

Hard Porous Pad™ for Copper CMP

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Thomas West, Inc.

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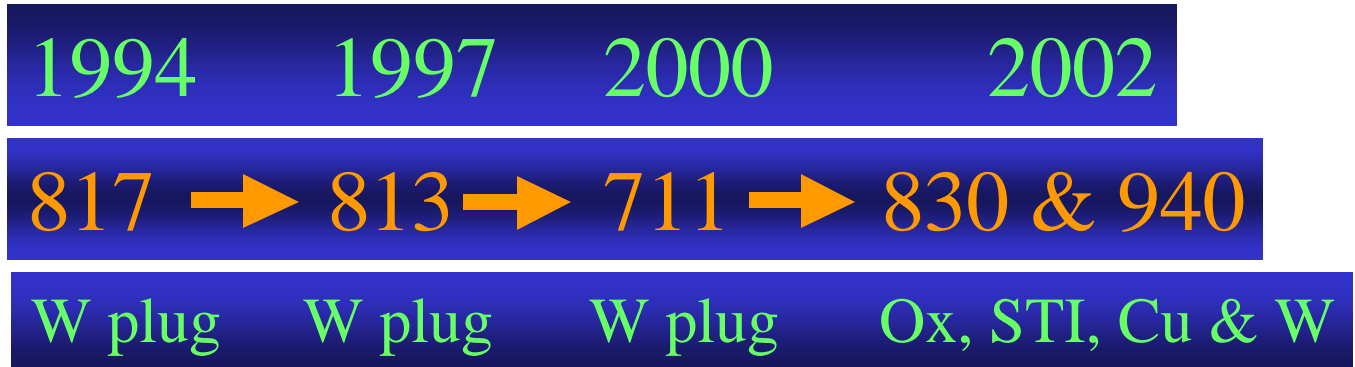
*Materials Development
for Process Excellence*

The logo consists of two thick, black, downward-pointing chevrons that are slightly offset from each other, with a small black dot positioned to the right of the upper chevron.

Introduction – Pad Classification

- Solid Polyurethane Sheet
 - Example: IC2000
- Polyurethane with void
 - Isolated void; e.g., IC1000, FX 9
 - Interconnected void
- Polyurethane with abrasive
 - Fixed abrasive pad / table
- Felt impregnated with polyurethane
 - *TWI: 817, 813, hard porous pads*; Rodel: Suba series
 - Pad properties can be tailored for specific application by adjusting porosity, ratio of polyurethane to fiber.
- Poromeric
 - *TWI: BP-30*; Rodel: Politex;

Evolution TWI Porous Pads

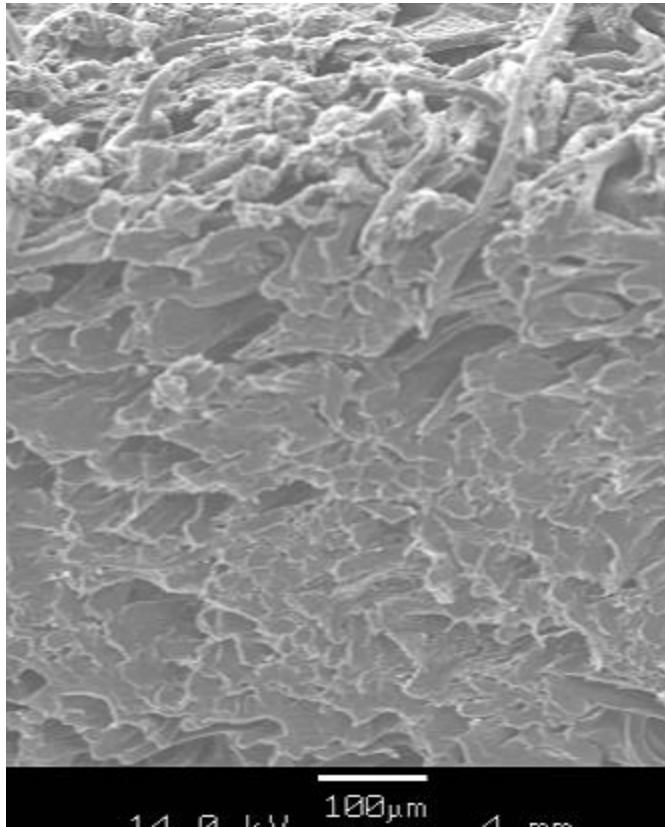


pad	817	813	711	830/940
Density / g/cm ³	0.35	0.37	0.59	0.61
Hardness / Shore D	70 (A)	30 - 35	49 - 55	51 - 57
Compressibility / %	4.5	2.4	2.3	2.2
Rebound / %	85	76	85	75

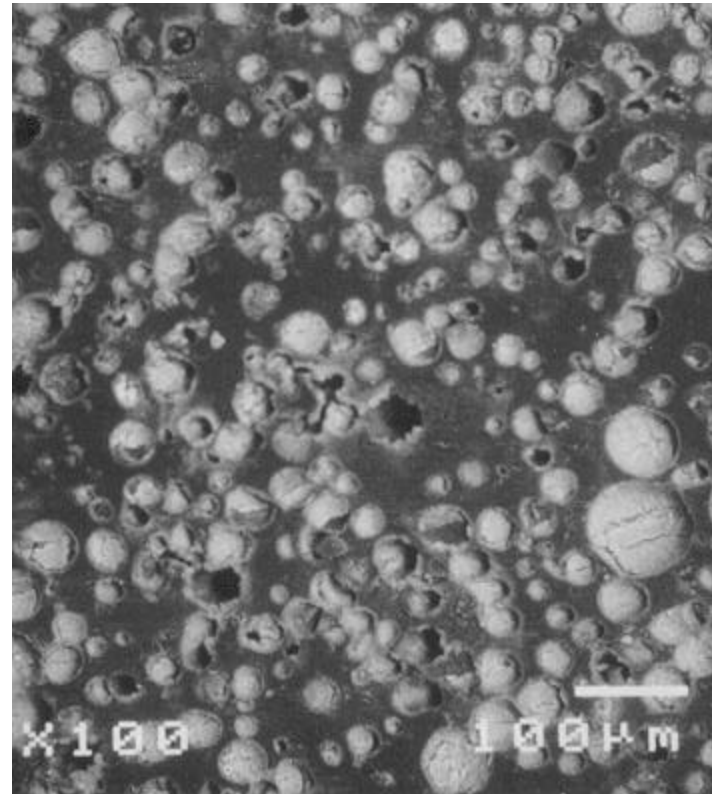
Hard Porous Pads

Appearance of Pads

TWI's Hard Porous Pad



Rodel's IC1000



Physical Properties

Property	Hard Porous Pad	IC 1000
Thickness / mm	1.2	1.3
Hardness / shore D	51 – 57	52 - 62
Density / g/cm ³	0.61	0.75
Compressibility / %	2.2	2.1
Rebound / %	75	73
Modulus / Mpa	250*	300 **
Pore Size / μm	10 - 100	10 -80

* Bulk modulus from compression measurement; ** storage modulus from DMA @ 40 °C.

Impact of Fiber on Pad Properties

- Create continuous pore (inter-connect pore)
 - RR, NU, defect
- Improve mechanical properties of pads*
 - Hardness: 51 – 57 for hard porous pad; ~46 for IC 1000 if density = 0.61 g/cm³.
 - Modulus: IC 1000's storage modulus will become 200 Mpa if the density = 0.61 g/cm³.

*James D. CAMP 5th International CMP Symp. Aug. 2000

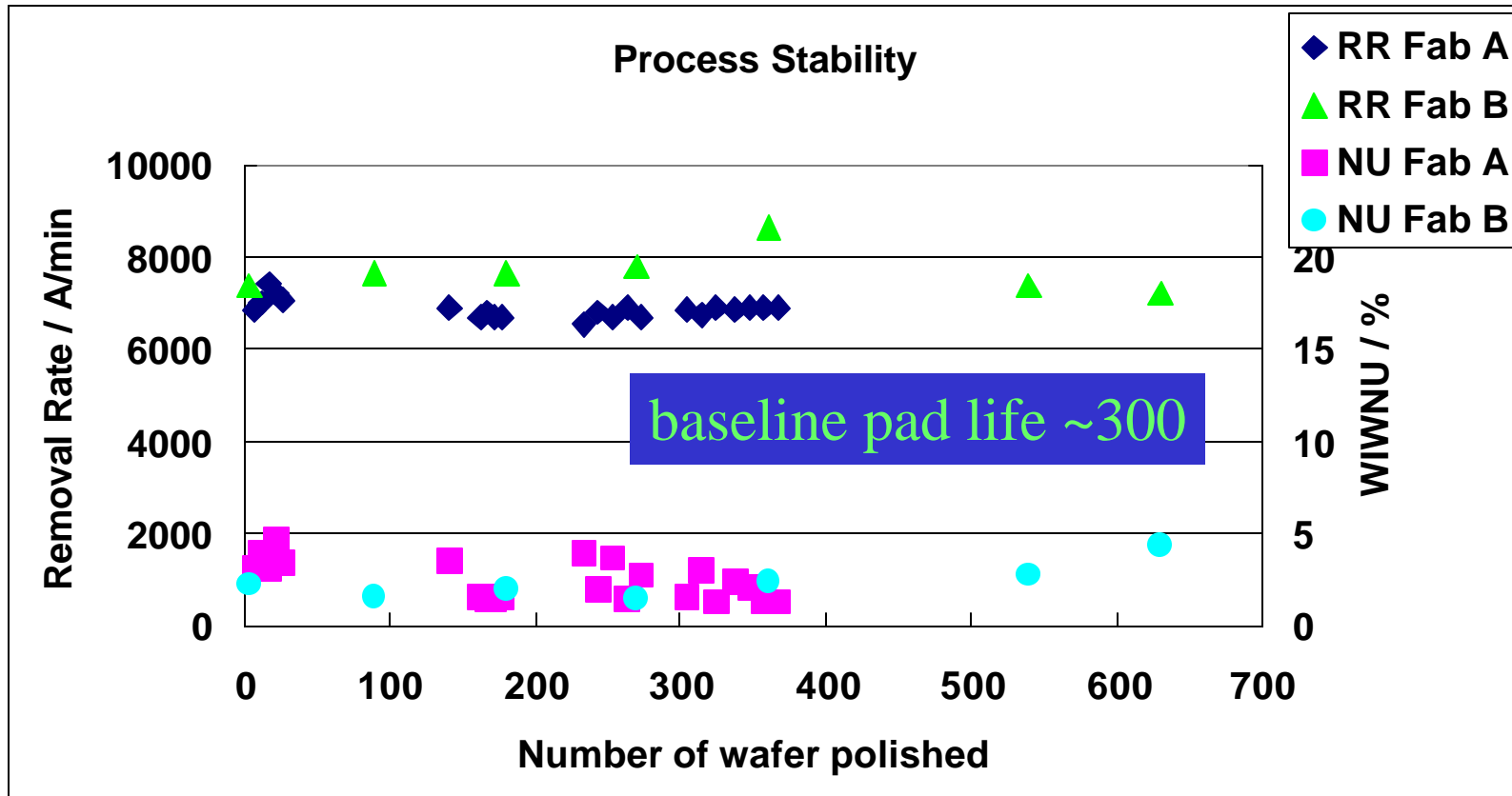
Effect of Pad Properties on Polishing Performance

- Removal rate:
 - slurry transport; slurry retention capability
- NU
 - Slurry transport; pad hardness; compressibility
- Defectivity
 - Pad hardness; capability to remove polishing residue
- Planarity / dishing - erosion
 - Pad hardness; modulus; stiffness
- Pad life
 - Conditioning method, thermal stability

Features of Hard Porous Pads

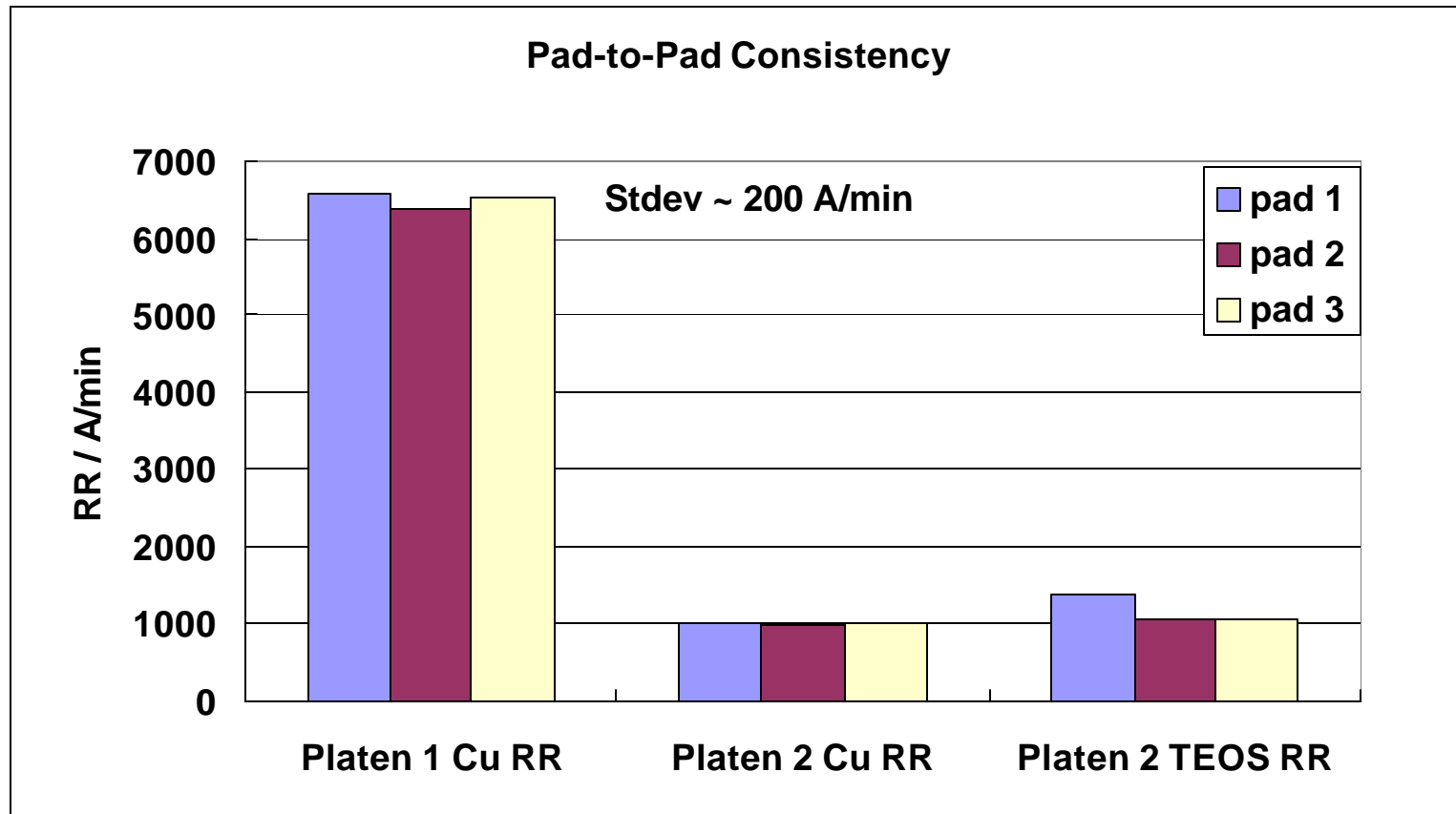
- Excellent lot-to-lot, pad-to-pad consistency
- Open pore structure improves slurry transport
 - Can operate at significantly lower flow rate
 - Better non-uniformity
- Open pore structure becomes easier to remove polishing residue
 - Lower defect
- Requires minimal break-in and conditioning
 - Reduce tool down time
 - Extend conditioner lifetime
 - Longer pad life

Lot-to-Lot Consistency



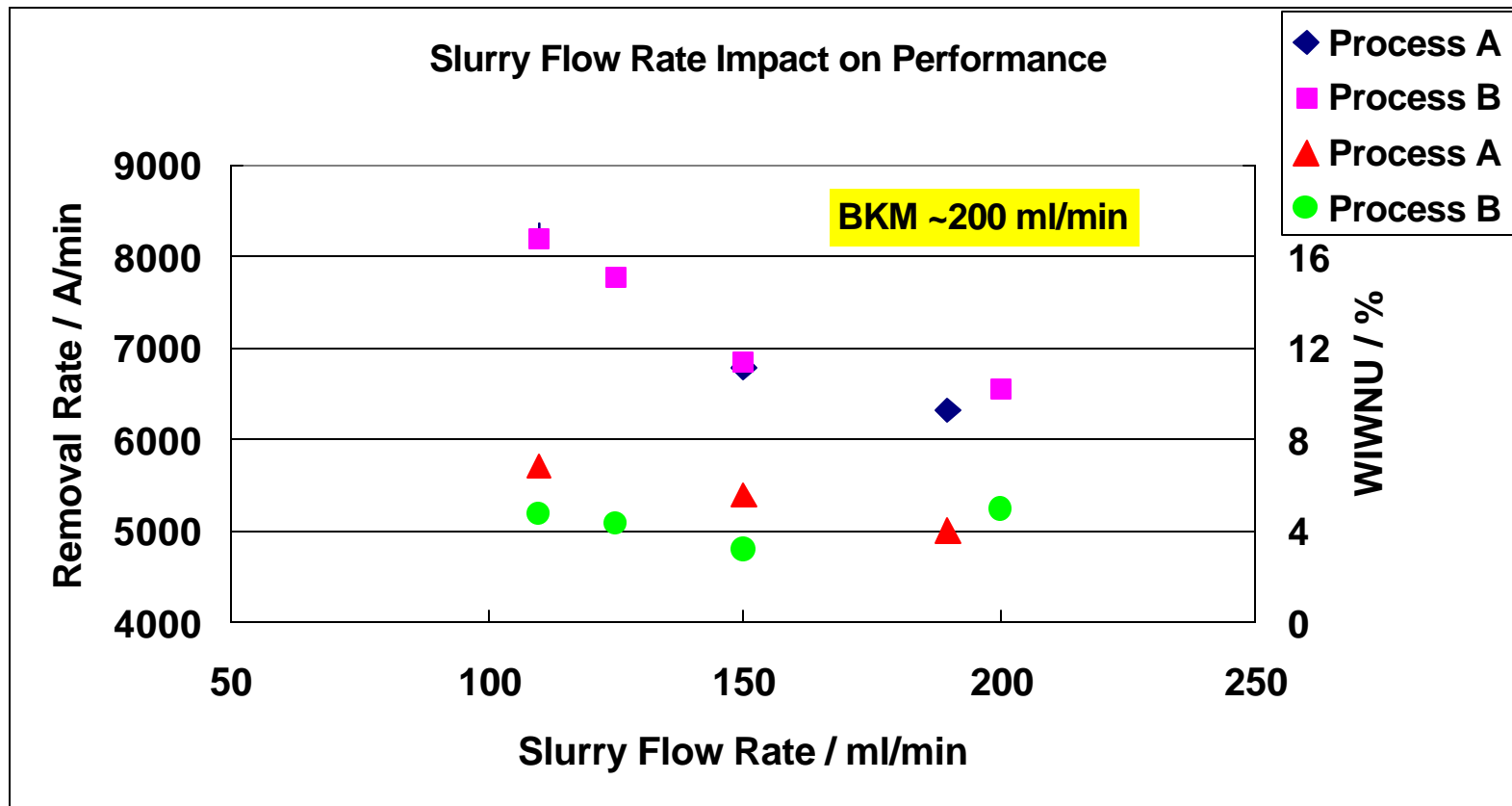
Pads used at fab A and B are from different lots.

Pad-to-Pad Consistency



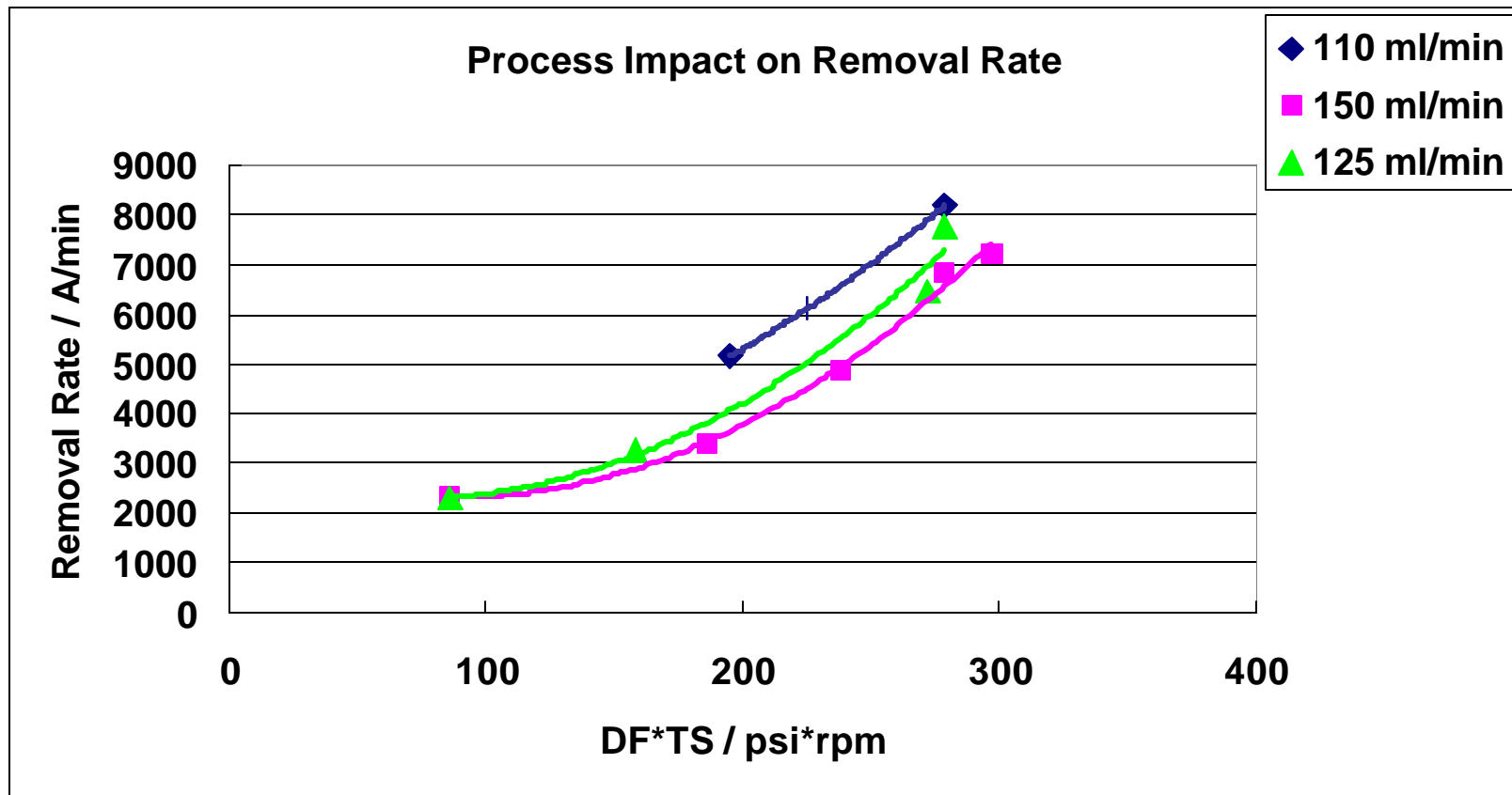
Icue-5001 (P1) / 10K-2 (P2) / Mirra @ 3 psi

Slurry Flow Rate Impact on Performance



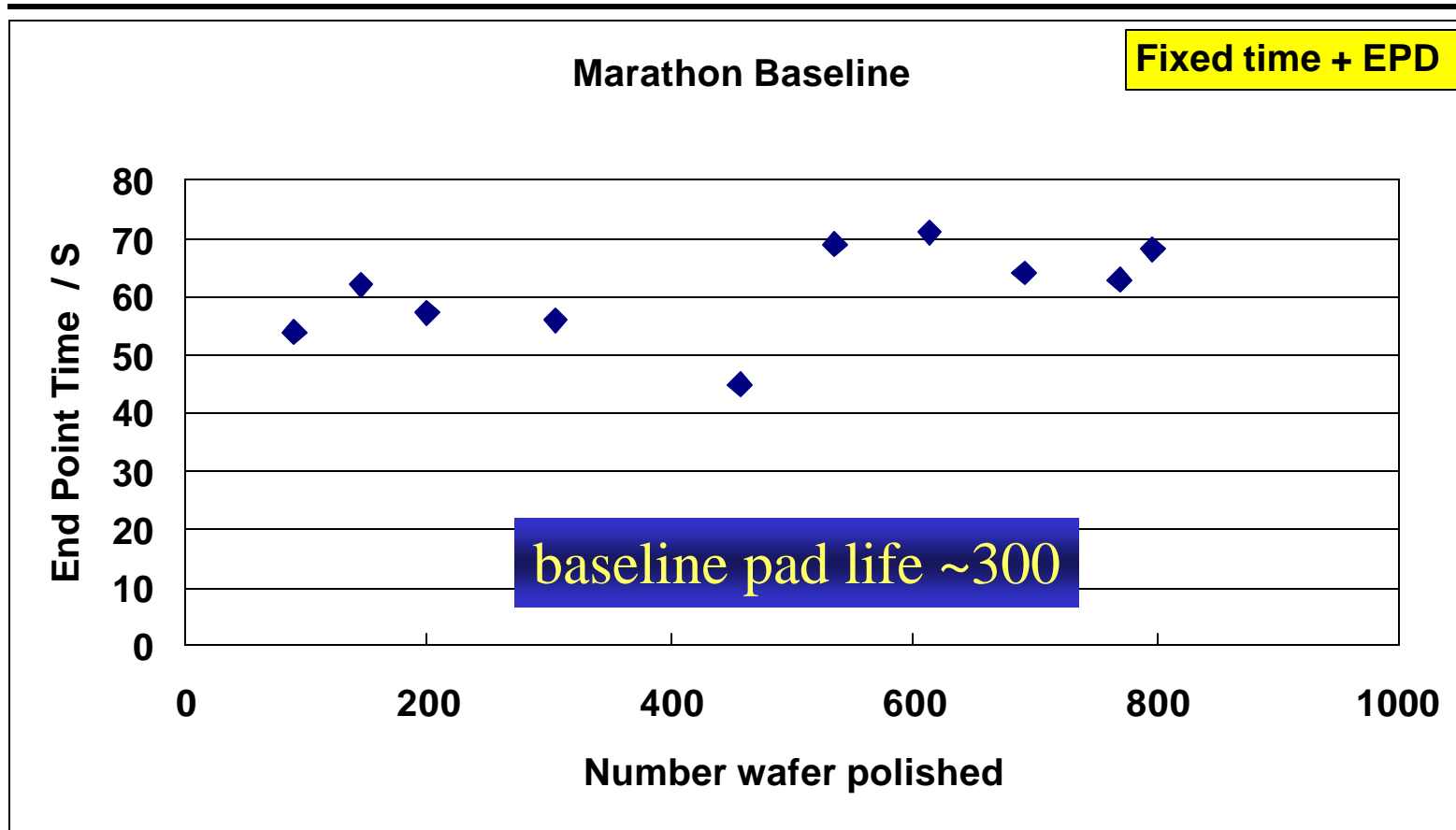
Hard Porous Pad can operate at wide range of slurry flow rate.

Process Tunability



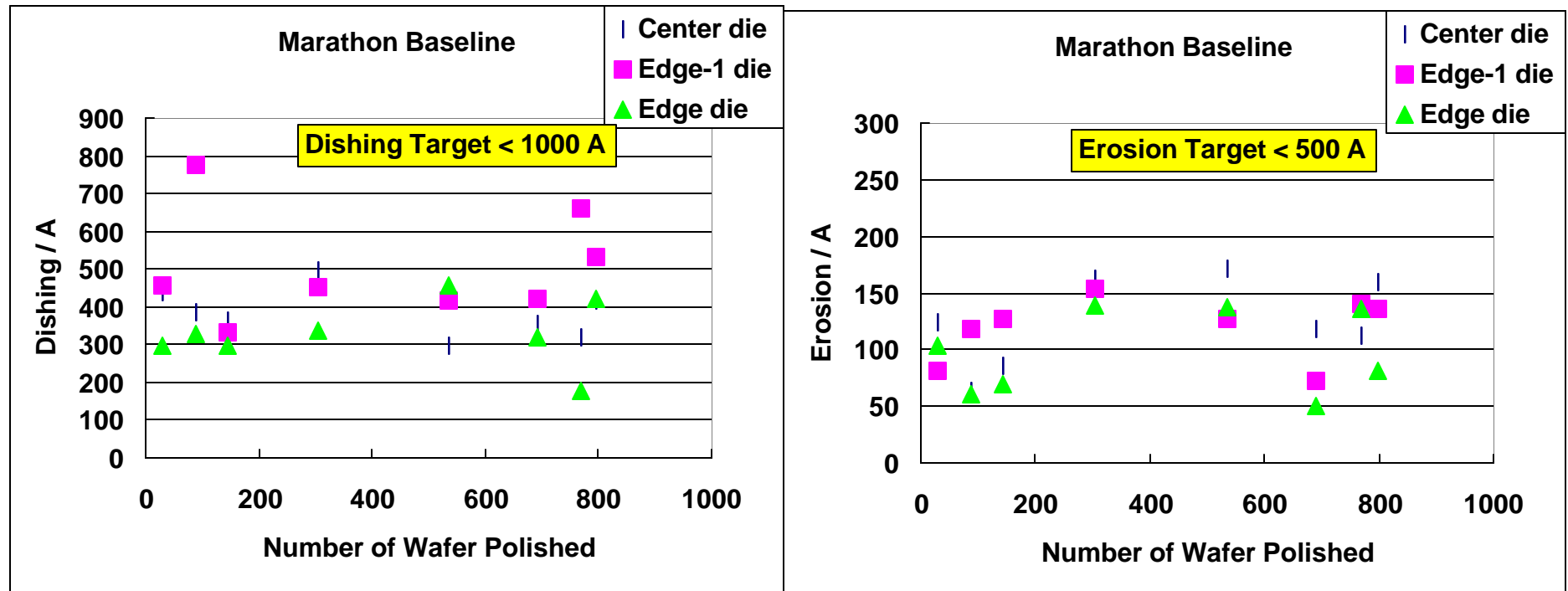
Polishing behavior does not follow Preston at full process range.

Performance Stability



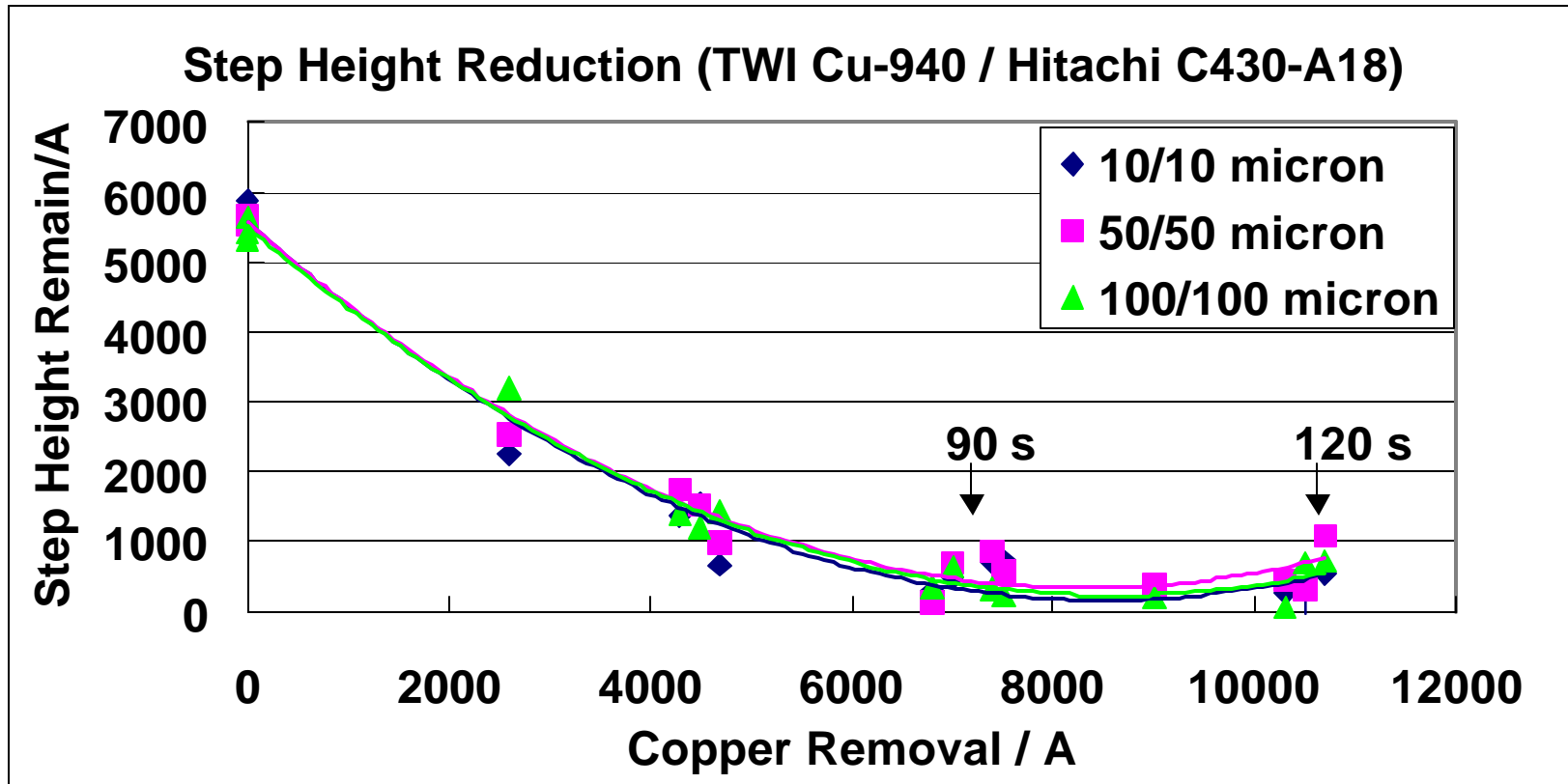
Icue-5001 / Mirra

Pattern Wafer Performance



Icuc-5001 for copper removal / 10K-2 for barrier removal / Mirra

Compatible with Different Slurries



Copper removal only / IPEC 472

For Barrier Removal Application

TWI Cu-940 / Hitachi HS T805-1A

H ₂ O ₂ Process	1.20%		2.00%		3.00%	
	Cu	TEOS	Cu	TEOS	Cu	TEOS
2 psi; 93/87; 150 ml/min	184	526	169	474		
2 psi; 93/87; 200 ml/min	291	558	313	431	376	403
3 psi; 93/87; 150 ml/min	620	884	546	768		

Selectivity can be tuned by changing:

Peroxide concentration

Slurry flow rate

Process parameters

Summary

Wish list

Performance:

- Good RR and NU
- Low defect
- Low dishing and erosion
- Easy to use (conditioning)
- Stable performance

Cost:

- Long pad life
- Minimal slurry flow rate
- Cheap
- Gentle conditioning

Hard Porous Pad offers:

Performance:

- Excellent consistency
- Good RR and NU
- Low dishing and erosion
- Easy to use (conditioning)
- Very stable process

Cost:

- High throughput
- Longer pad life
- lower slurry usage
- Longer conditioner life