

Your Global Partner in Material Solutions™

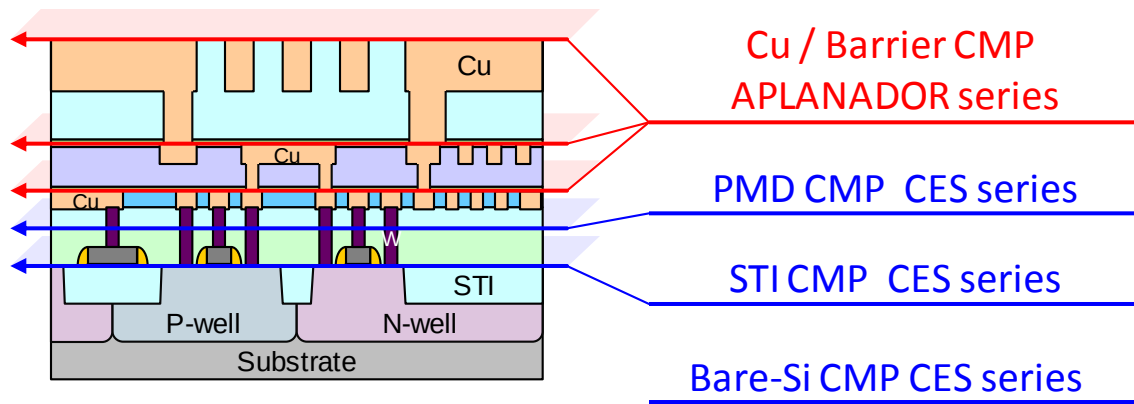
Front-end, Back-end and Substrate Slurries: Key Process Data and Advantages

Current Products

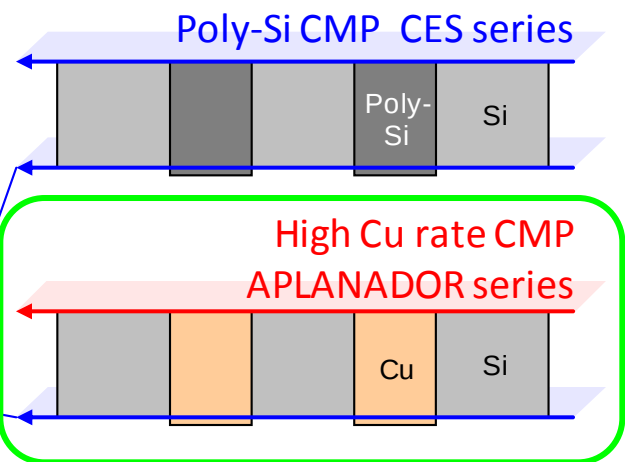
- Ceria Slurry
 - STI/RMG process (used for 22nm HVM)
 - Poly Si CMP: high rate and selective to oxide and SiN
 - Poly Stop – High TEOS/Poly selectivity
 - TSV – Backside: Tunable Cu, TEOS rate
- Cu Slurry
 - TSV: Frontside: high Cu rate, Cu/Ta, Ti ratio
 - Cu : High planarization on soft pad
- Barrier: Customized for integration
- Sapphire: good Ra, low cost
- SiC: good Ra

Device Integration and Polishing applications

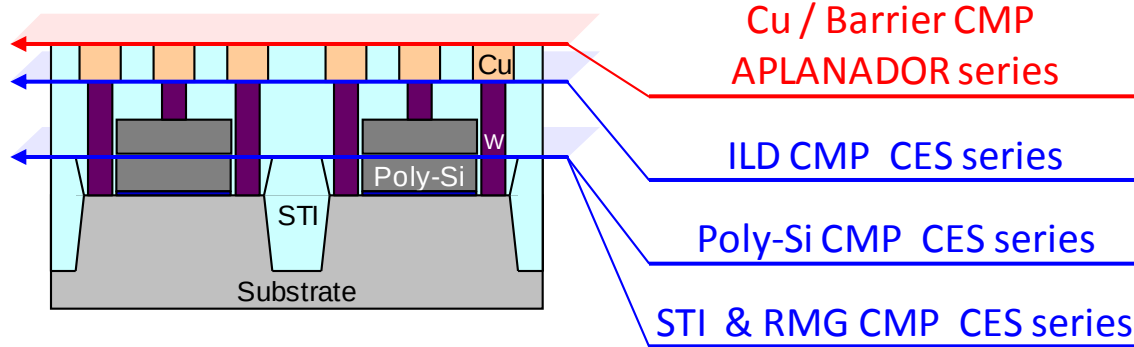
Logic application



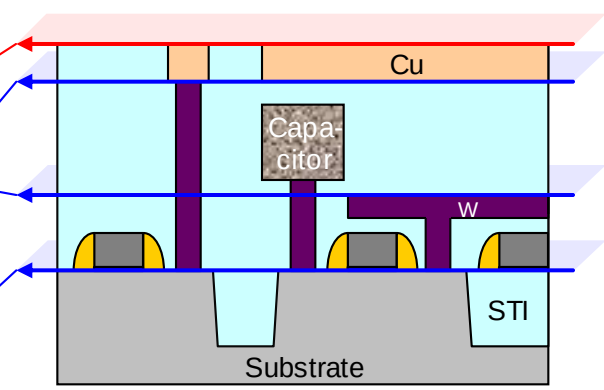
TSV application



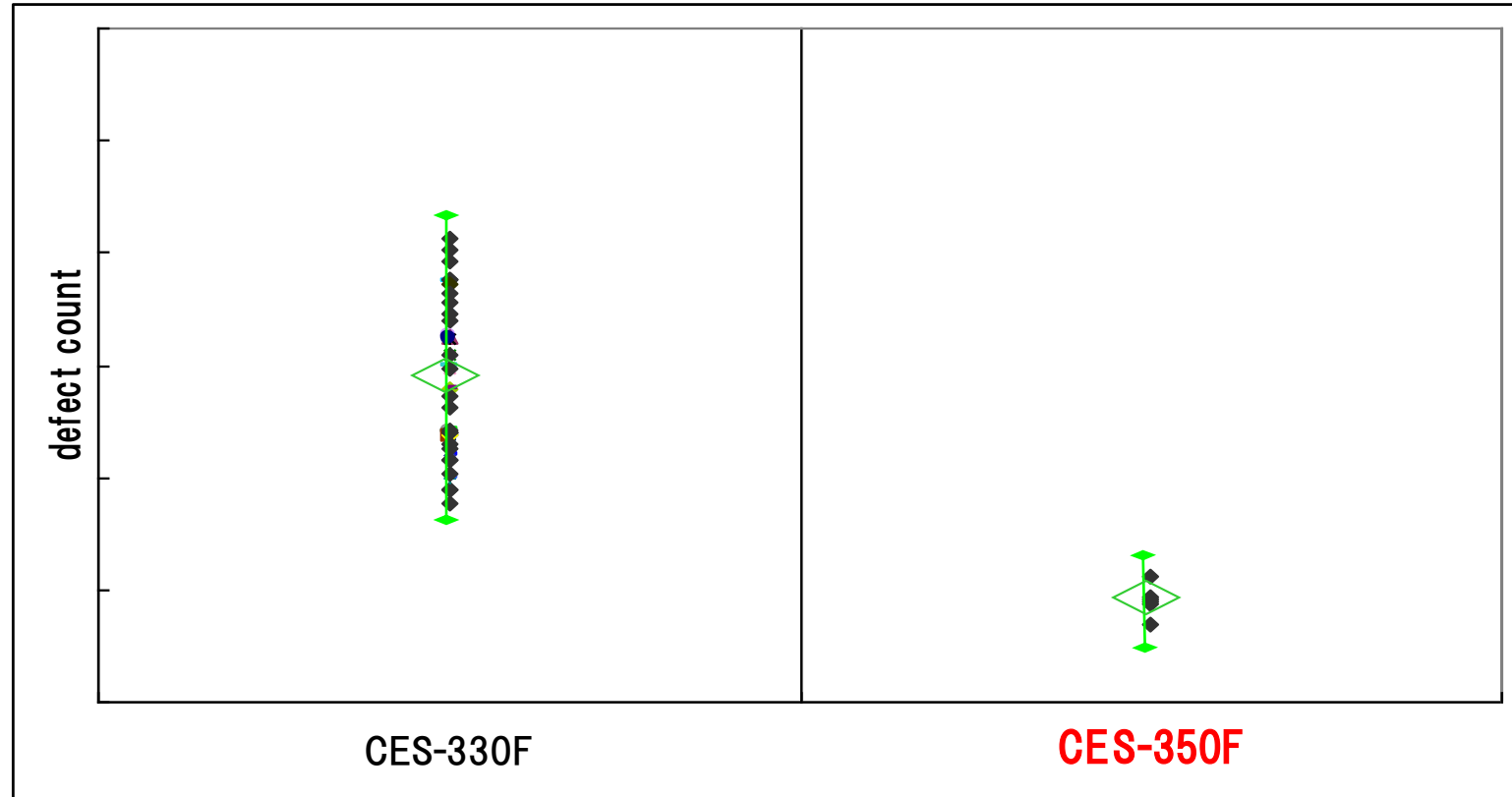
Flash application



DRAM application



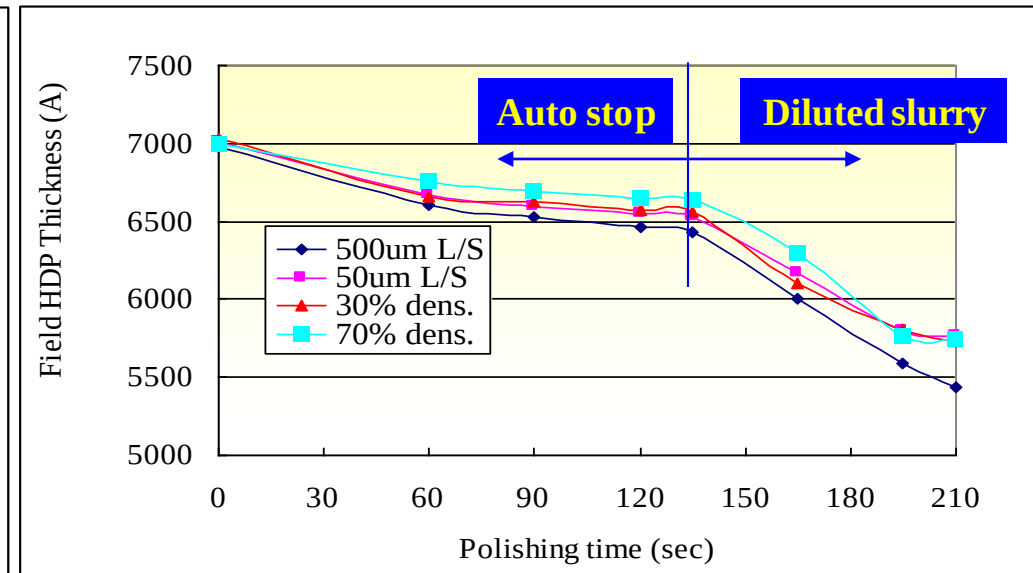
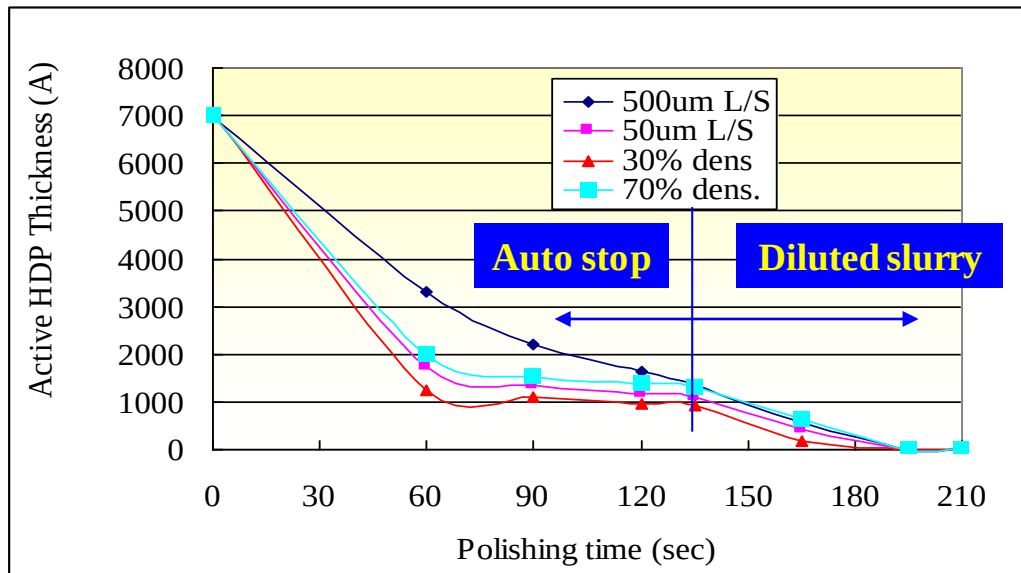
Comparison of defect count as a function of ceria particle size



The CES-350 abrasive show 1/3 of the defectivity for CES-330 abrasive.

CES 333F series type slurry for STI and RMG

Step Height Reduction and Overfill Removal:



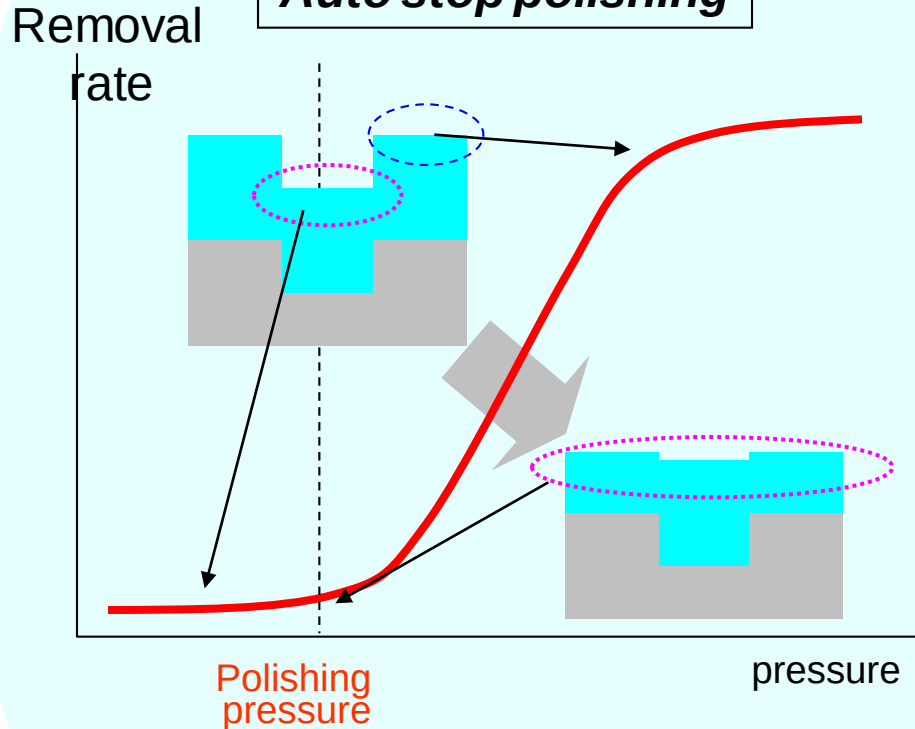
- CES-333-2.5 demonstrated auto-stop properties.
- Thick overfill cleared by dilute slurry polishing.
- High selectivity to SiN

Additive chemistry engineering for improved planarization: Concept of higher planarity polishing slurry

Higher planarity

- smaller dishing (range)
- smaller SiN loss (range)

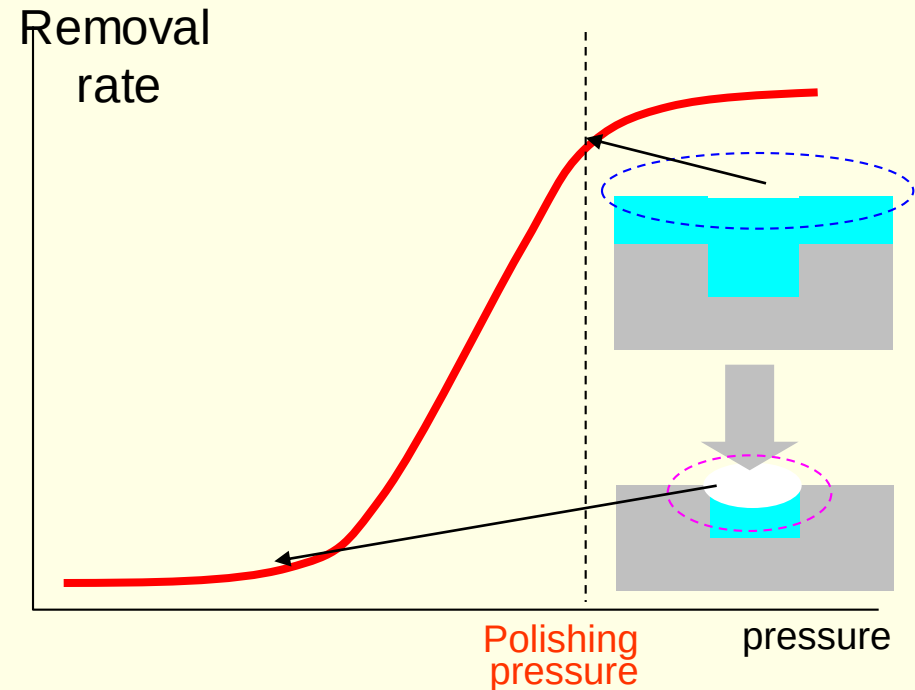
Auto stop polishing



Threshold > polishing pressure

Removal rate would be lower,
when step height cleared.

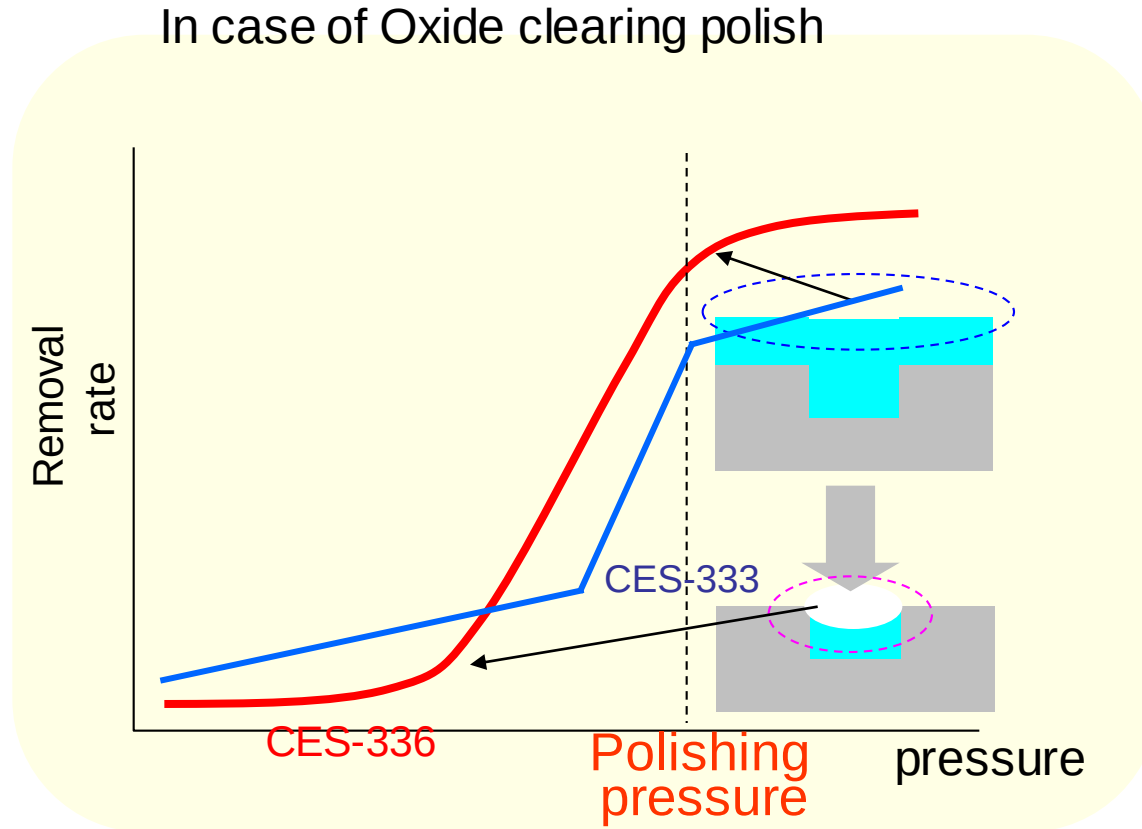
Low dishing polishing



Threshold < polishing pressure

Removal rate would be lower,
when dishing occurred.

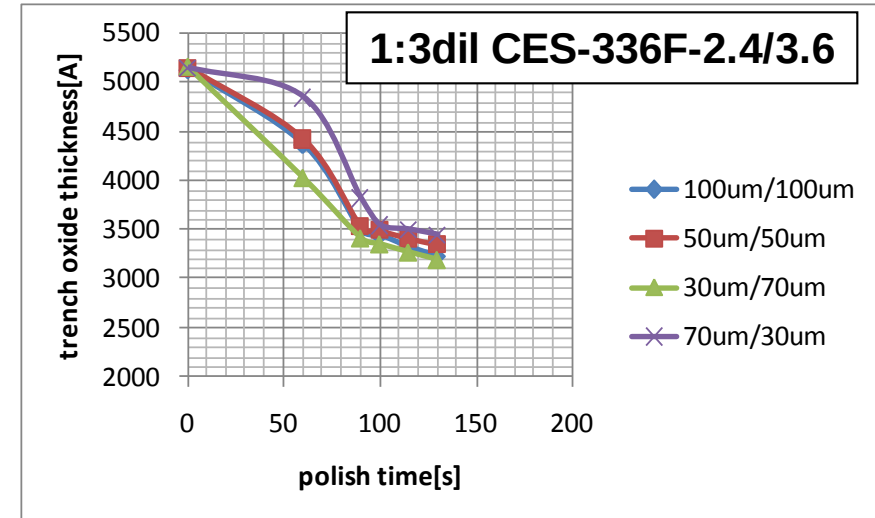
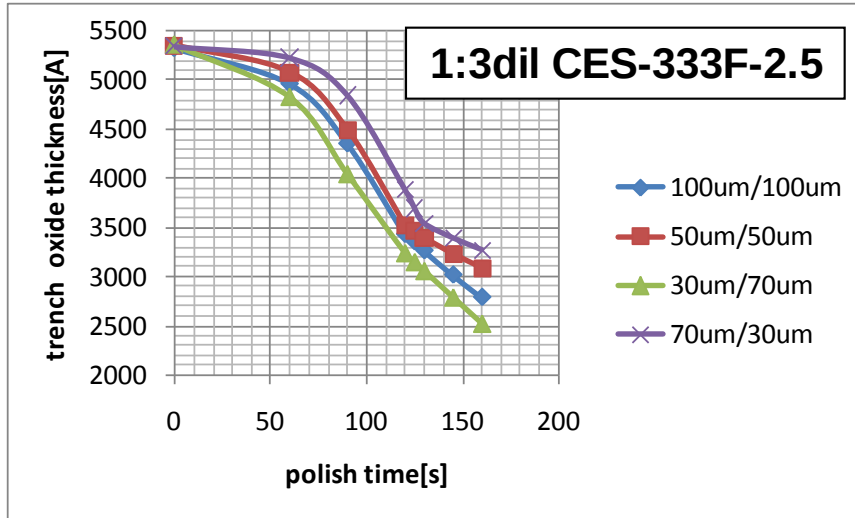
Concept of new additive for higher planarity



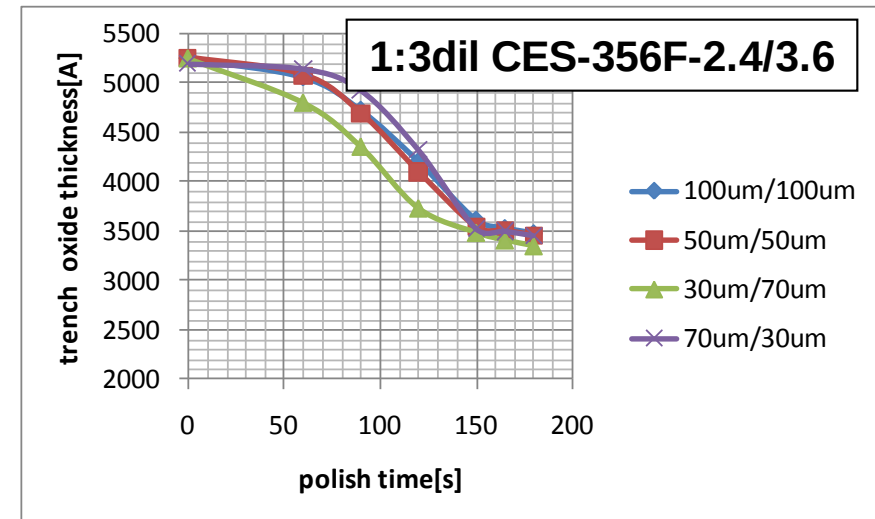
New additives protect trench oxide at low down force area.
Removal rate ratio(High/low pressure) is higher with new additive.

CES-336F series for high planarity and over-polish Window

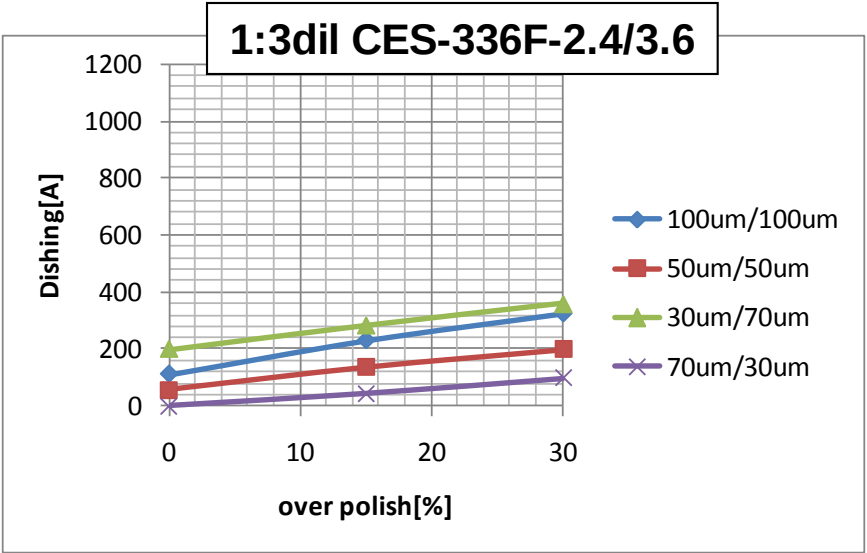
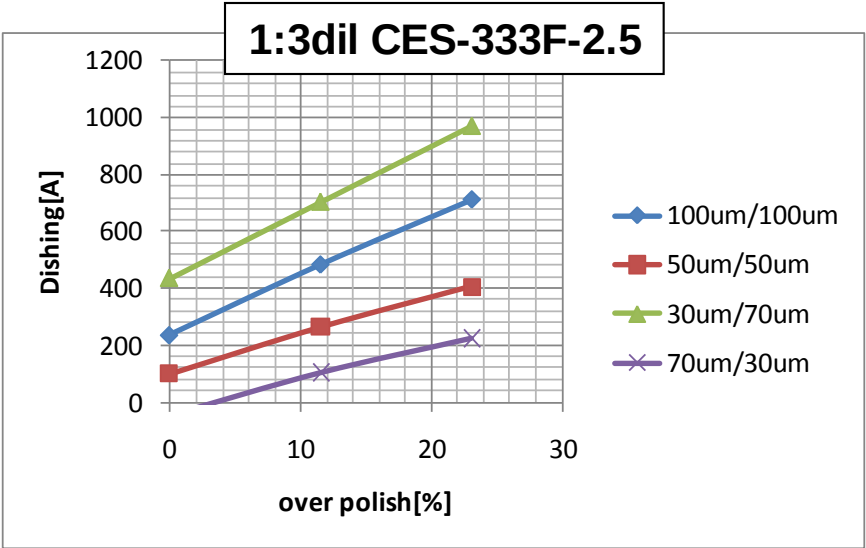
Results of patterned wafer polishing (trench oxide)



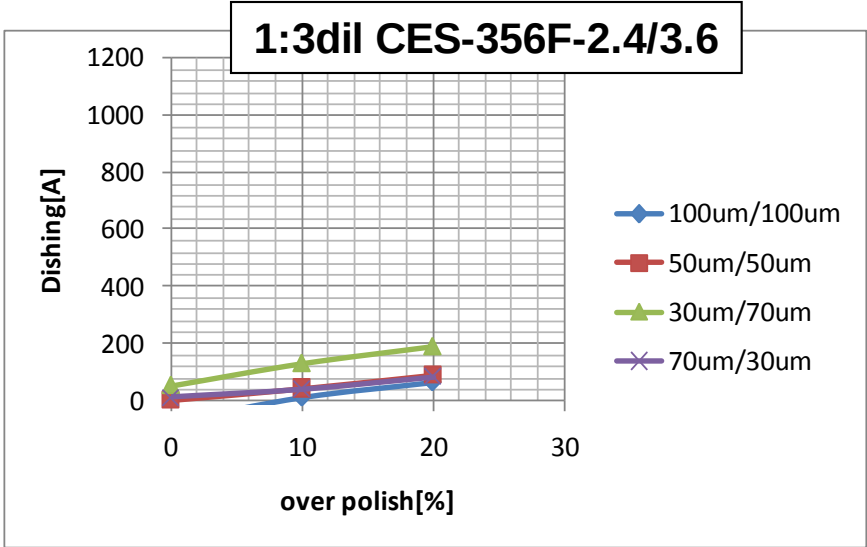
CES-330 F + ADD-106 = CES-336F slurry
Improved Dishing and over-polish margin.



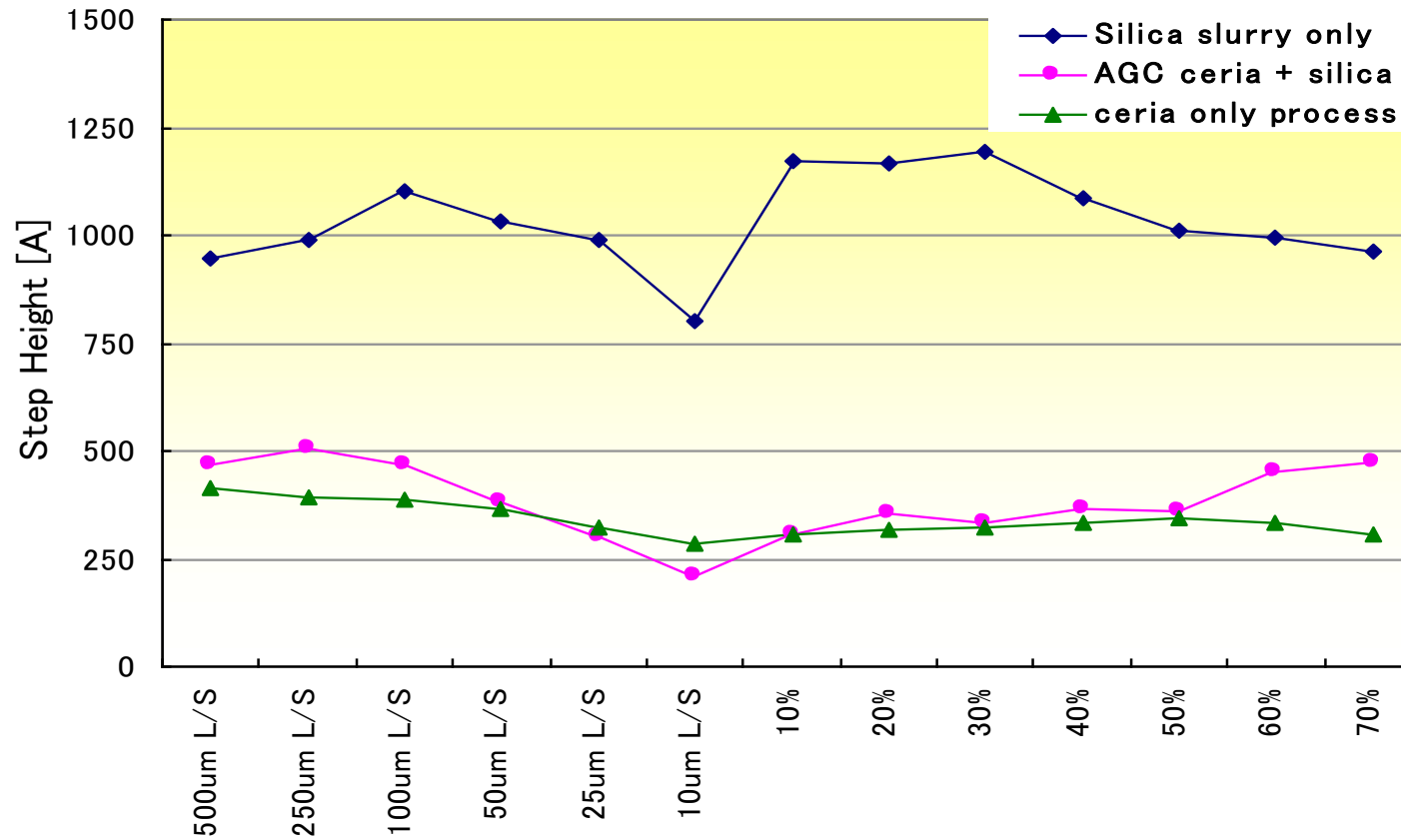
Dishing as a function of over-polish



/Slurry with ADD-106 showed wider over polish margin against dishing.



High selective Poly Si slurry: Two step Ceria slurry process for reduced step height



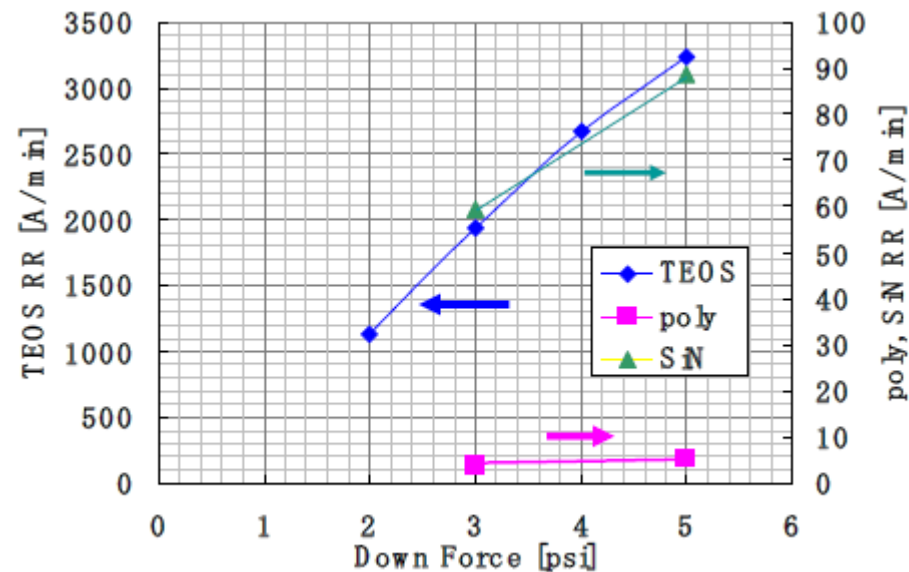
- ◆ Conventional Ceria slurry polish for planarization
- ◆ High selective Poly-Si slurry for poly-Si clearing and stop on oxide.

Poly Si stop Slurry with high oxide rate

Slurry: CES series p-Si stop type
Polisher: AMAT Mirra
Pad: IC-1400 k-groove
Conditioning: Mitsubishi Material MEC-100, In-situ, 9lbf
Wafer: P doped (3E20) poly-Si
Measurement: KLA-Tencor UV-1280SE

Polish Recipe:

Inner	Membrane	R.Ring	Platen	Head	Slurry
[psi]	[psi]	[psi]	[rpm]	[rpm]	[mL/min]
x	x	1.15x	77	73	200



TEOS/poly selectivity is higher than 500.

CL-1500 Series Cu slurry: CL-1524

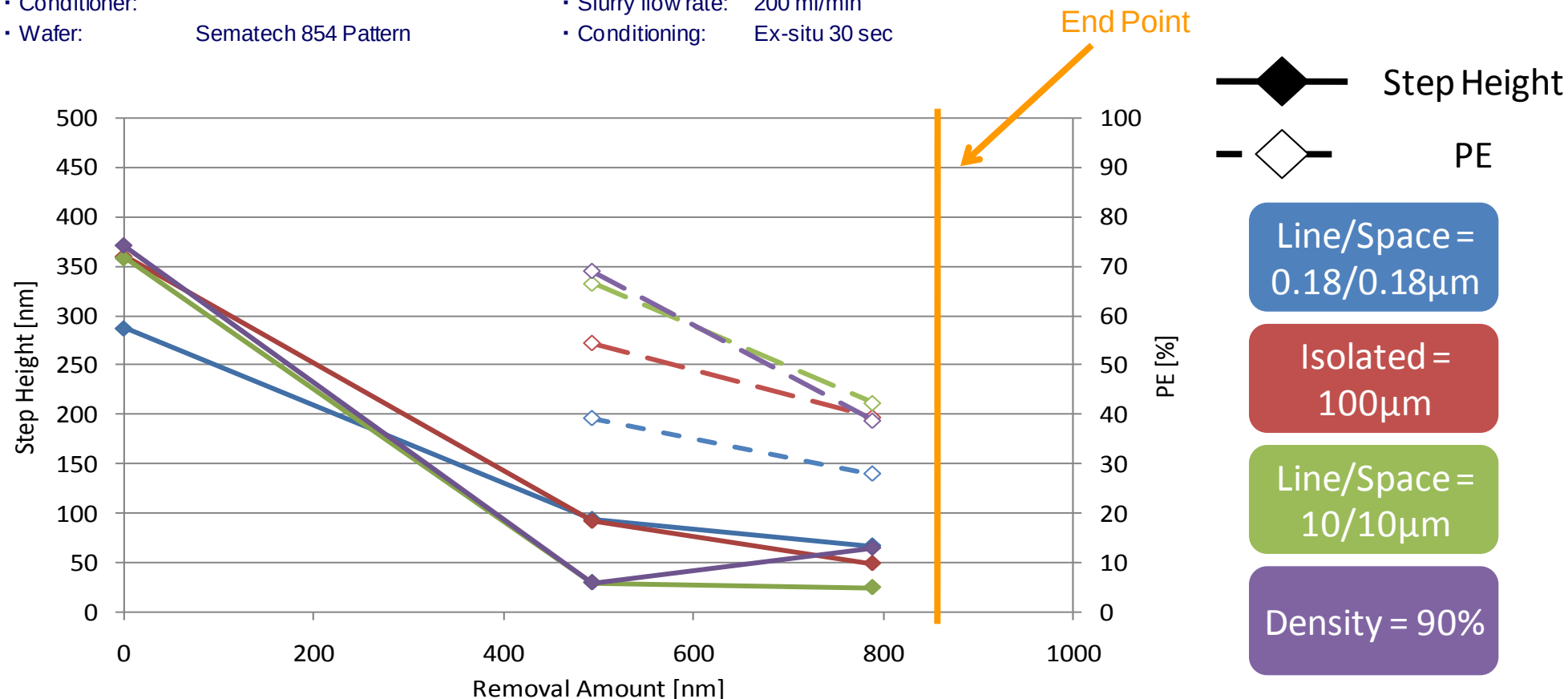
High Planarization Efficiency on Soft Pad

Equipment/Consumables

- Equipment: AMAT Mirra
- Slurry: CL-1524
- Polishing Pad: softer pad
- Conditioner:
- Wafer: Sematech 854 Pattern

Polishing condition

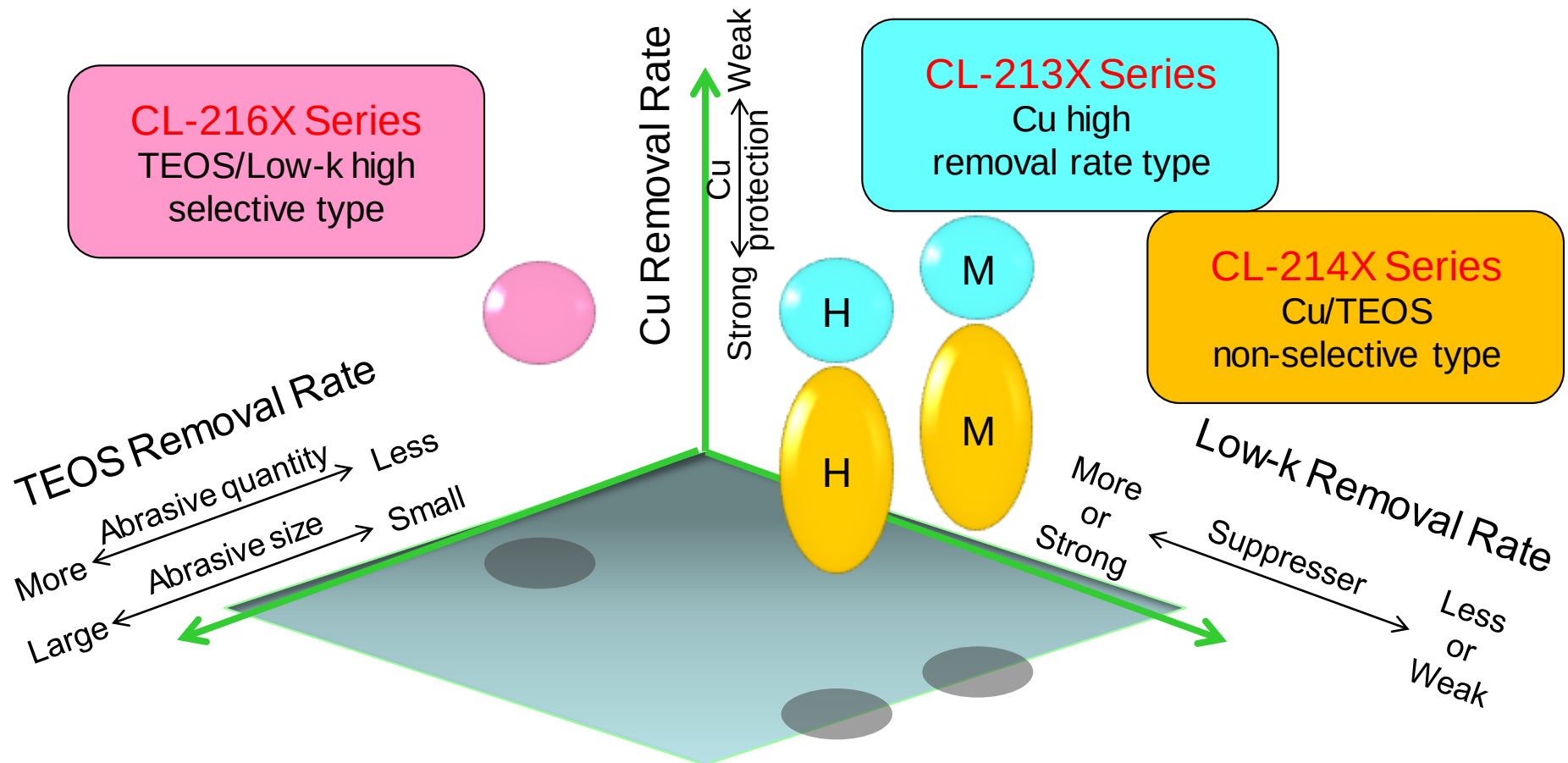
- Polishing Time: 30, 50 sec
- Membrane/R-ring Pressure : 2.0 / 4.0 psi
- Platen/Head rotation speed: 123 / 117 rpm
- Slurry flow rate: 200 ml/min
- Conditioning: Ex-situ 30 sec



- CL-1524 has good PE.

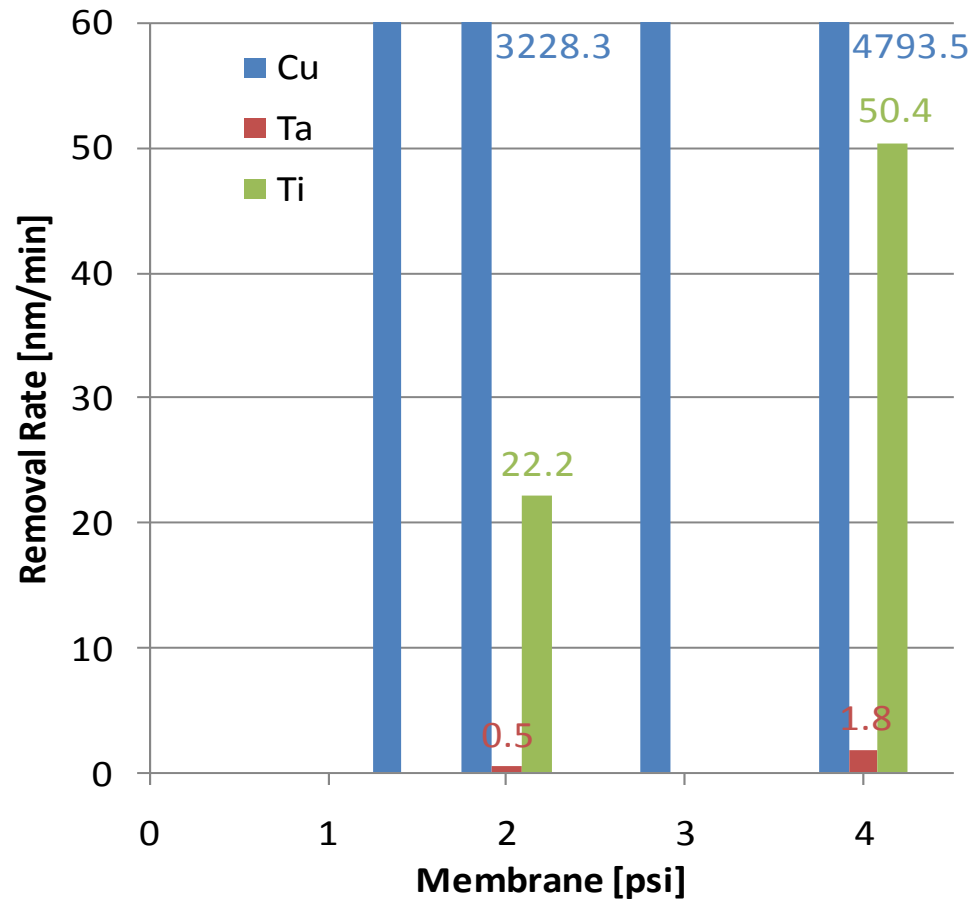
CL-2100 Series Barrier Slurry: Customization for Integration scheme & Design Concept

- Cu removal rate (R/R) is controlled by H_2O_2 content.
- TEOS R/R is controlled by abrasive content and size.
- Low-k R/R is controlled by variation of suppresser and quantity.



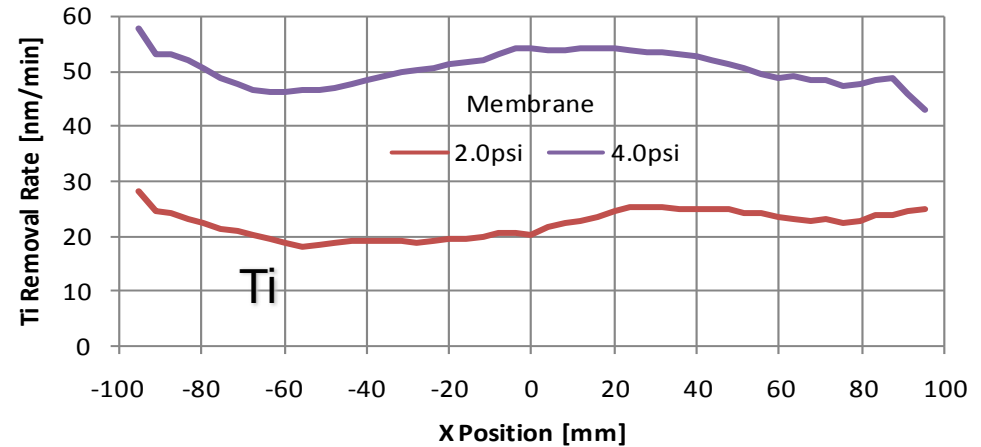
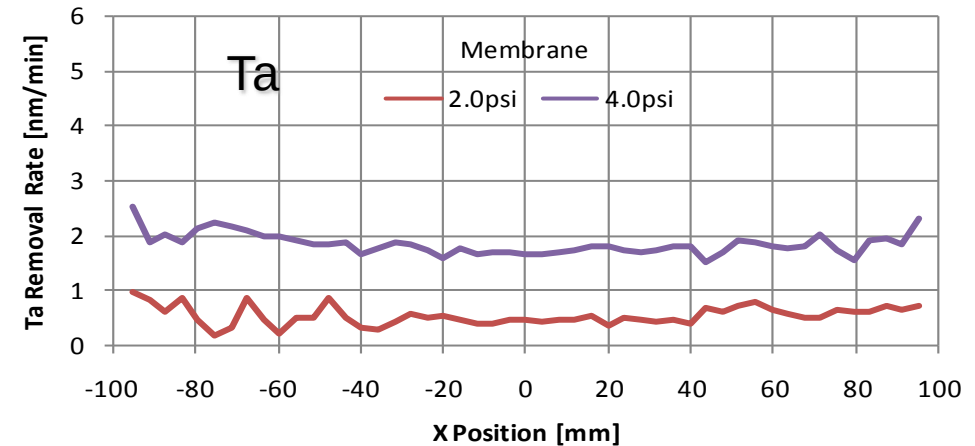
CX-1001 Series Front side TSV slurry

High Copper Removal Rate and barrier Selectivity



Removal Rate

- Cu/Ta Selectivity is 6124@2.0psi, 2619@4.0psi
- Cu/Ti Selectivity is 145.7@2.0psi, 95.2@4.0psi



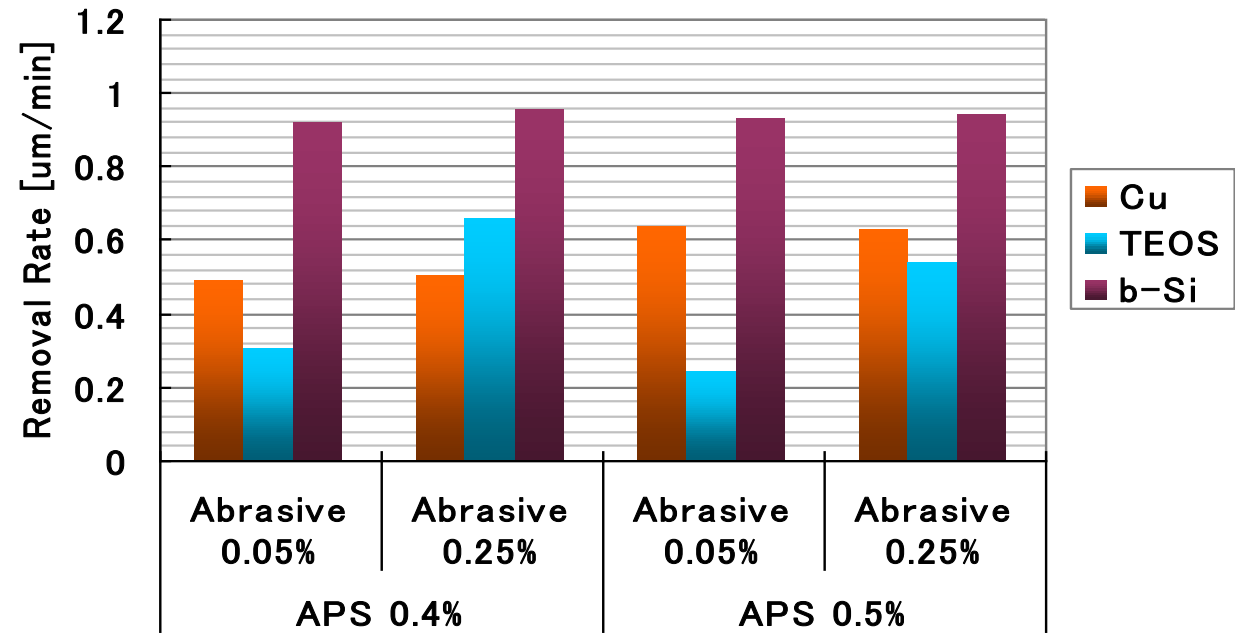
Removal Profile

Ceria Based back side TSV slurry:

Si/Cu Non-selective slurry (High TEOS RR type)

Slurry: CES-330 series for Silicon/Copper polish
Polisher: AMAT Mirra
Pad: IC-1000/Suba 400 XY-P (A21)
Conditioning: Mitsubishi Material MEC-100, ex-situ 9lbf
Wafer: bare-Si, Cu, Ta, TEOS
Polish Time: bare-Si 5min, Cu, TEOS 1min, Ta 10sec

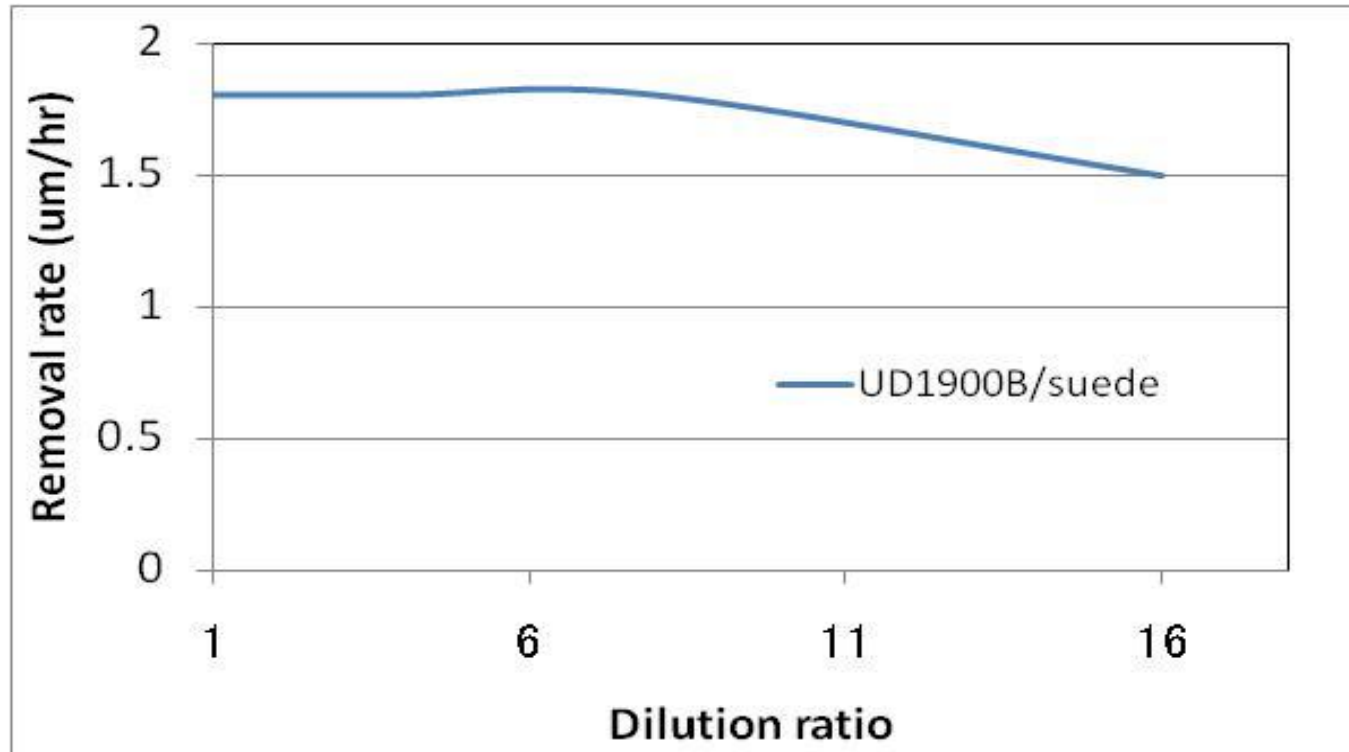
IT	M	R.R	Platen	Head	Slurry
[psi]	[psi]	[psi]	[rpm]	[rpm]	[mL/min]
4	4	4.6	127	123	200



High TEOS rate without changing the rate of Si and Cu

UD 1900B Sapphire slurry: Low Cost Removal rate

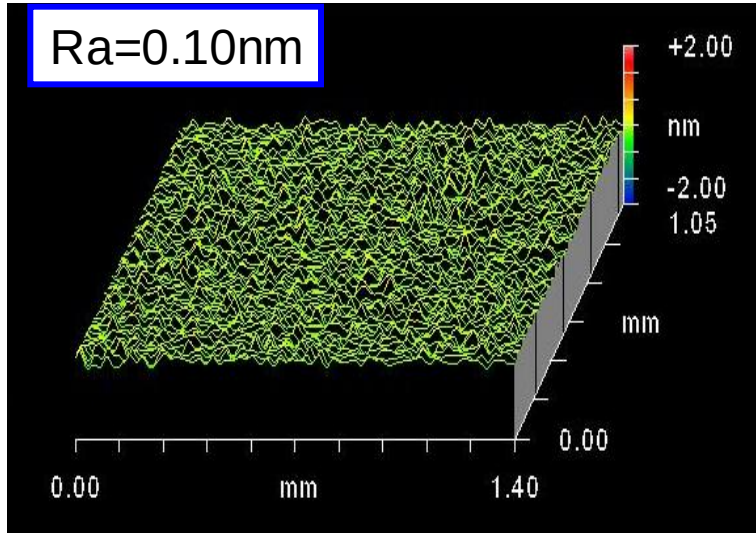
	Polishing pressure (psi)	Rotation speed (rpm)
UD1900B/suede	3.0	60



- UD1900B on suede pad maintains high removal rate with wide dilution range.
 - ⇒ Slurry cost reduction!
 - ⇒ Minimal removal rate change due to slurry dilution shift.

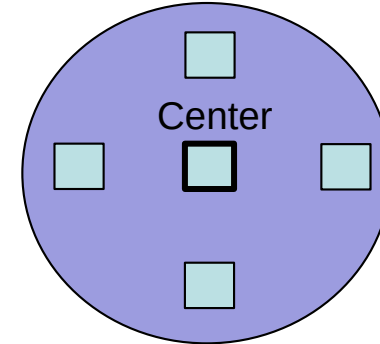
Sapphire surface roughness & scratch

UD1900B/suede



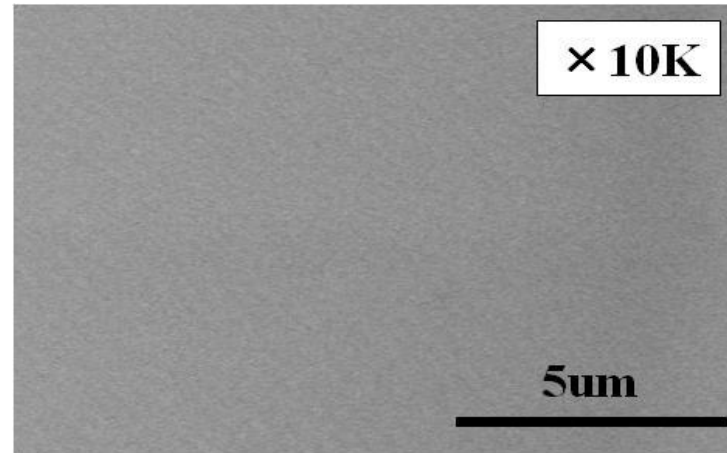
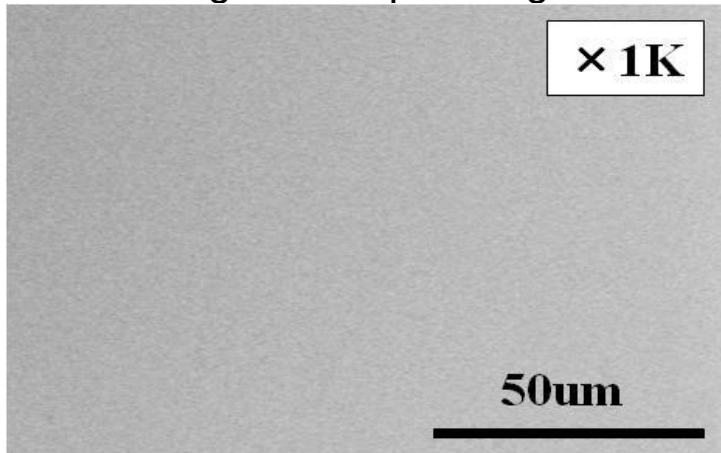
Equipment
SEM
Zygo

Five points
measurement



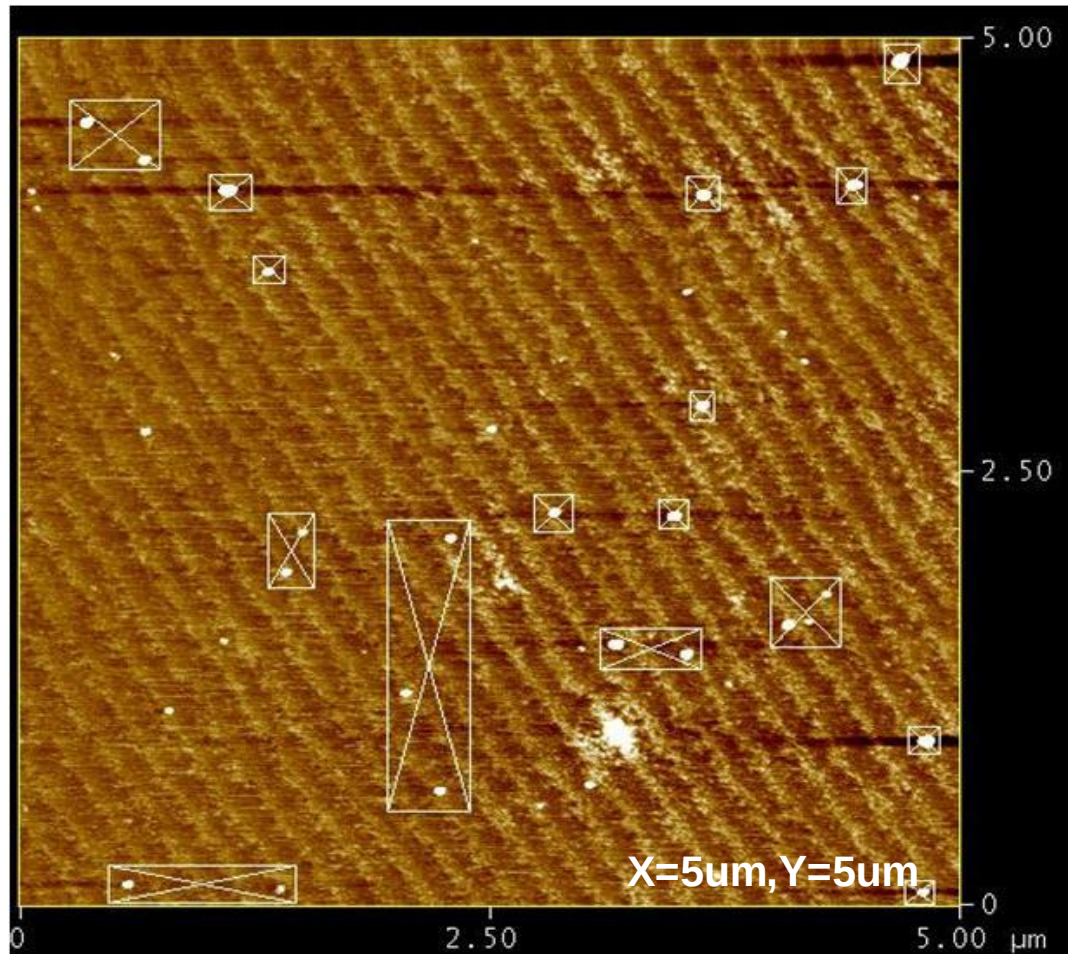
Sapphire
wafer

SEM images after polishing with UD1900B/suede



➡ UD1900B/suede shows very smooth surface and
no scratches on surface.

UD-1405 SiC substrate polish slurry



SiC: good Ra
Surface observation by AFM
(3" , On-axis , Si)

Image Statistics	
Img. Z range	
Img. Mean	-0.006 nm
Img. Raw mean	134.63 nm
Img. Rms (Rq)	0.120 nm
Img. Ra	0.091 nm
Img. Rmax	2.923 nm
Img. Srf. area	23.055 μm^2
Img. Prj. Srf. area	23.052 μm^2
Img. Srf. area diff	0.012 %
Img. SAE	1.000

Achieves high planarity ($Ra < 0.1\text{nm}$)