Analysis and Optimization of AlTiC CMP Using Advanced Heads

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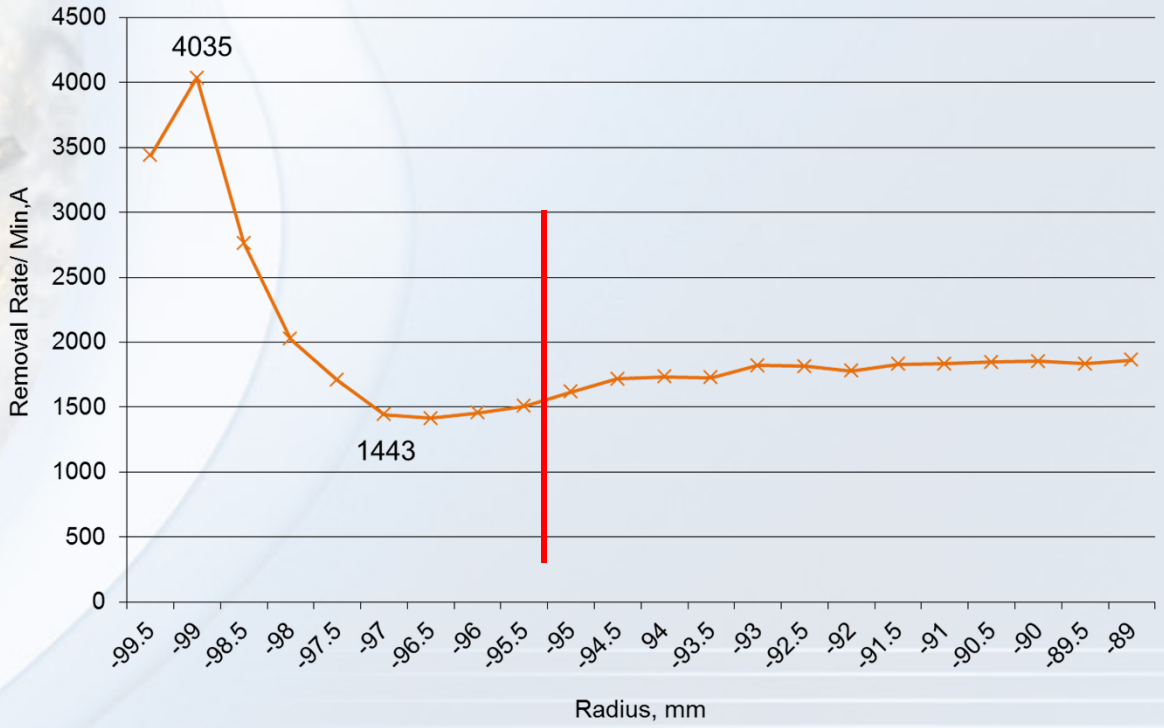
18 Sept 2012

Outline

- Results with rigid plate carriers
- Tuning of modified Titan carrier tuning with single factors
- Initial oxide/AlTiC CMP data
- Simultaneous tuning of modified Titan
- Summary and Follow-up work

Rigid Plate Carrier Edge Exclusion

- Best NU only achieves 5mm edge exclusion at best
- Requires high downforce and slow speeds
  - Incompatible with most modern processes



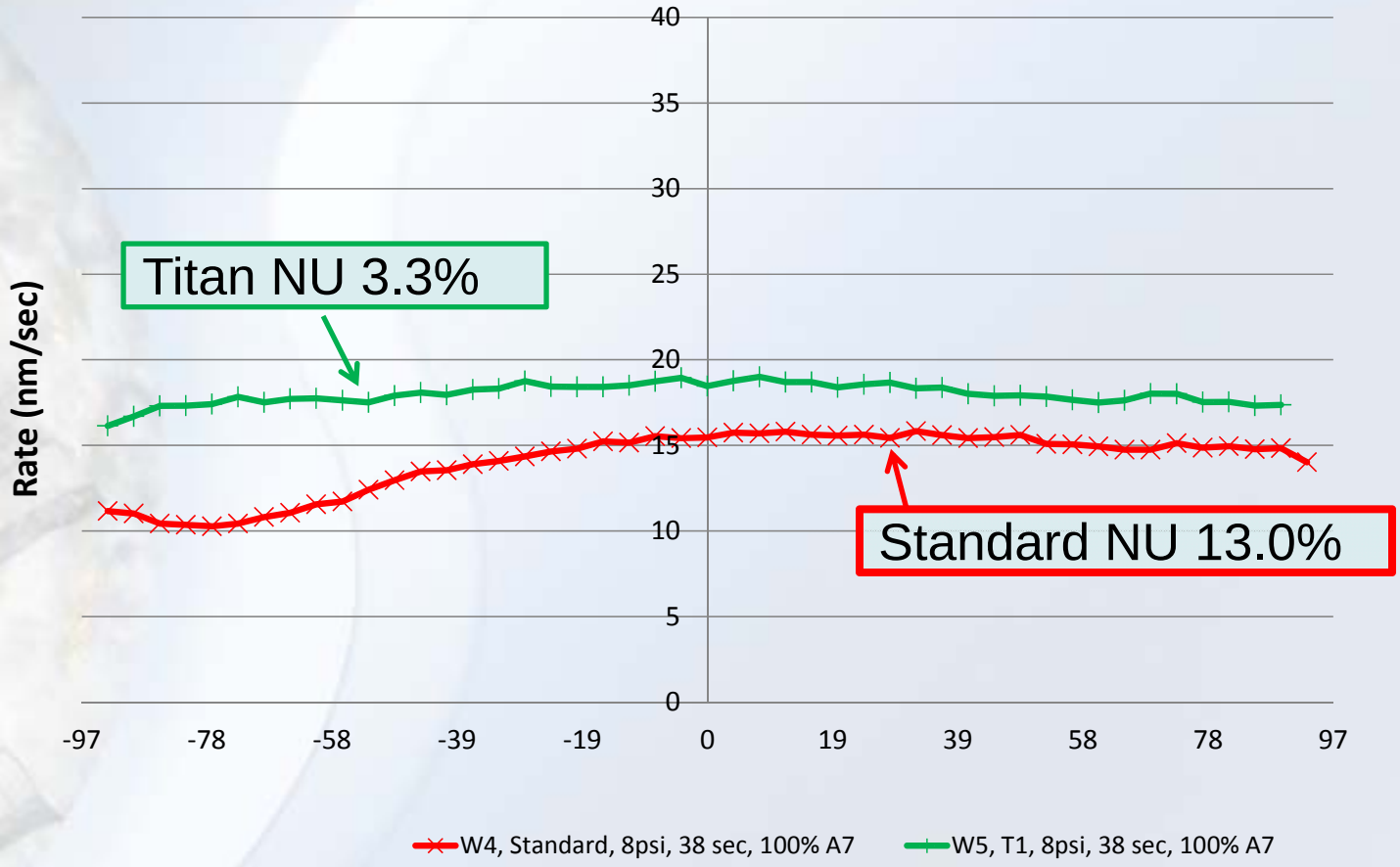
200mm Mirra Taken Through Upgrades

- Started with Titan (3 zone) membrane carrier
  - Membrane enables front referencing technology
  - Flat edge to 3mm, some edge tuning
  - Has advantages for volume production applications
    - ISRM, multiplaten, etc.
- Upgrades have been available
  - Profiler (4 zone) head
    - Increased edge tuning
  - Contour (6 zone) head
    - Full radial control

Path for 150/200mm Legacy Tools

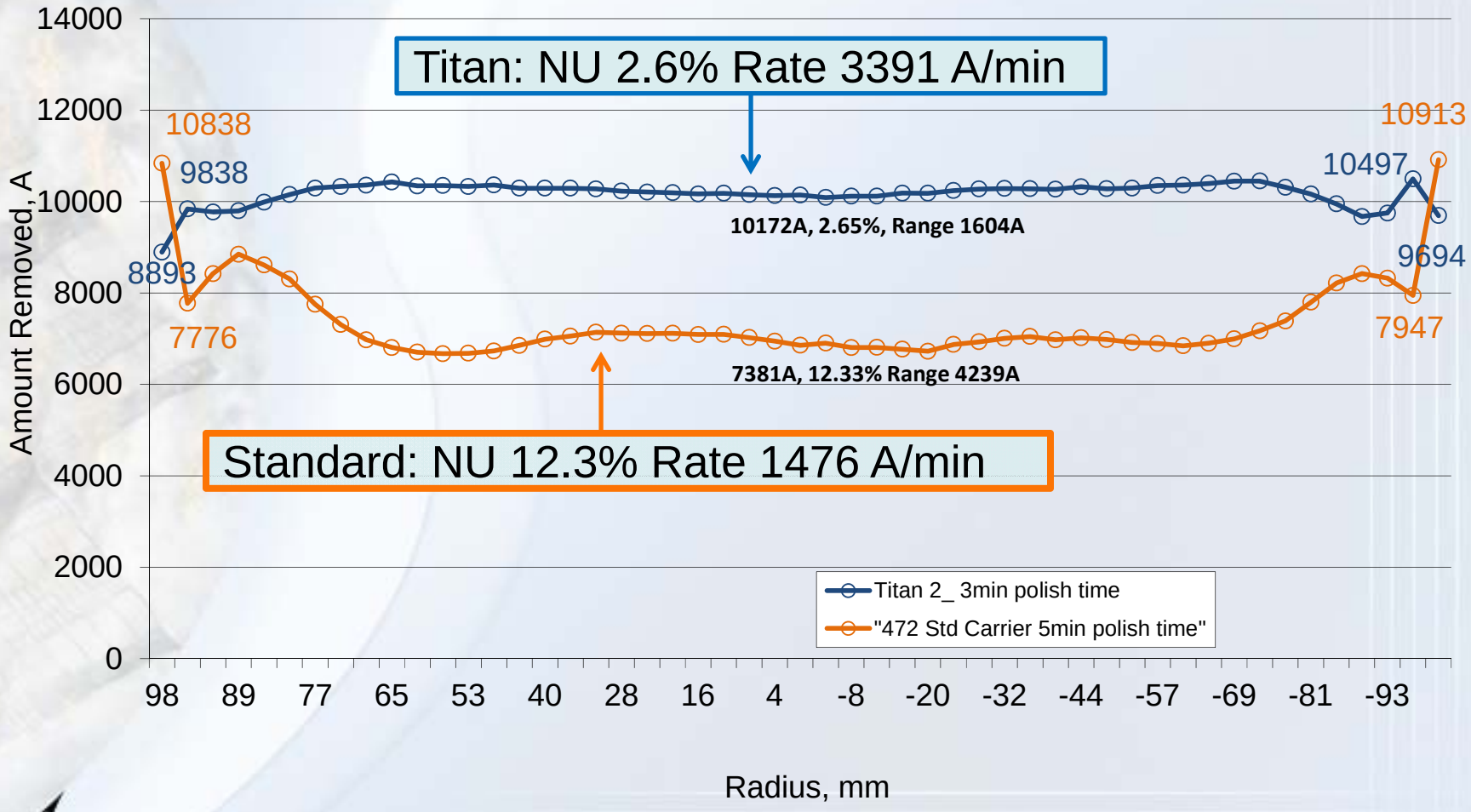
- Older equipment with rigid plate carriers being extended
  - IPEC 372M/472
  - Strasbaugh 6DS-SP/6EC
    - ViPRR controls retaining ring
  - Ebara EPO
  - Still good for lower volume / flexible purpose
- Carrier upgrade path developed
  - 200mm: ViPRR, Titan, Profiler, and Contour
  - 150mm: Titan and now Profiler (from AMAT)

AlTiC Wafer Process on 6DS-SP/Titan



Uniformity improved with 8 psi 55 RPM process

Customer/New Processes on 472/Titan



Uniformity improved 5X, Rate 2x with new process

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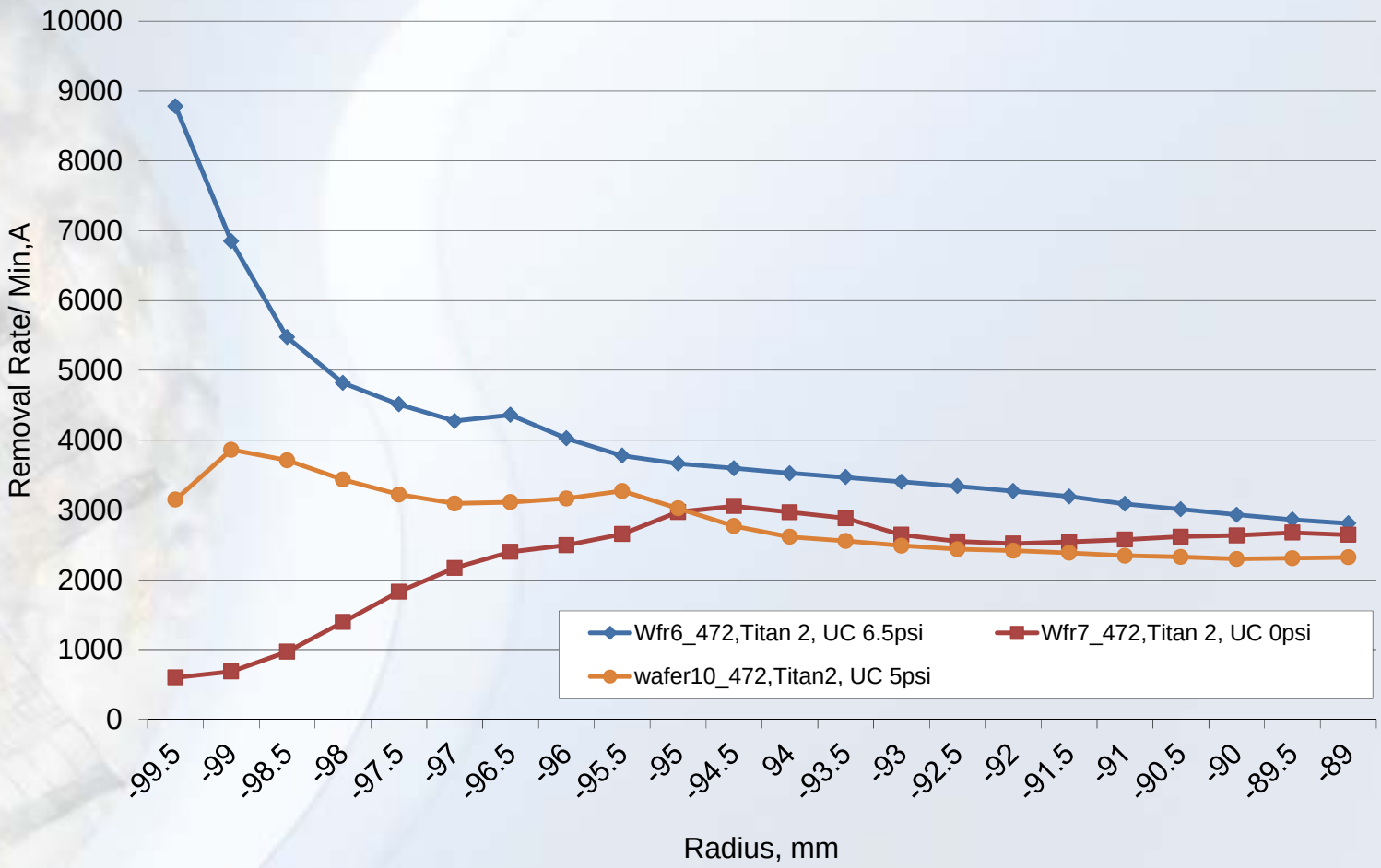
Edge Tuning on 472/Profiler



Dramatic changes in edge rate possible with Profiler
Similar results now available with modified Titan

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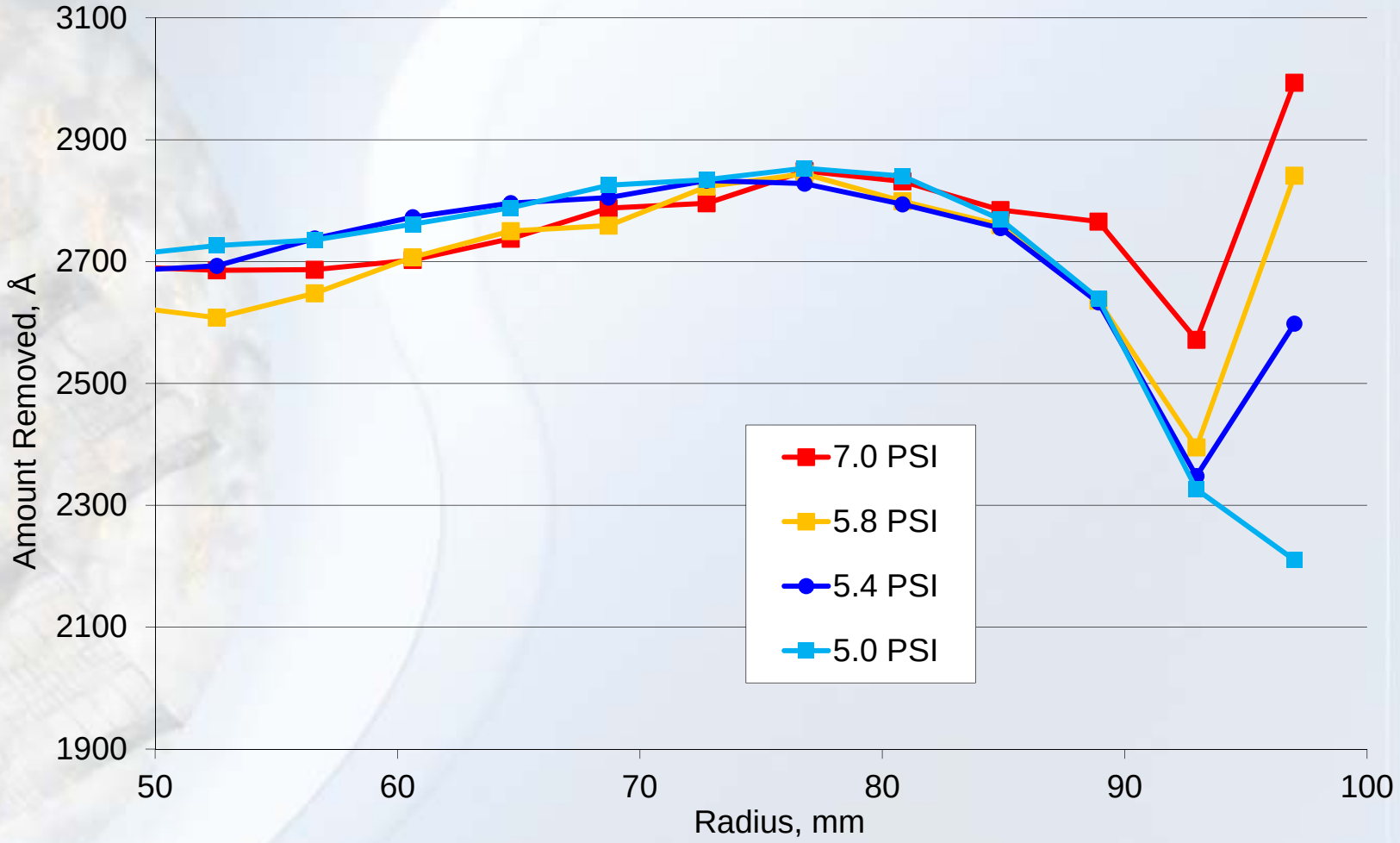
Axus Technology Modified Titan 200mm
Normalized Diameter Scan 3mm EE
Oxide on Silicon Blanket Wafers



NU improved by raising the retaining ring pressure up to 7

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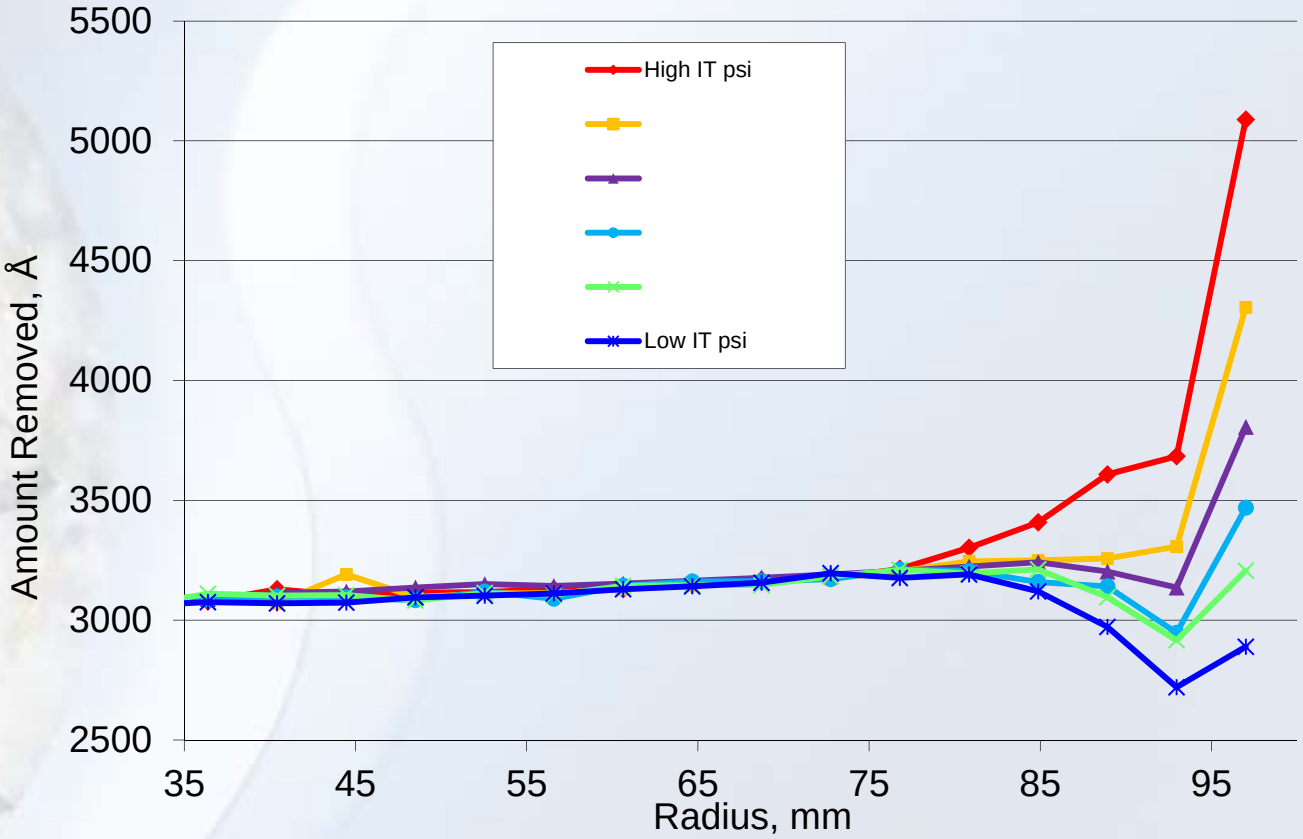
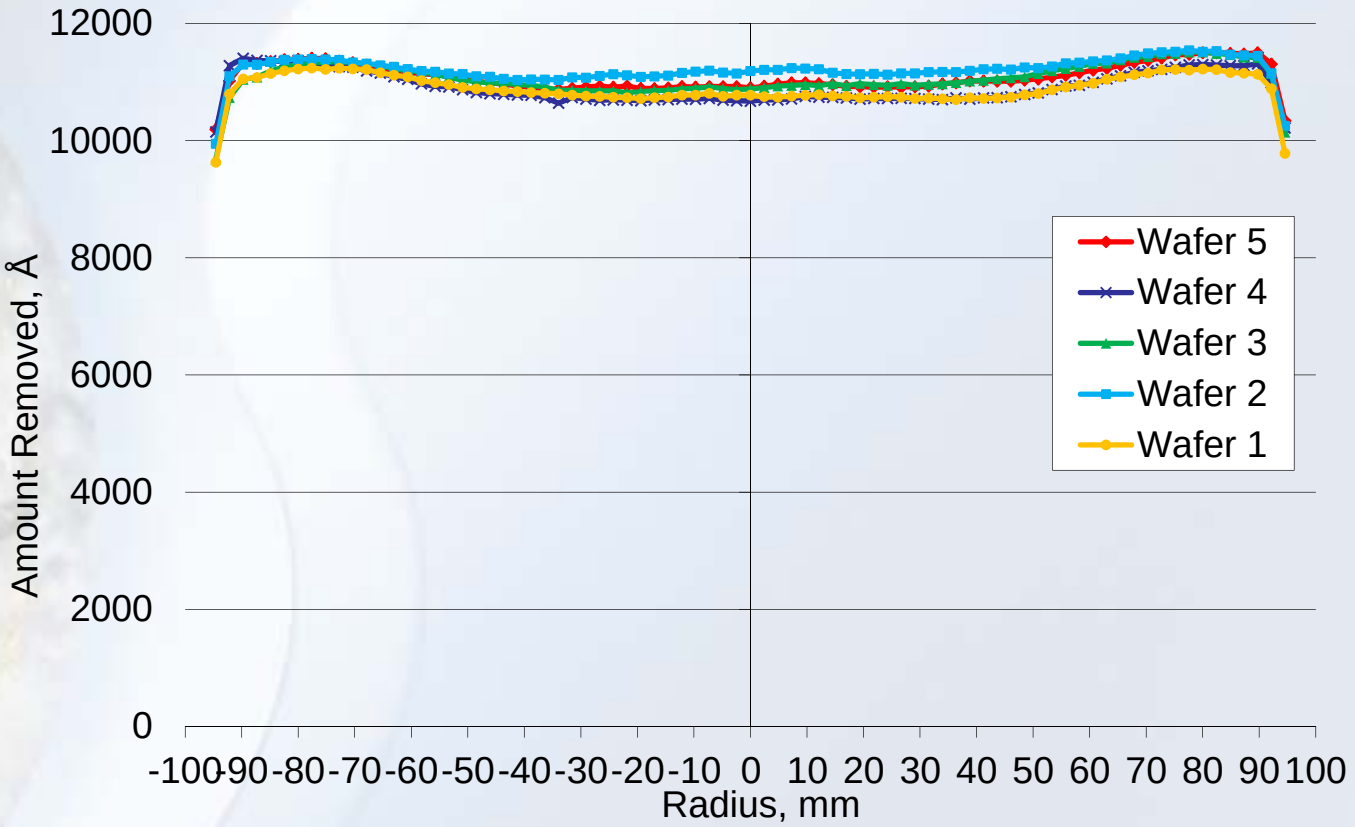
Axus Technology Modified Titan 1 200mm
Normalized Diameter Scan, 3mm EE
Oxide on Silicon Blanket Wafers



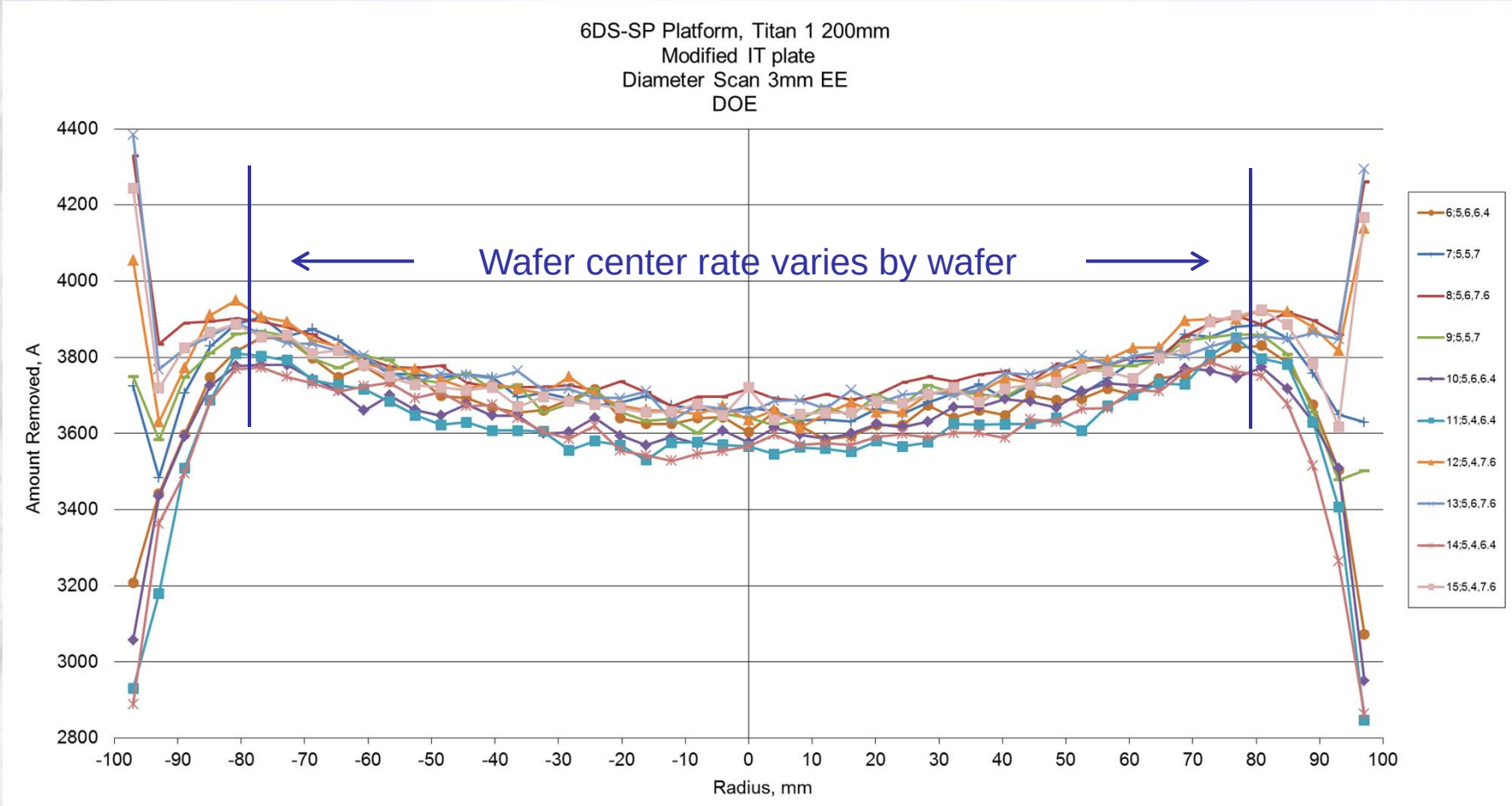
Overall shape of edge can be driven by IT piston pressure

AlTiC Diameter scan, 60 sec at 5 psi, Initial BKM (Non-optimized*) 5mm Edge



Initial run using Axus Technology BKM prior to optimization
Even non-optimized process gives 2.0-2.6% radial NU at 5mm
Want to investigate tuning edge up and down

DOE with R Ring and Modified IT Plate



Ox on Si, Membrane 5 psi, Platen/Carrier 93/87 rpm
Retaining Ring 6.4-7.6 & IT bladder 4-6 (piston) psi
Rate at 3mm varies ~1500A/min

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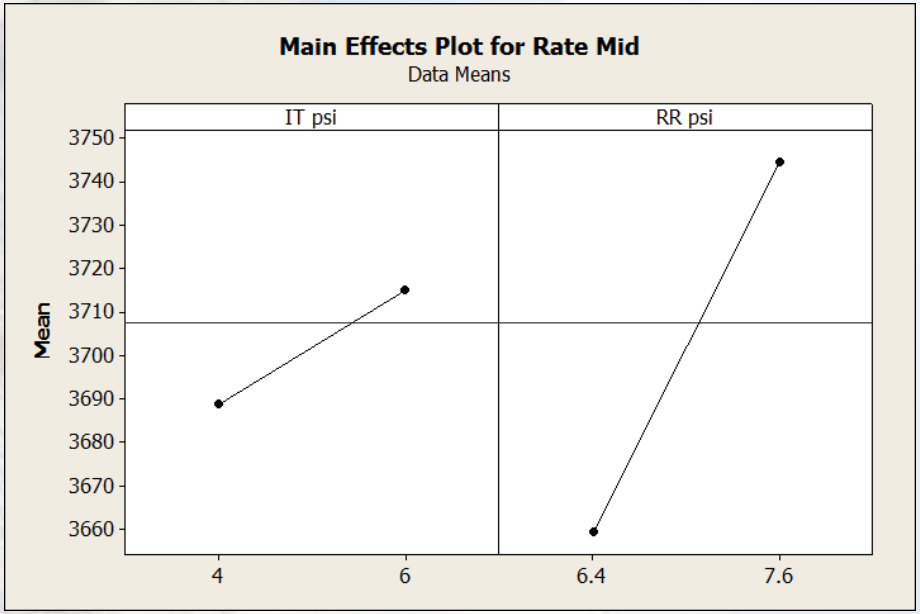
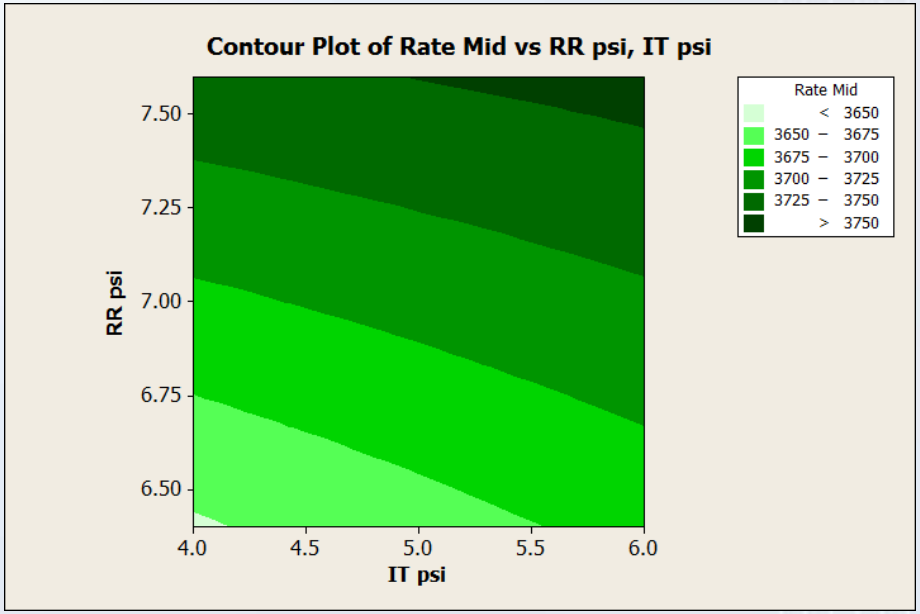
Rate Across Wafer Center





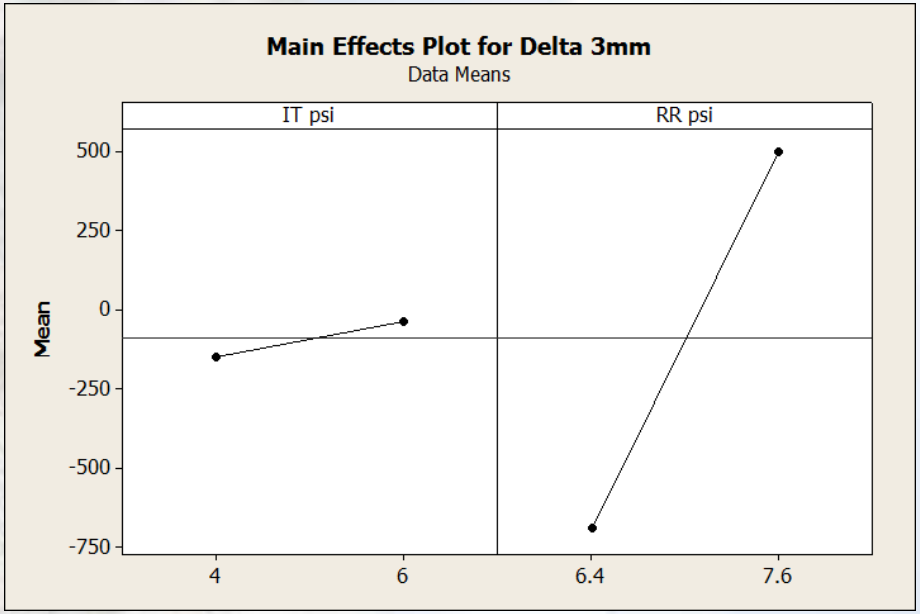
p = 0.09

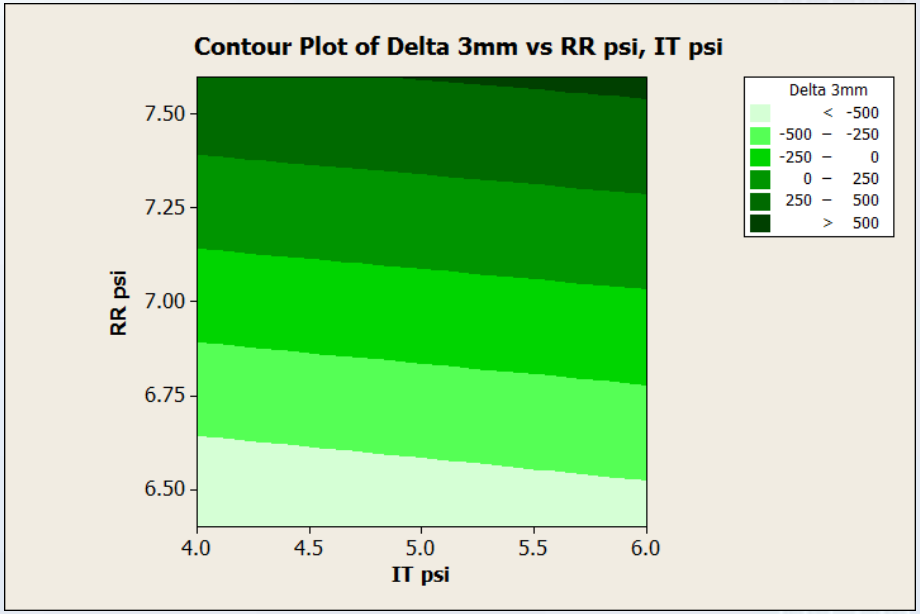
p < 0.01

Model Rsq = 0.89

Parameters have influence on center rate
Likely the result of fluid film and temperature changes
Zone control will be evaluated as delta to center rate

Rate at 3mm from Edge





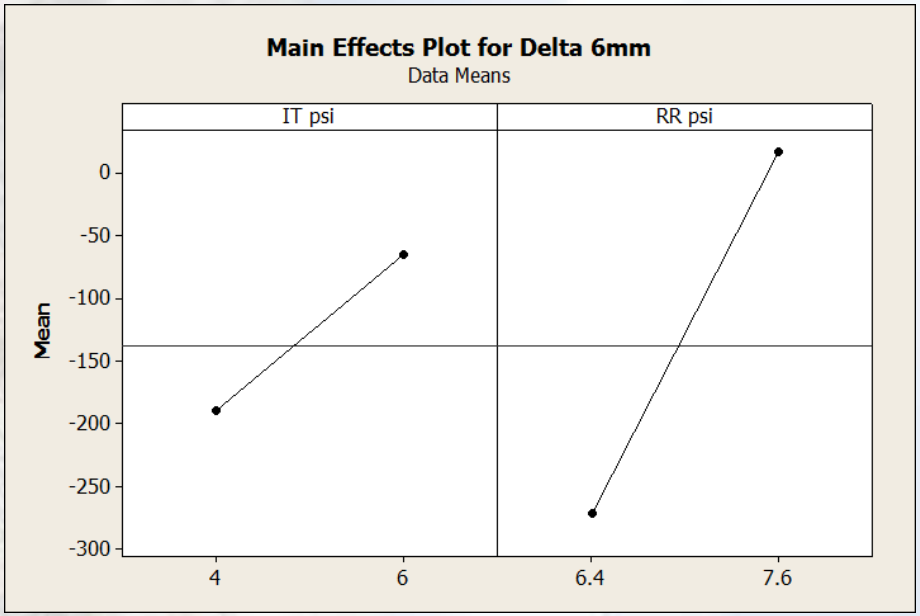
p = 0.06

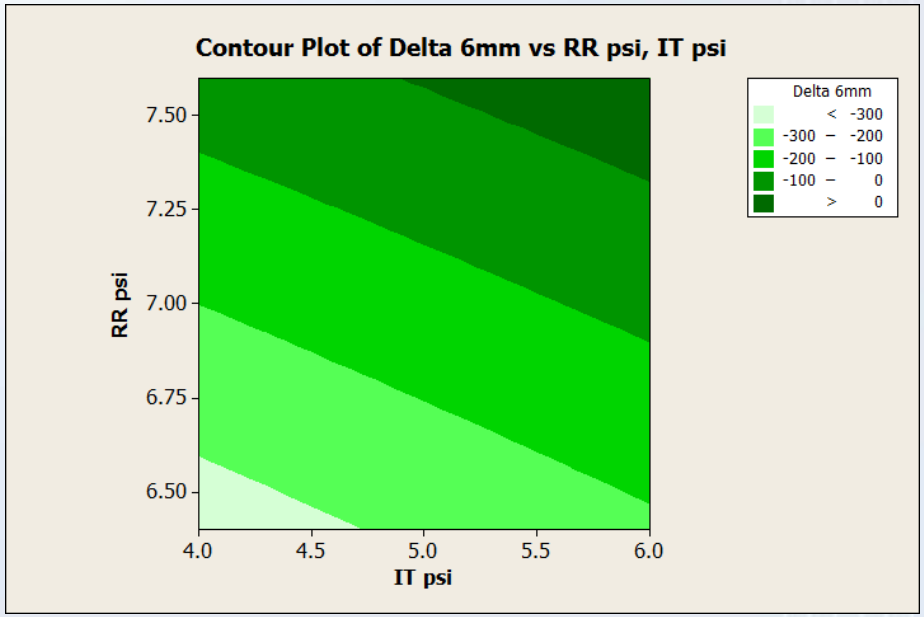
p < 0.01

Model Rsq = 0.99

Retaining Ring pressure has large influence on 3mm rate

Rate at 6mm from Edge

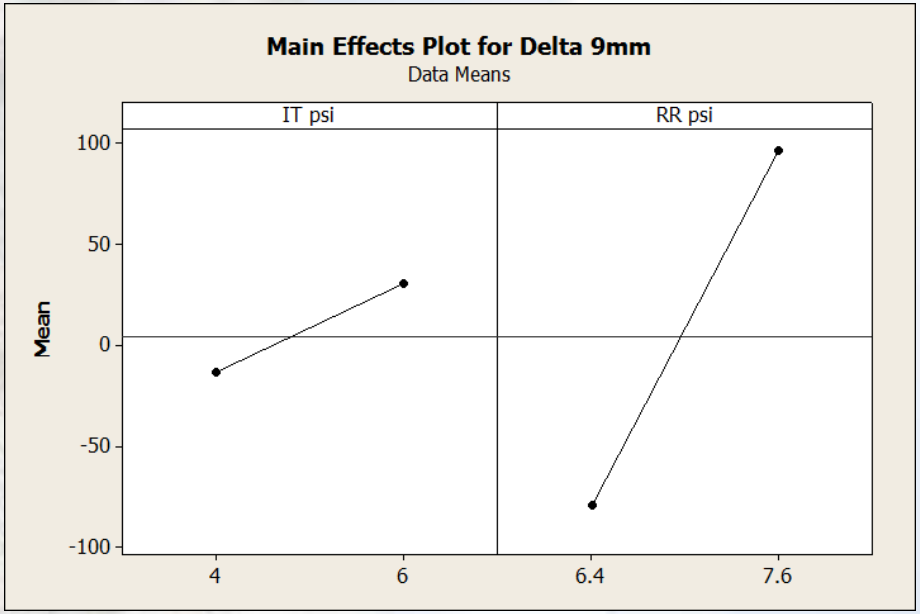


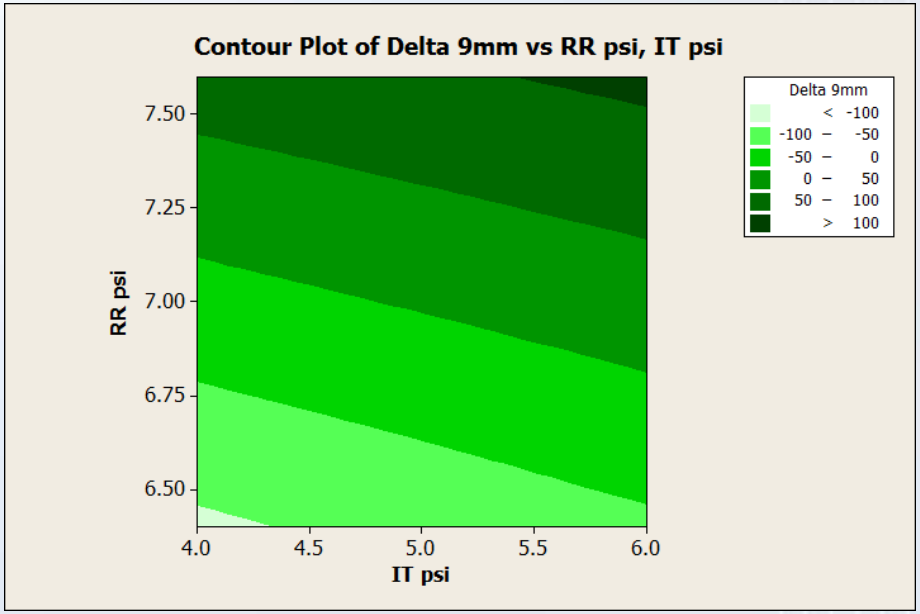


p < 0.01 p < 0.01 Model Rsq = 0.97

Both factors influence 6mm rate
Can utilize higher pressure to raise 6mm rate without large effect on 3mm

Rate at 9mm from Edge





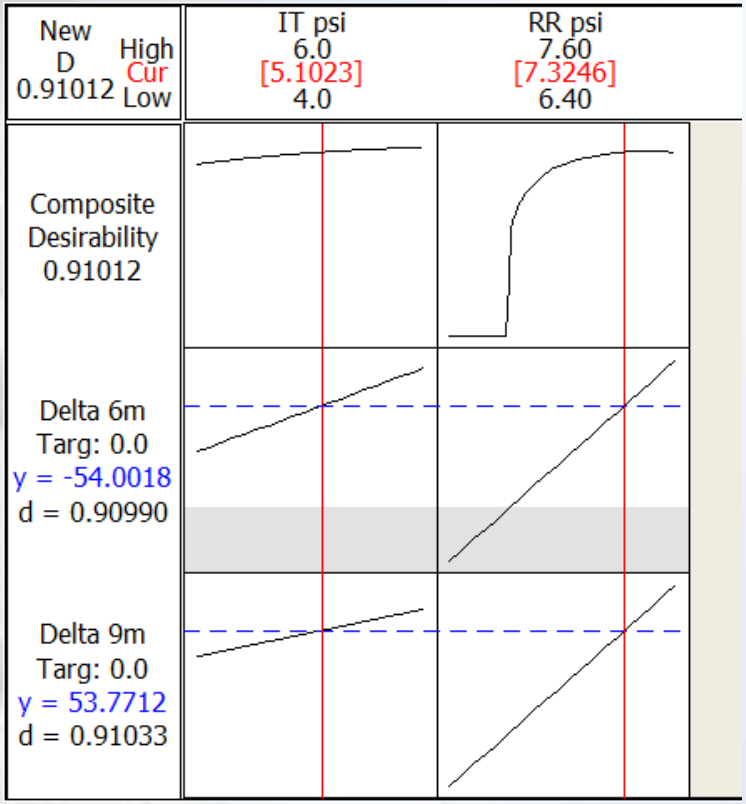
p = 0.05

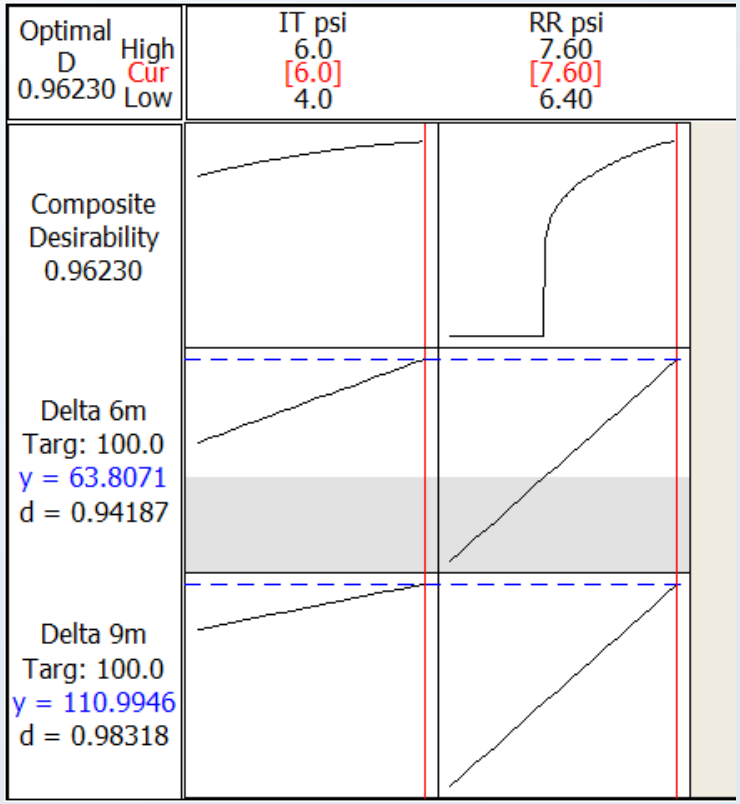
p < 0.01

Model Rsq = 0.94

Both parameters have smaller effect on 9mm rate

Optimization of 6mm and 9mm Rates





Best uniformity
Want 0
Fix shape instead

Flattest edge
Want +100
Go beyond IT of 6

Summary and Follow-up

- Back referenced carriers create limits on non-uniformity and edge tuning as well as rate and cost of ownership
- Upgrading legacy tools with original Titan carriers enables gains in non-uniformity and rate/CoO
- Modifications to Titan IT done at Axus enable edge tuning that was previously only possible with Profiler
- Tuning characterized for easy optimization

- Latest results to be tested on AlTiC wafers