



# **Advanced Slurry/Pad Technologies for Cu/Low-K CMP Process**

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# General Requirement

to CMP process for **65nm-generation and beyond.**

- Soft polishing to prevent damage of delicate film stack and structure with low-k dielectric materials
- Higher planarity...Low dishing / erosion
- Faster bulk polishing for higher through-put
- Low defects

# Causes of Scratch

Contamination of large particles

Uncontrolled shape and morphology of abrasives

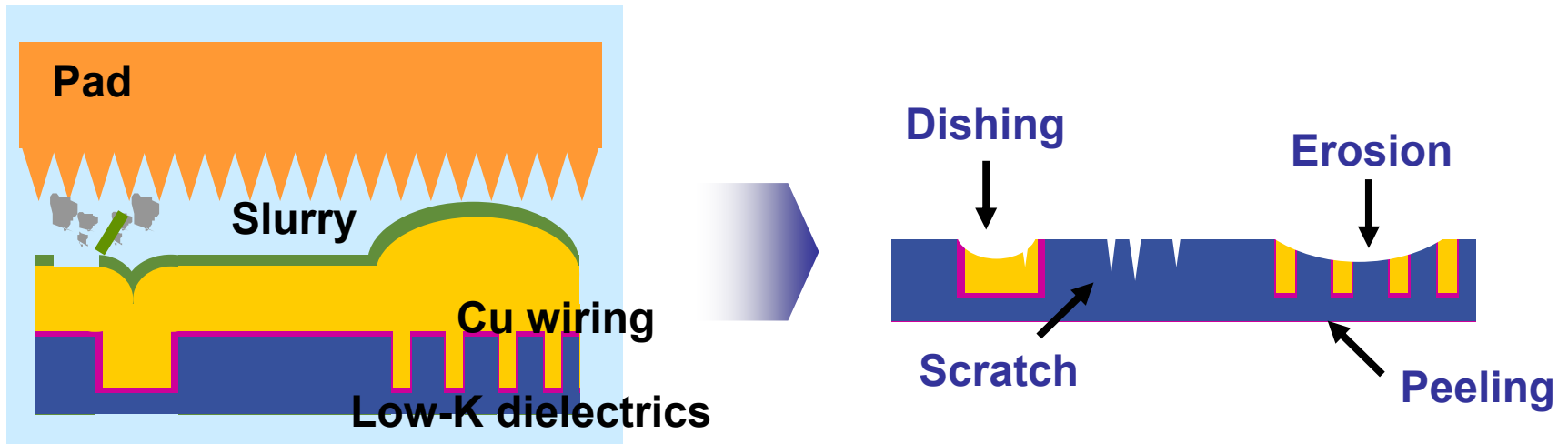
Uncontrolled surface status of pad

Scum (cleanliness)

Coagulation and precipitation of ingredients and polished materials by sudden pH change during the process

Unnecessarily high down-force

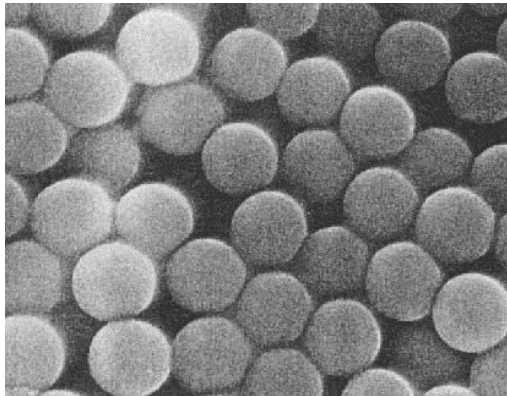
# Requirement for Cu/Low-K CMP Process



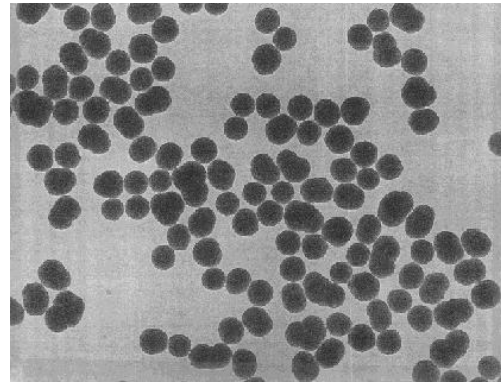
- Minimal Low-K Damage and Less Scratches
- High Planarity • Fast Removal Rate

➔ ***Approach by Slurry/Pad Technology***

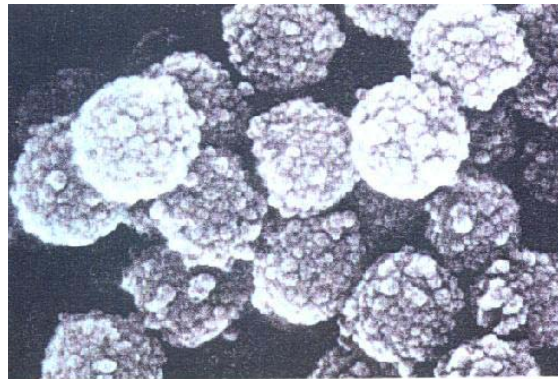
# Soft-brasive™ Technologies



**Polymer Abrasives**



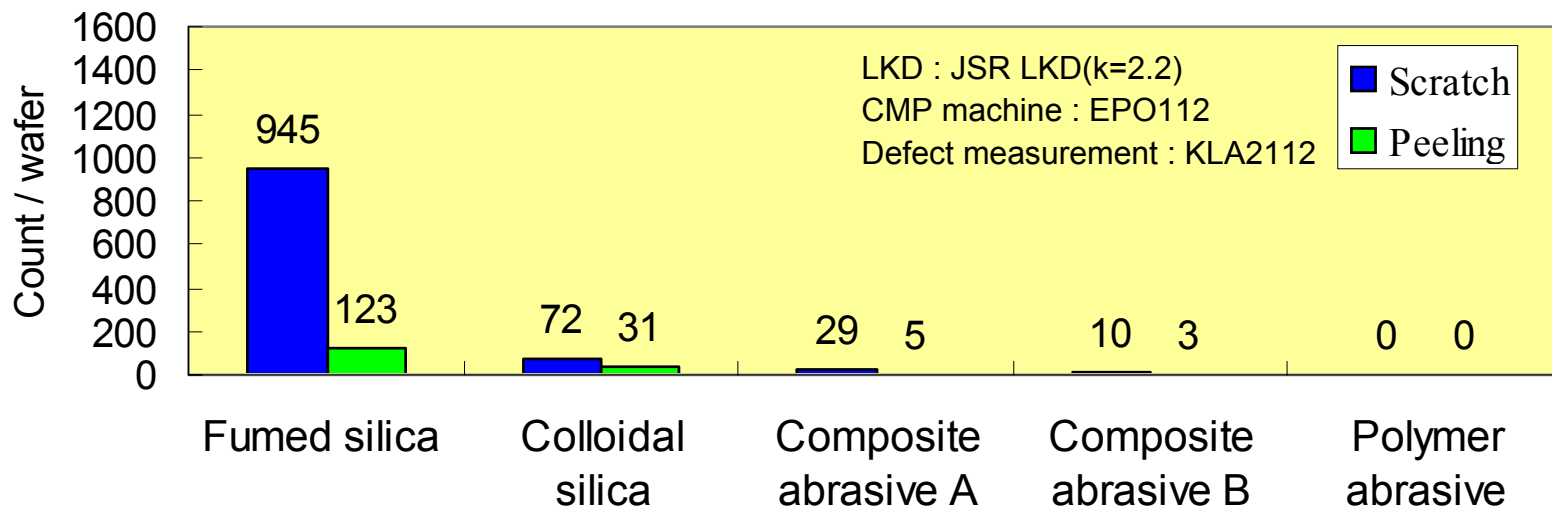
**Colloidal Silica Abrasives**



**Composite Abrasives**

- Totally controlled shape and morphology
- Minimized large particle formation by well-established production process
- Cushion effect to local high down-force

# Scratch Counts by Various Abrasives



	Fumed silica	Colloidal silica	Composite abrasive A	Composite abrasive B	Polymer abrasive
TaN-RR (A/min)	945	625	760	235	65

***Soft-brasive™ Technologies accomplish less scratches and Low-K damages.***

# High Performance Cu Slurries

- Chemicals

For scratch prevention

*Stabilization of polished material to prevent coagulation and precipitation*

For high planarity / fast removal rate

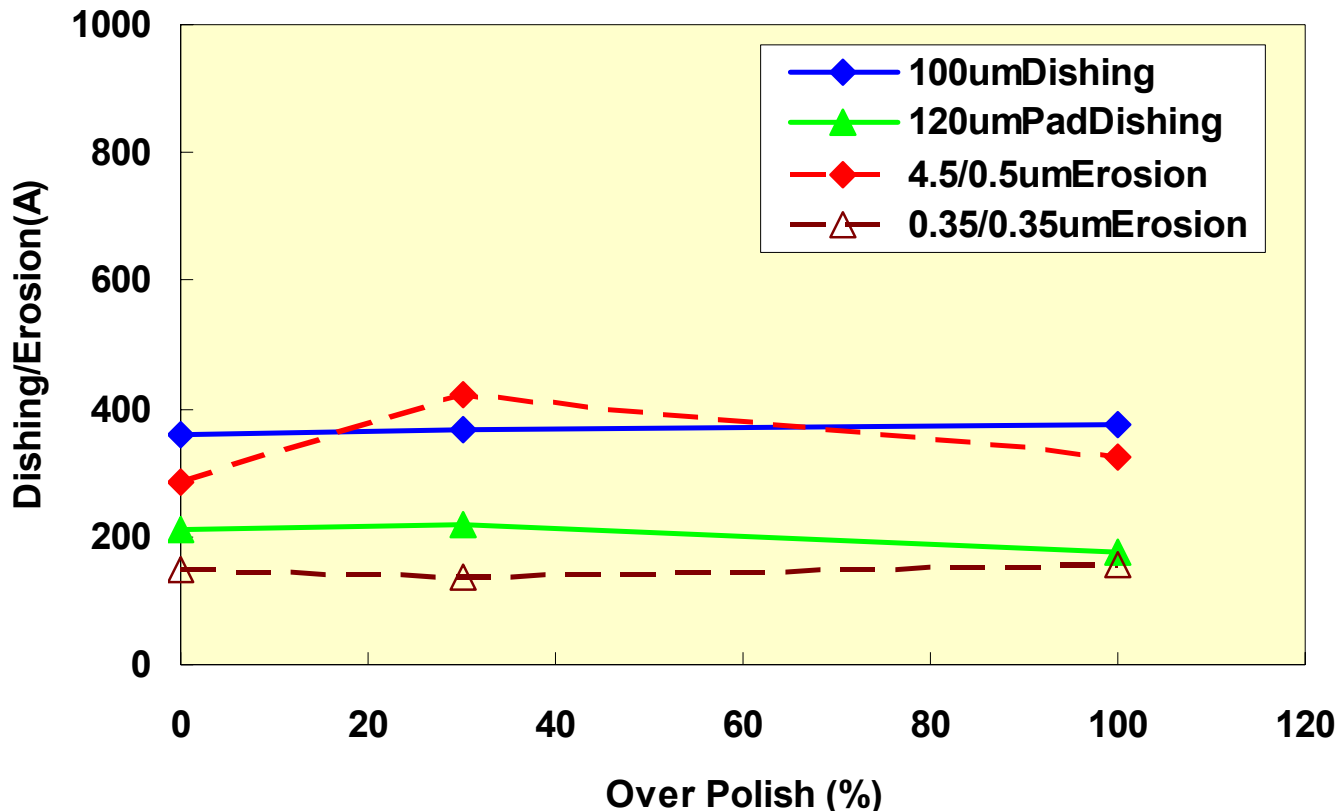
*Controlling the etching rate to prevent dishing and erosion.*

*Controlling the strength of passivation layer on the Cu surface.*

## **JSR CMS7400/8400 series**

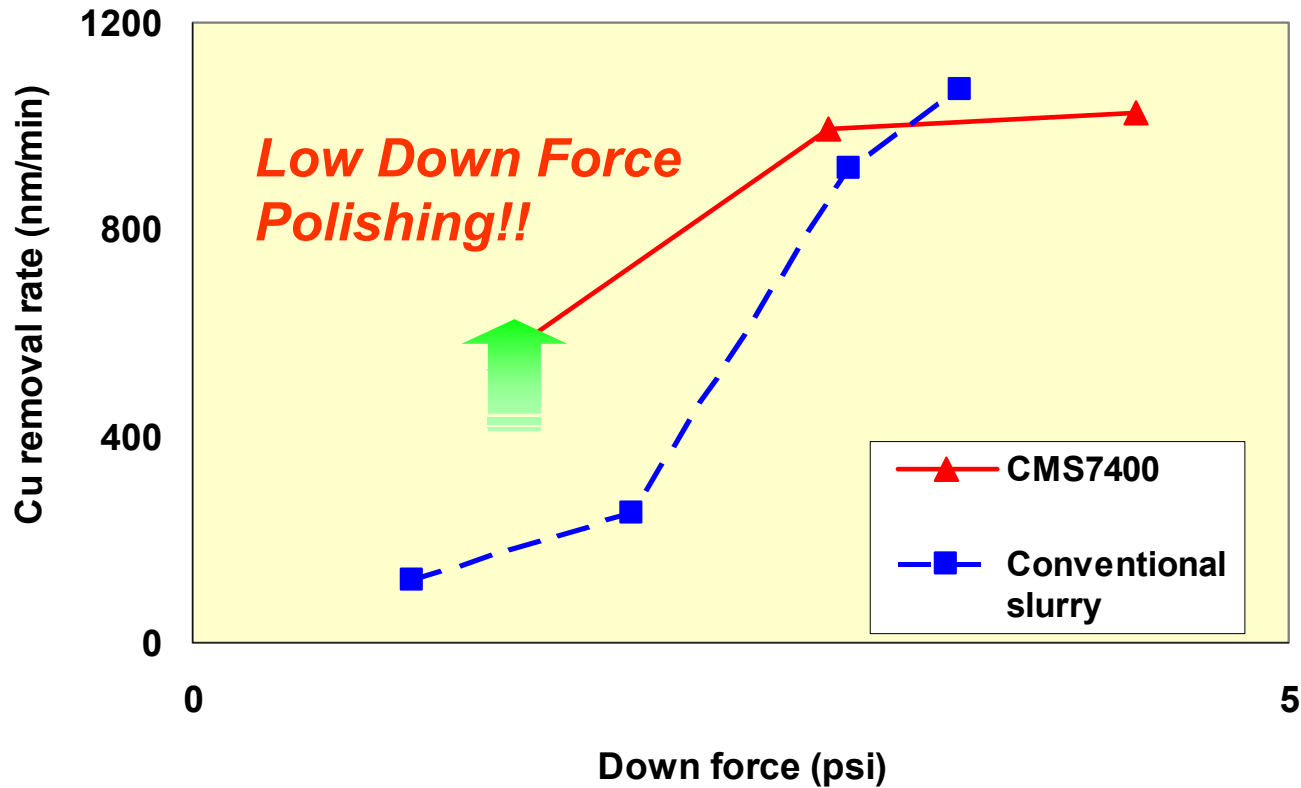


# Dishing/Erosion Performance with Over Polish Margin (Cu Polish)



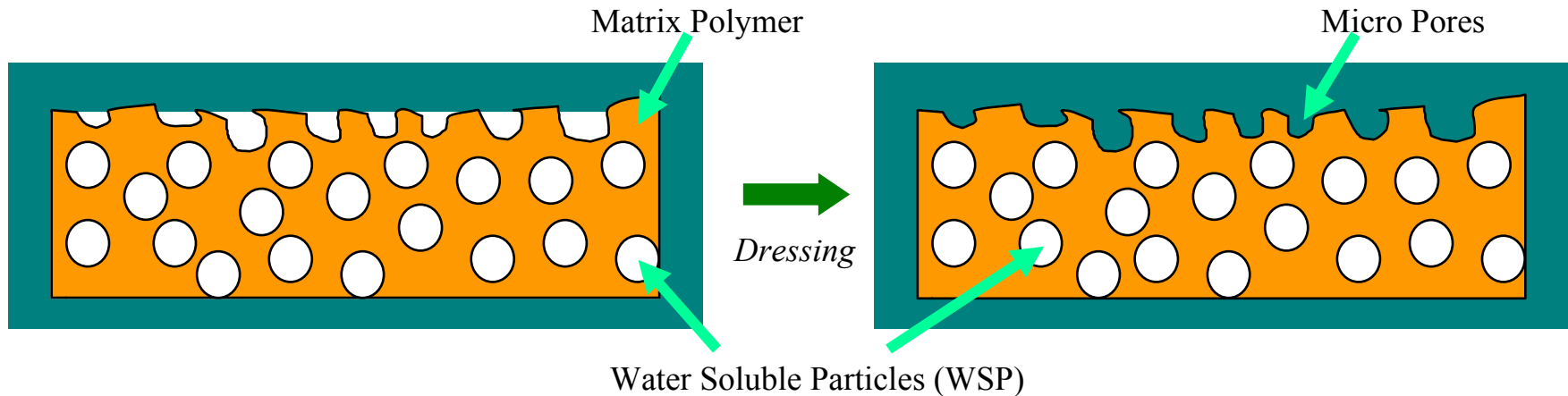
***CMS7400 series exhibit excellent Dishing/Erosion performance with wide over polish margin.***

# Down Force Dependency



***CMS7400 series shows smaller down force dependency.***

# Innovative Technology of JSR CMP Pads

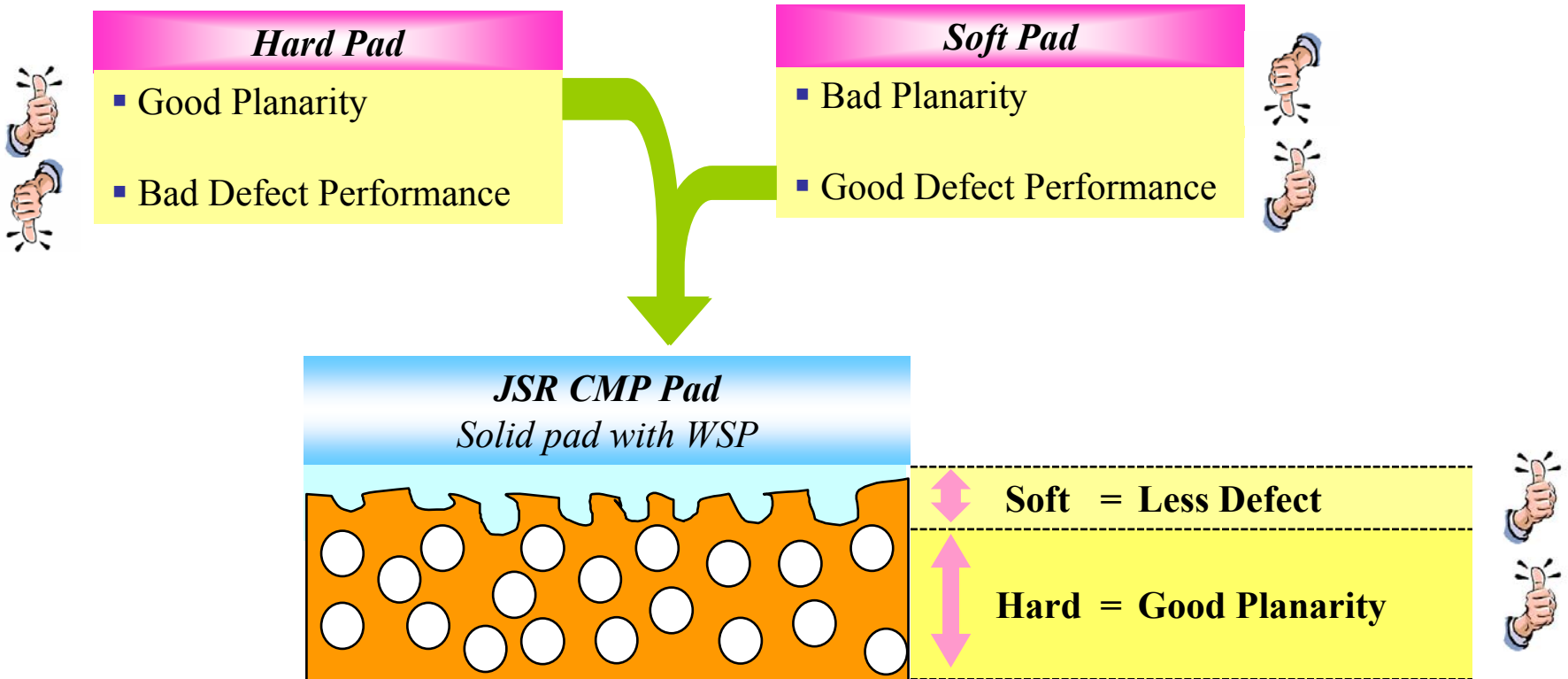


## JSR's Innovative Solid Pad

- When exposed to polishing liquids, the water soluble particles (WSP) at the pad surface dissolve, forming micro pores.
- WSP in the pad bulk remains solid so the pad maintains a very low compressibility providing superior planarization efficiency and consistent pad-to-pad quality
- The size, shape and distribution of the pores are well-controlled, being directly related to WSP particle size, shape and dispersion.



# Low Defect & Good Planarity Concept



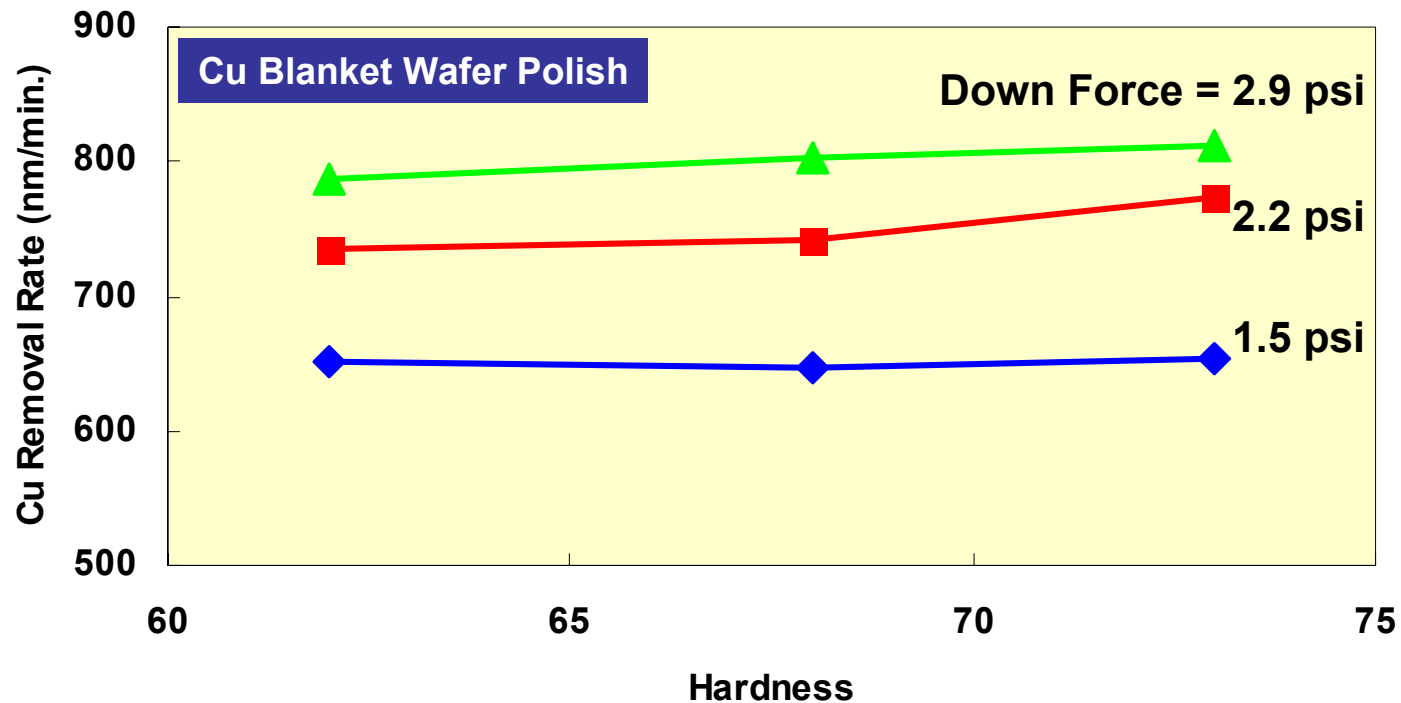
- JSR Pad: Excellent defect performance without sacrificing RR/Planarity performance.

# Hardness vs. Scratch



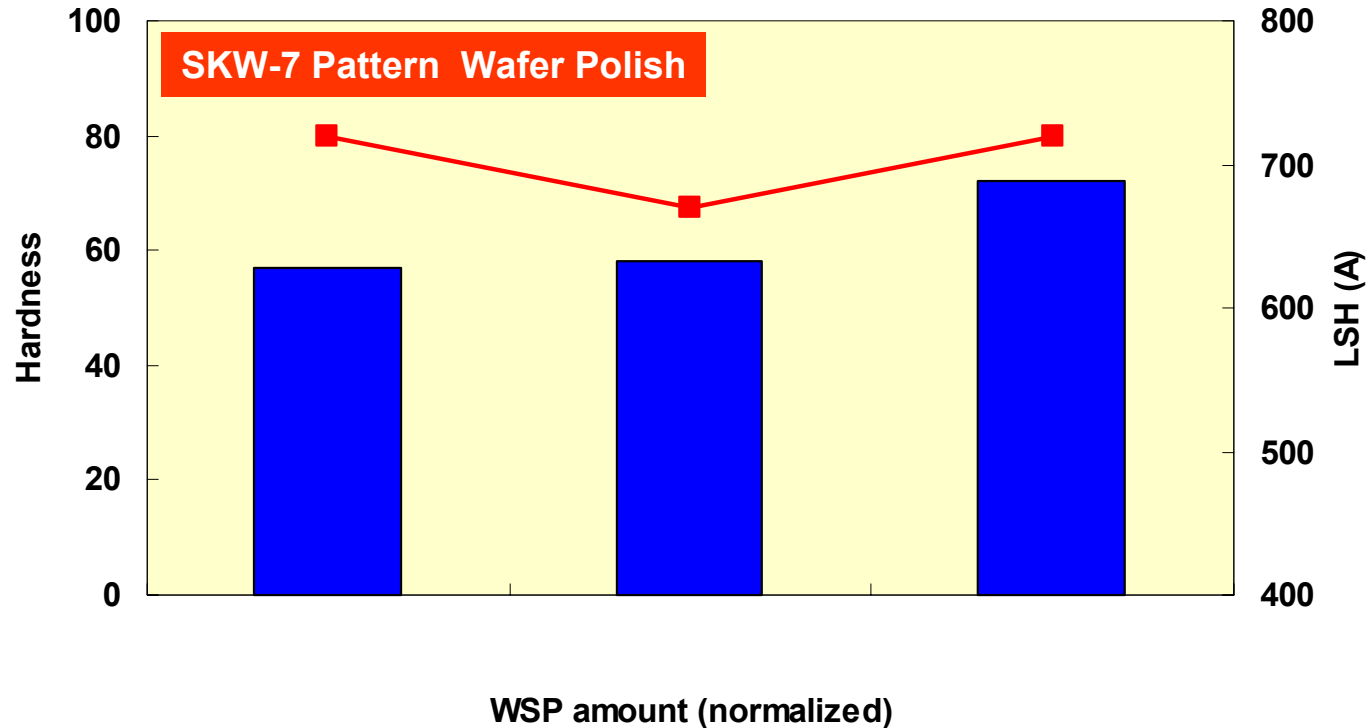
***Reduction of the hardness affects the scratch counts***

# Hardness vs Removal Rate



***Surface micro pore structure maintains the constant removal rate over the variation of hardness.***

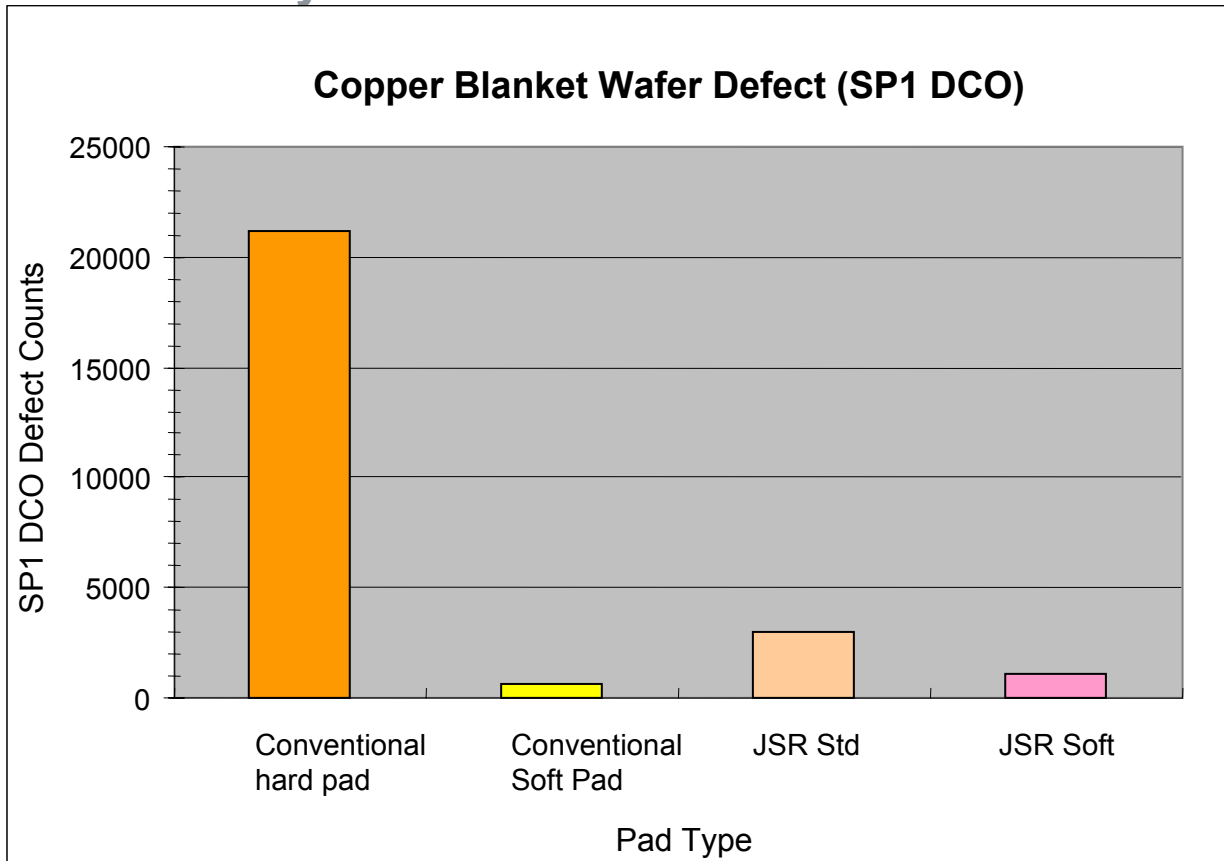
# WSP amount vs. Hardness/Planarity



*The polymer matrix reinforced by WSP gives wide margin of planarity over the deviation of bulk hardness.*

# CMP Pad Defect Comparison

## Barrier Slurry Evaluation



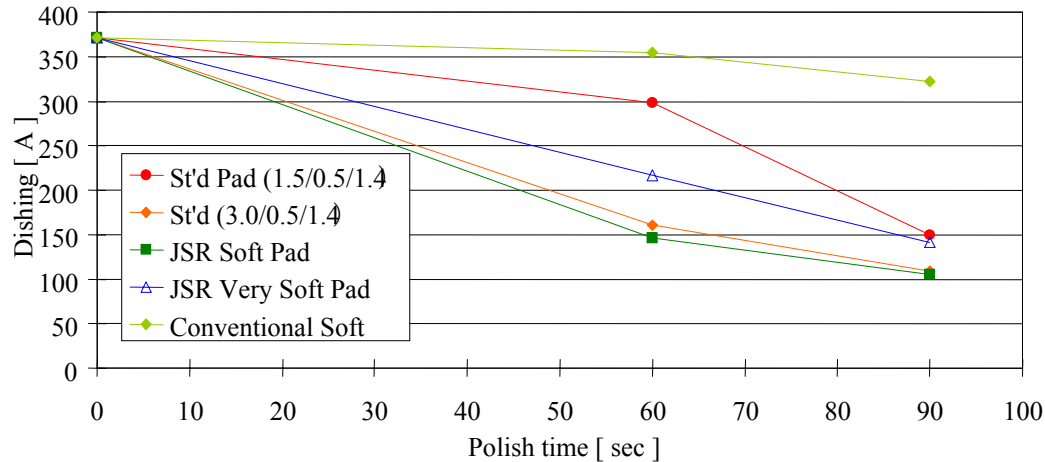
- Polishing conditions
  - Polisher: Mirra Mesa
  - Slurry: JSR Barrier Slurry
- Defect evaluation
  - SP1 tbi
  - Low throughput
  - High Sensitivity recipe (calibrated on silicon):

- The defect level of JSR pads is more than 10x less than conventional hard pad.
- Defect level of JSR soft pads are close in performance to conventional soft pad.

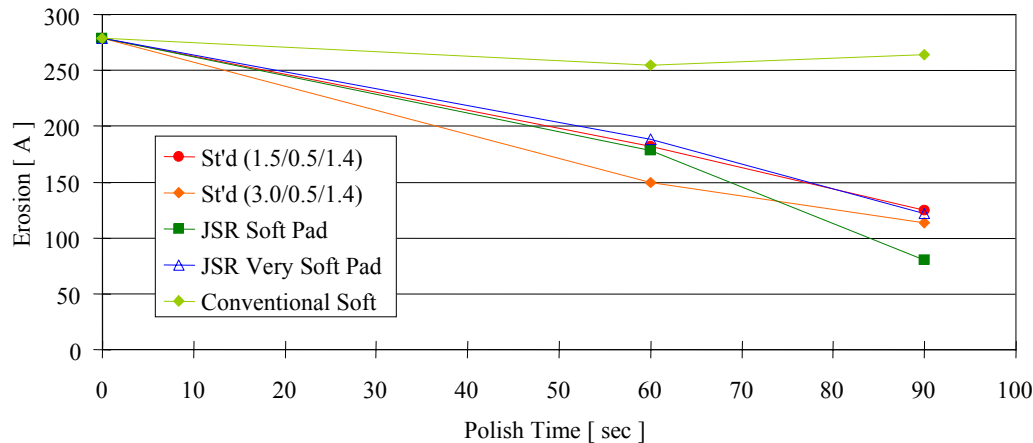


# Dishing/Erosion Comparison

100/100 Dishing (Mask831)



4.5/0.35 Erosion (Mask831)



- JSR pads show better topography correction compared with conventional soft pad.
- JSR standard and soft pads show comparable performance.

# CMP Process for Cu/Low-K

Scratch and  
Low-K Damage

***Filler Pad Technology***

High Planarity

***JSR CMS7400  
/8400 series***



***Advanced Cu/Low-K CMP Process***

## Cu CMP using CMS7400/Filler Pad

	Cu Polish
Cu RR (A/min)	10,020
WIWNU (%)	1.8
End Point Time (sec)	127
Over Polish (%)	20
Dishing [A] (L/S=100/100)	404
Dishing [A] (120um pad)	160
Erosion [A] (L/S=4.5/0.5)	279
Erosion [A] (L/S=0.35/0.35)	116

***High Cu removal rate and good uniformity***

## Barrier Metal CMP using CMS8400/Filler Pad

	Barrier Metal Polish
Cu RR (A/min)	404
Ta RR (A/min)	884
TaN RR (A/min)	1,360
Polish Time (sec)	60
Dishing [A] (L/S=100/100)	98
Dishing [A] (120um pad)	22
Erosion [A] (L/S=4.5/0.5)	170
Erosion [A] (L/S=0.35/0.35)	56
Scratch Counts (OM)	6

***Excellent planarity and less scratches***

# Conclusions

- *High Performance Slurries* exhibit excellent Dishing/Erosion performance and high Cu removal rate.
- Pad surface control is the key technology for less scratches. JSR proprietary *Filler Pad Technology* enables the soft and controlled micro-pore structured surface for less scratches while maintaining sufficient removal rate and planarity.
- *Advanced Cu/Low-K CMP process is proposed using the combination of High Performance Slurries with Filler Pad Technology.*