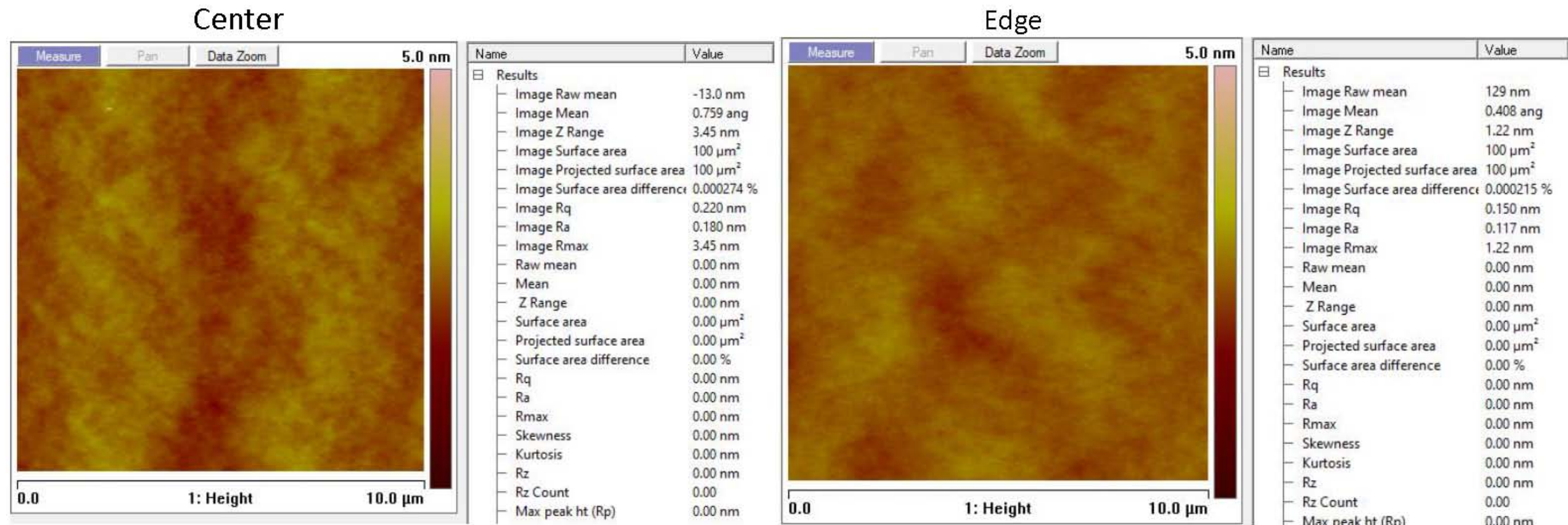
- Low post-CMP defectivity has been observed for all pads, with a post-CMP LPD count of 34 on the Spartan AMG-5 and 41 on the Spartan Omni Pad, for 0.2 um and greater sizes
  - Prior to CMP, each prime silicon wafer had less than 100LPD for 0.2um and greater sizes.

- Surface roughness measurement values were 1.49A on Spartan AMG-5 and 1.93A on Spartan OMNI Pad.
  - All observed values are considered low
  - Significant differences were **not** observed.

Appendix – AFM Images, Defect Maps, and ADE Scans

Post-CMP Silicon/Sapphire Surface Roughness AFM Scans

Spartan AMG-5 PAD



Center

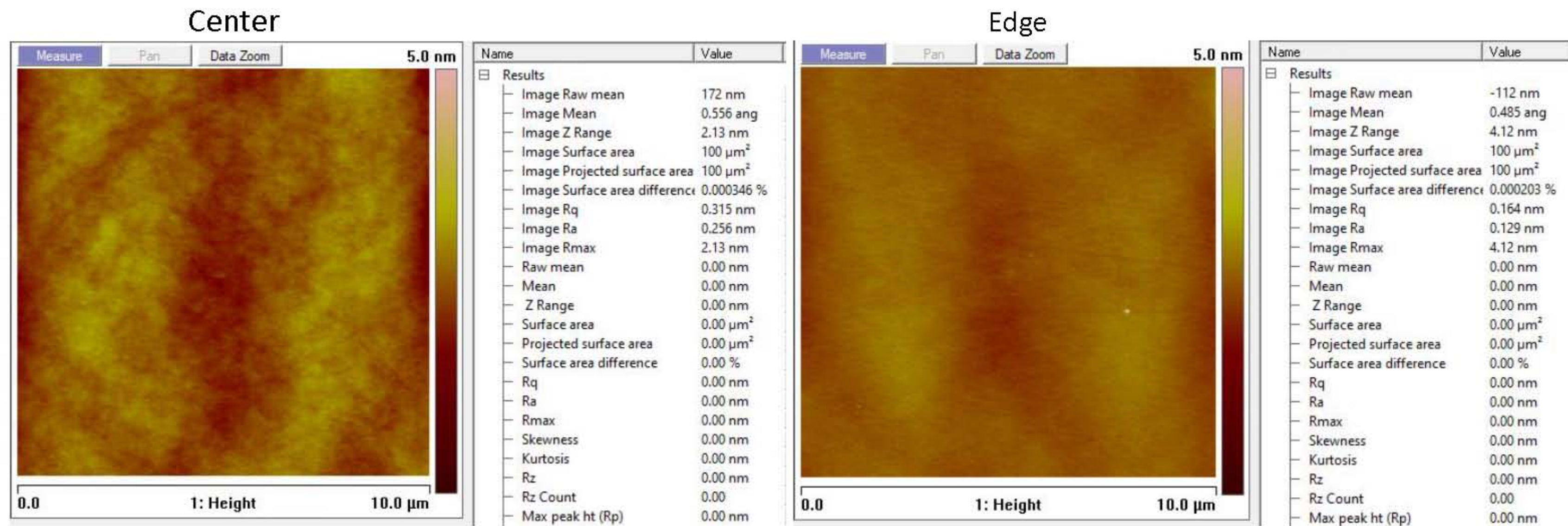
Name	Value
Results	
Image Raw mean	-13.0 nm
Image Mean	0.759 ang
Image Z Range	3.45 nm
Image Surface area	100 µm²
Image Projected surface area	100 µm²
Image Surface area differenc	0.000274 %
Image Rq	0.220 nm
Image Ra	0.180 nm
Image Rmax	3.45 nm
Raw mean	0.00 nm
Mean	0.00 nm
Z Range	0.00 nm
Surface area	0.00 µm²
Projected surface area	0.00 µm²
Surface area difference	0.00 %
Rq	0.00 nm
Ra	0.00 nm
Rmax	0.00 nm
Skewness	0.00 nm
Kurtosis	0.00 nm
Rz	0.00 nm
Rz Count	0.00
Max peak ht (Rp)	0.00 nm

Edge

Name	Value
Results	
Image Raw mean	129 nm
Image Mean	0.408 ang
Image Z Range	1.22 nm
Image Surface area	100 µm²
Image Projected surface area	100 µm²
Image Surface area differenc	0.000215 %
Image Rq	0.150 nm
Image Ra	0.117 nm
Image Rmax	1.22 nm
Raw mean	0.00 nm
Mean	0.00 nm
Z Range	0.00 nm
Surface area	0.00 µm²
Projected surface area	0.00 µm²
Surface area difference	0.00 %
Rq	0.00 nm
Ra	0.00 nm
Rmax	0.00 nm
Skewness	0.00 nm
Kurtosis	0.00 nm
Rz	0.00 nm
Rz Count	0.00
Max peak ht (Rp)	0.00 nm

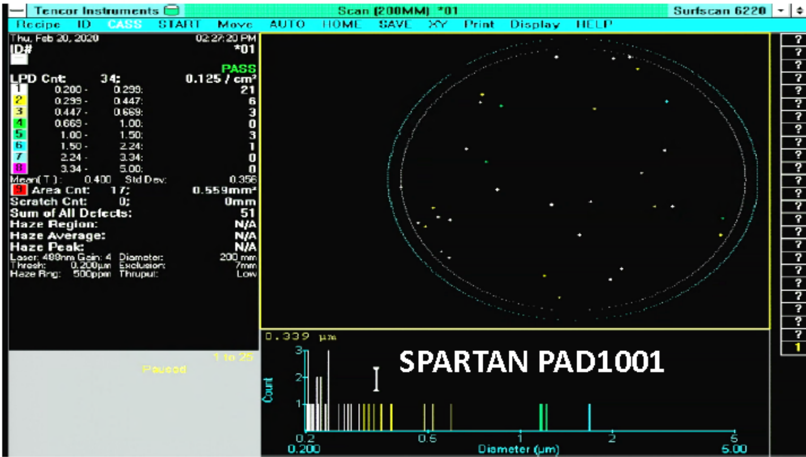
Post-CMP Silicon/Sapphire Surface Roughness AFM Scans

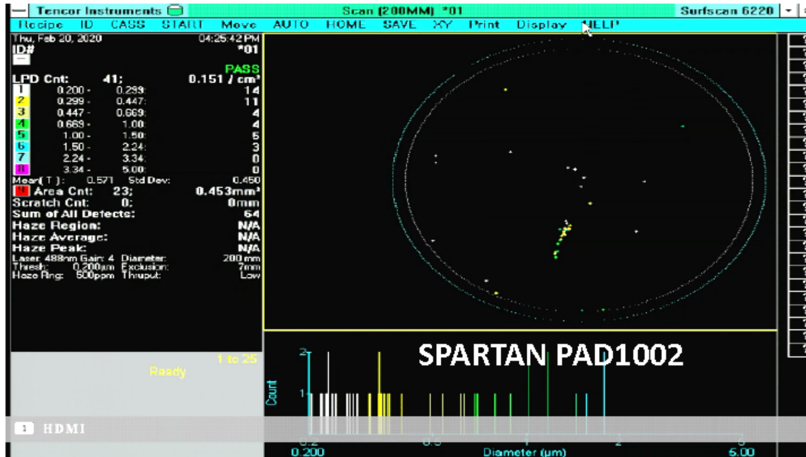
Spartan AMG-5 PAD



SurfScan 6220 Defect Maps,

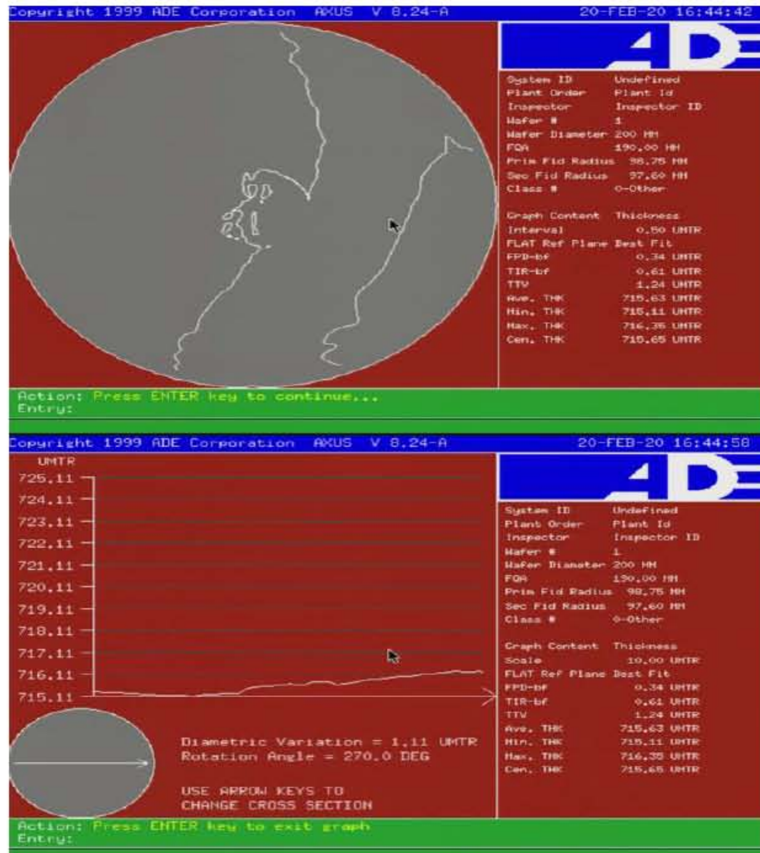
Post-CMP of Prime 200mm Silicon/Sapphire



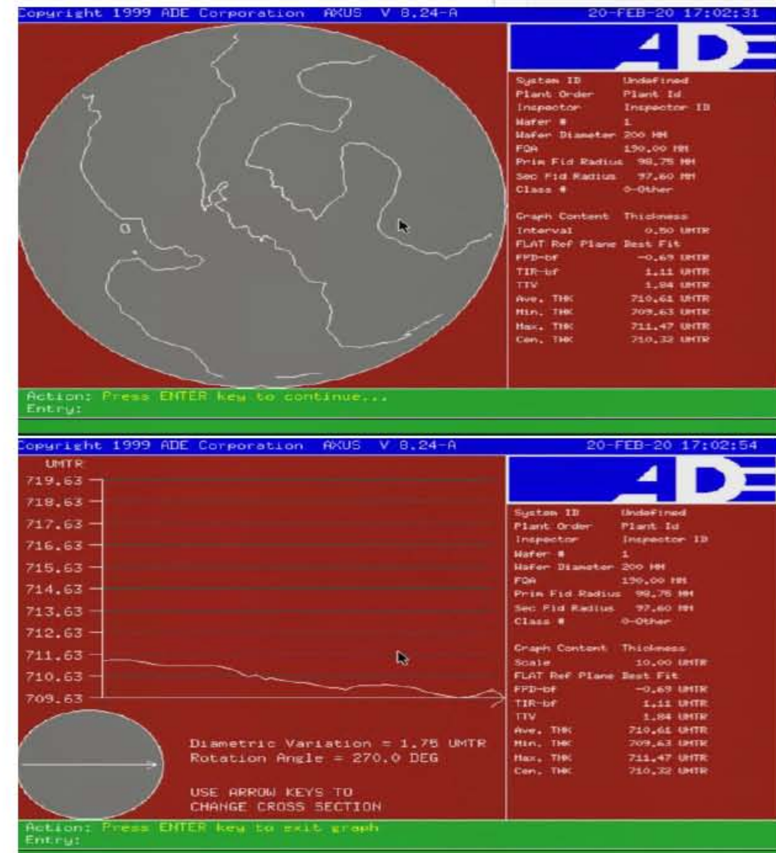


SPARTAN AMG-5, Run #3, Pre and Post Thickness

PRE-CMP

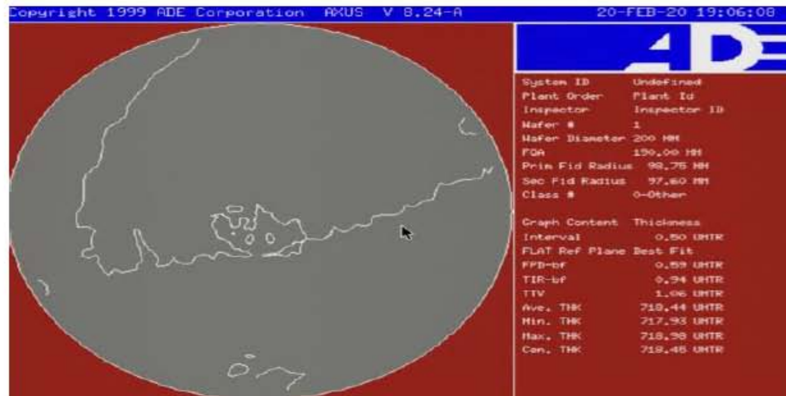


POST-CMP



OMNI PAD, Run #3, Pre and Post Thickness

PRE-CMP



POST-CMP