Modulating Interfacial Reactions to Develop “Soft” p-CMP Processes

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October 20th, 2021

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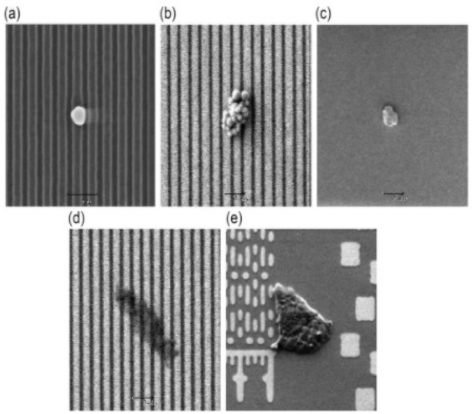
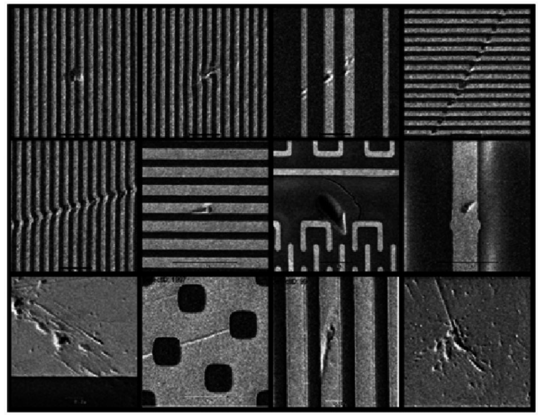
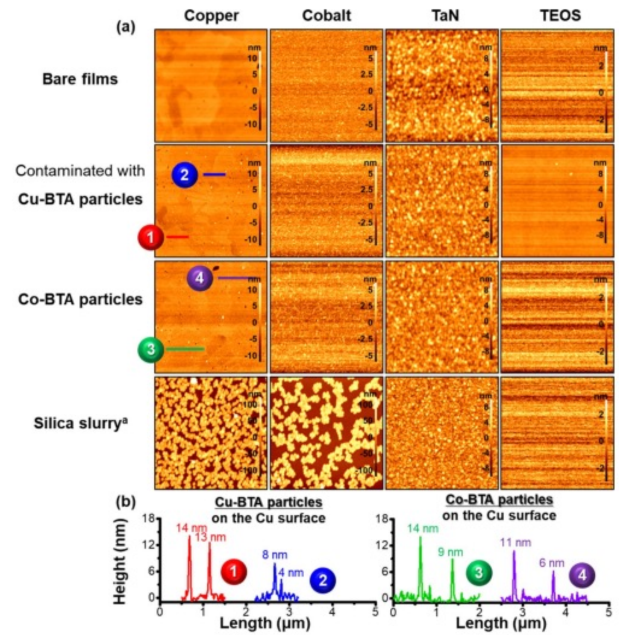
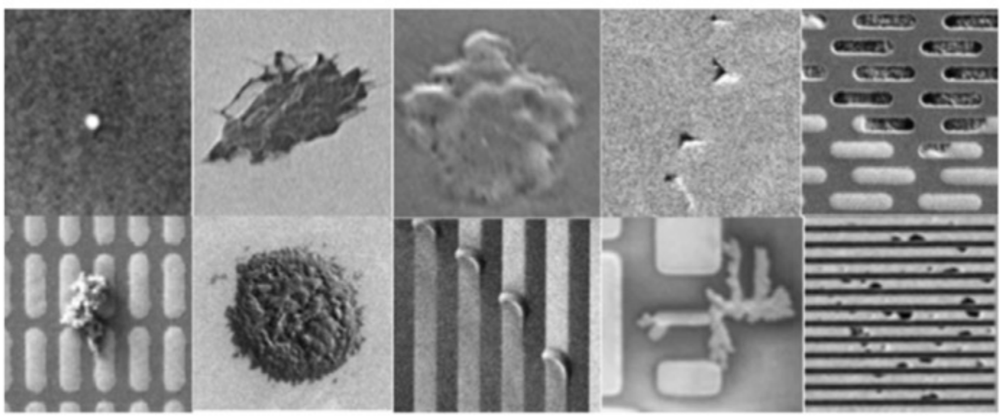
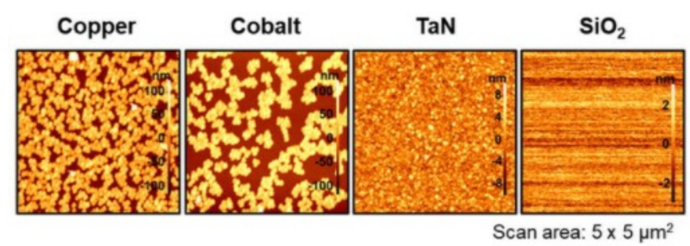
This may seems obvious but….. Defect Types?











W.-T. Tseng, in Advances in Chemical Mechanical Planarization (CMP), 2016

Jihoon Seo DOI: 10.5772/intechopen.94292

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Post-CMP Cleaning Solutions for the Removal of Organic Contaminants with Reduced Galvanic Corrosion at Copper/Cobalt Interface for Advanced Cu Interconnect Applications

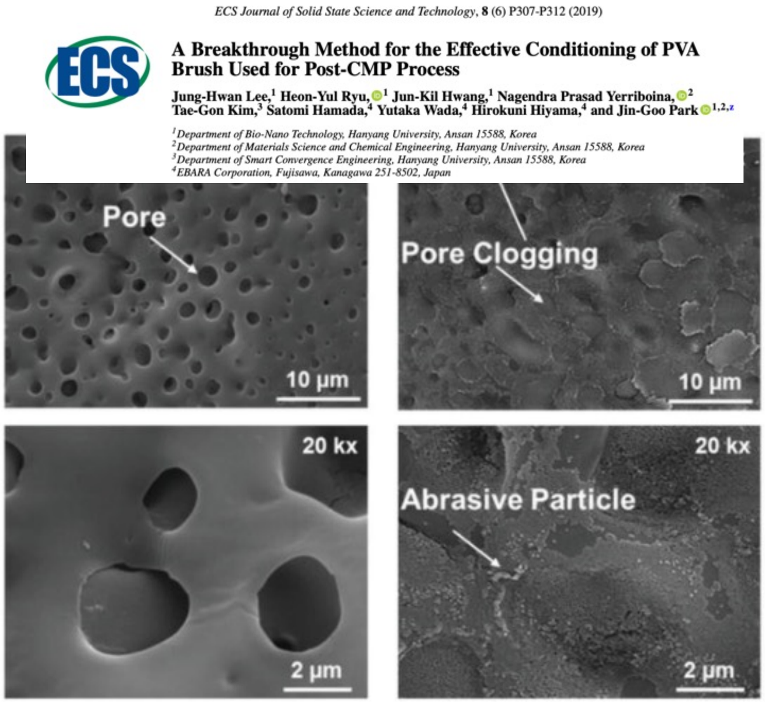
Jihoon Seo,[1,2,z] S. S. R. K. Hanup Vegi,[1,*] and S. V. Babu[1,2,*]

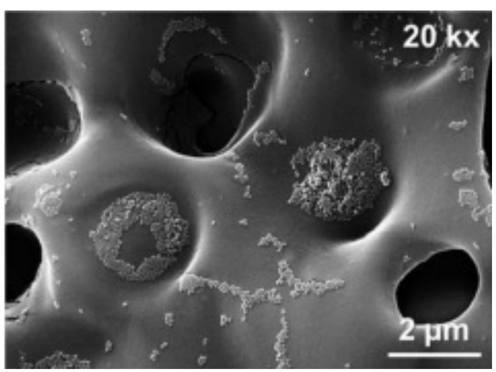
Chen, Y.; Mikhaylichenko, K.; Brown, B.; Redeker, F. Post-CMP Cleaning. In Handbook of Silicon Wafer Cleaning Technology; Elsevier Inc., 2018; pp 253–301.

Park, J.; Kim, T. Fundamentals of Post-CMP Cleaning. 2007, 991.

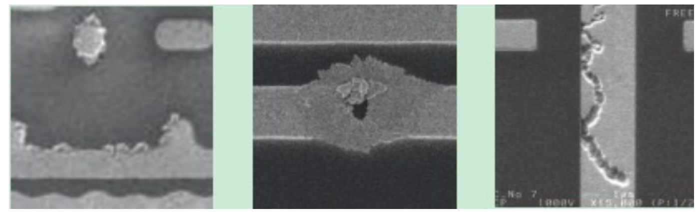
p-CMP Induced Defect Modes

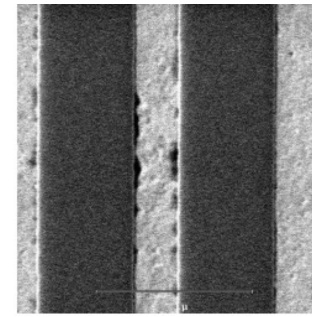
Complex Secondary Interactions



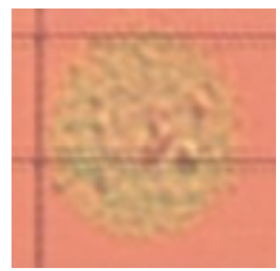


Galvanic Corrosion / Oxidation Defects

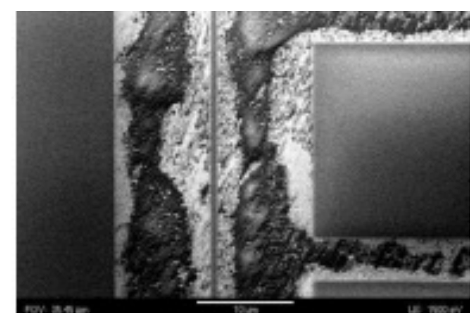


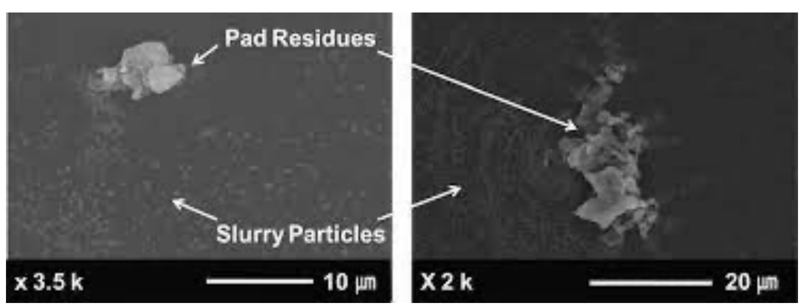


Cleaning Chemistry Residue

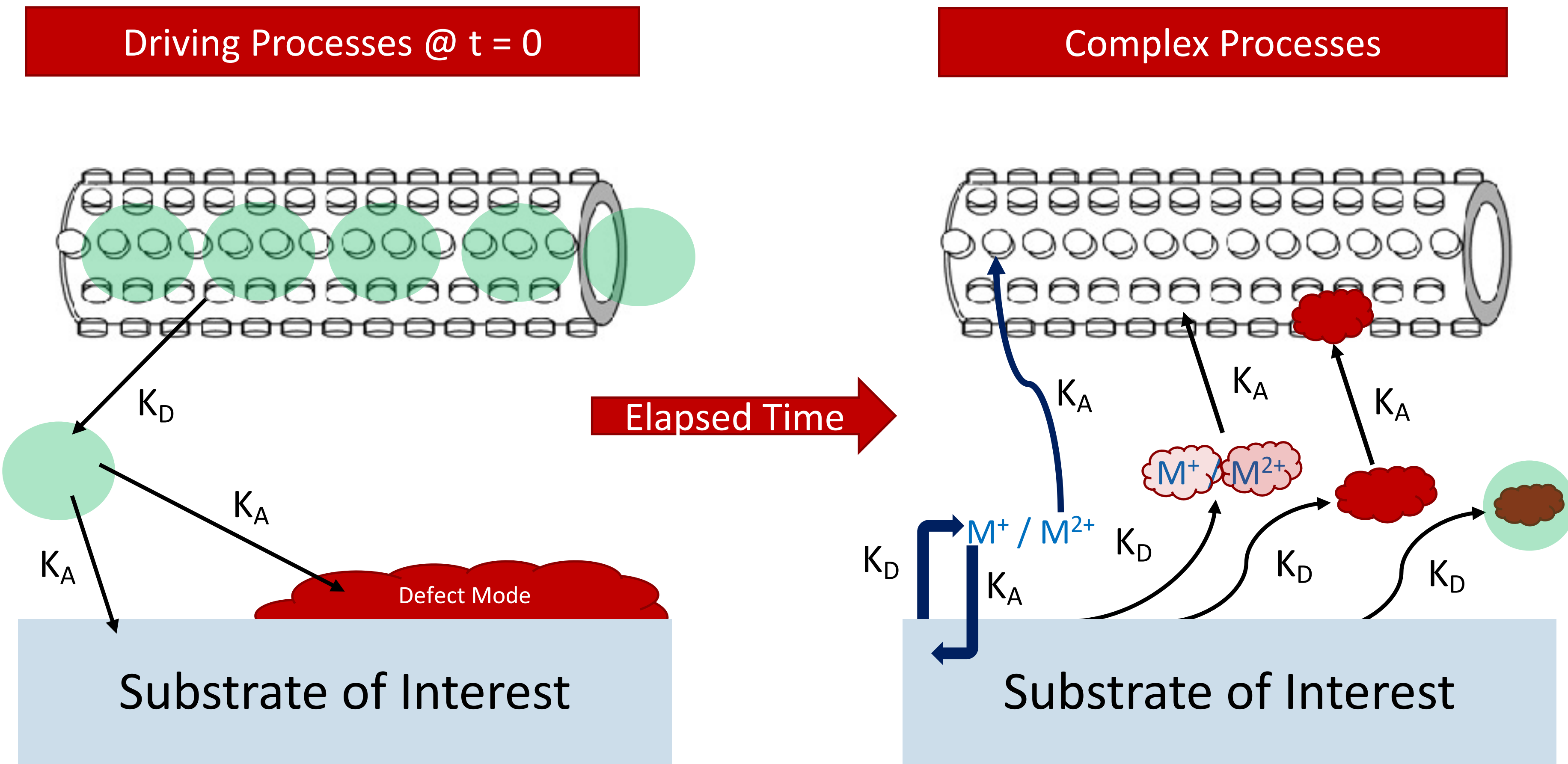


Organic Residue

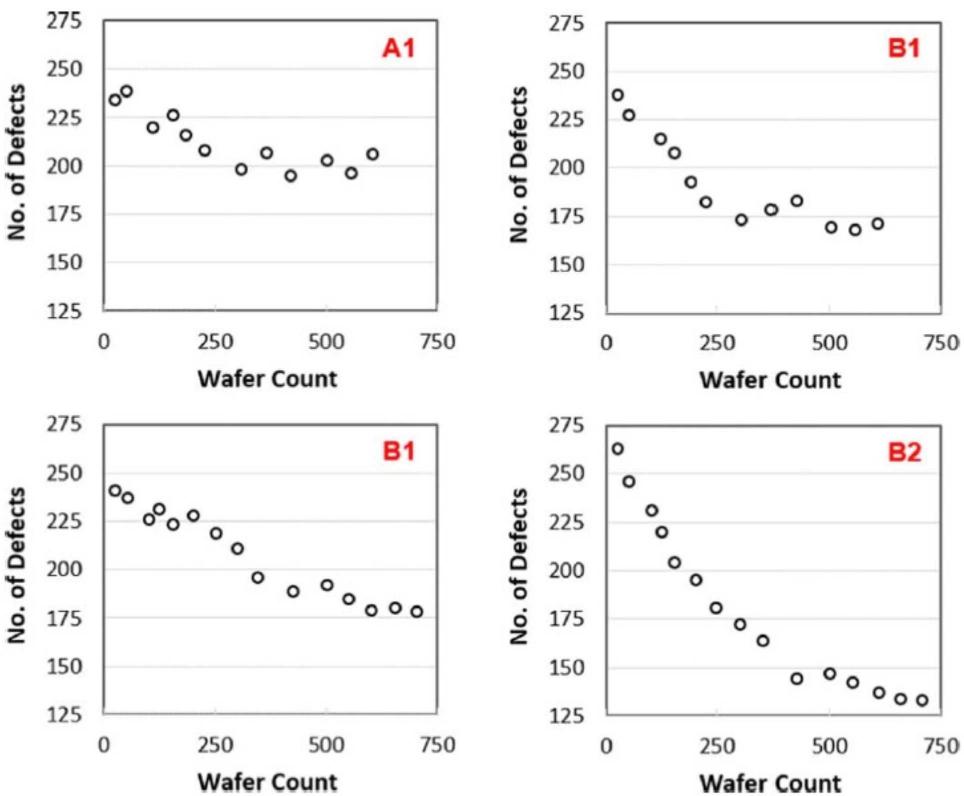




3-Body Dynamics in p-CMP Cleaning



Raw NADD data for the four marathon tests



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Understanding the Reasons Behind Defect Levels in Post-Copper-CMP Cleaning Processes with Different Chemistries and PVA Brushes

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[2] *Lewis University, Department of Chemistry, Romeoville, Illinois 60446, United States of America*
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Setting the Stage……

"Solution A" Composition

- An organic acid blend formulated for trace metals and residue removal
- A corrosion protectant
- A surfactant to reduce surface tension and improve lubrication
- Final pH of appx. 2

"Solution B" Composition

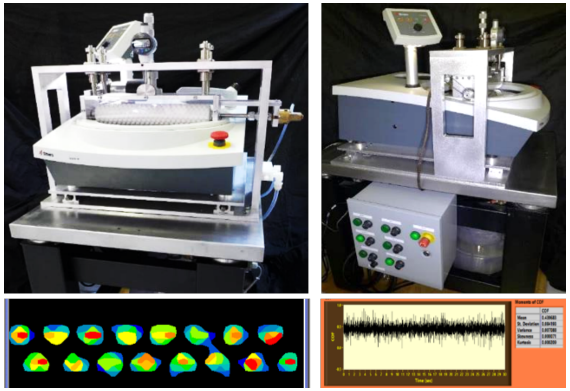
- An organic acid intended to remove trace metals and residue
- Same surfactant as Solution A, but at twice the concentration
- A polymer that was specifically added to further remove particles and trace metals
- An organic pH adjuster that further aided in particle removal
- Final pH of appx. 11

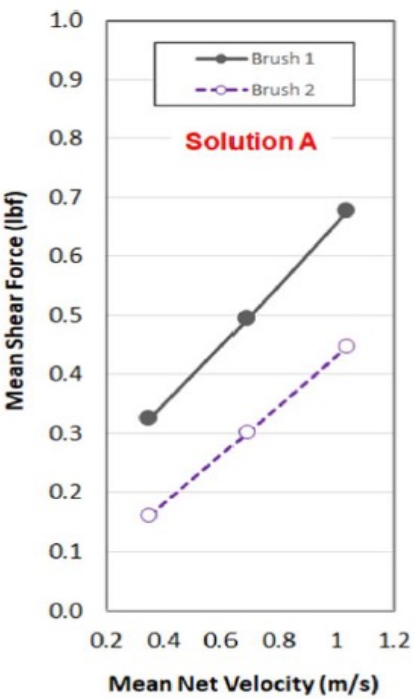
Standard HVM Brushes

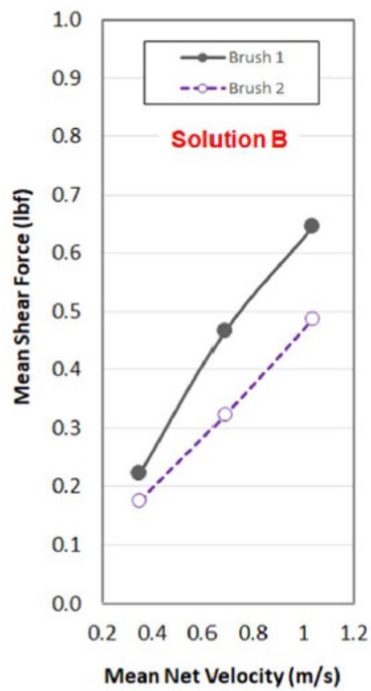
In both cases, the PVA was first set to a height such that it just barely contacted the wafer surface. Next, it was pressed towards the wafer by exactly 2mm, and locked in position. Prior to any tests, the brush was broken in for an hour with the wafer and brush rotating at 300 and 300 RPM, respectively.

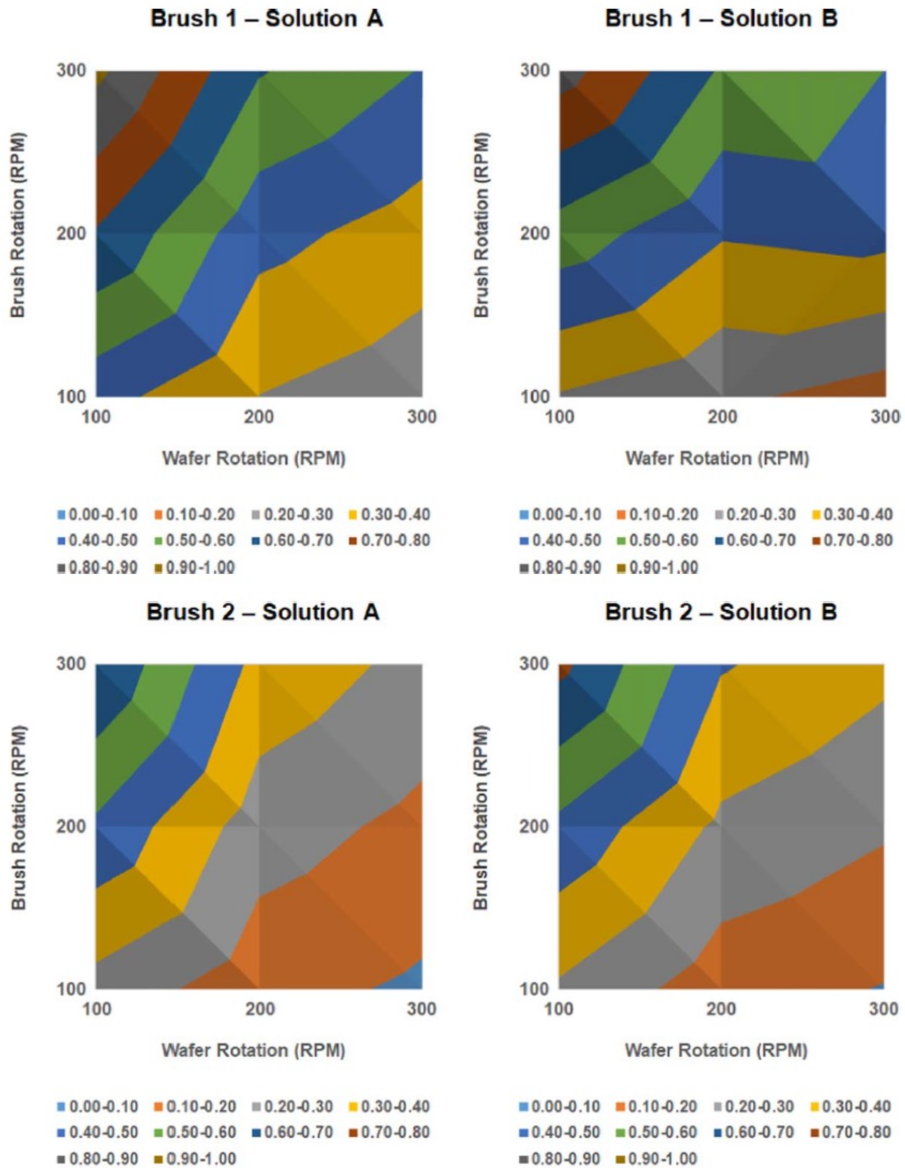
Correlation to Shear Force

PCC-300® PVA Brush Scrubber and Tribometer

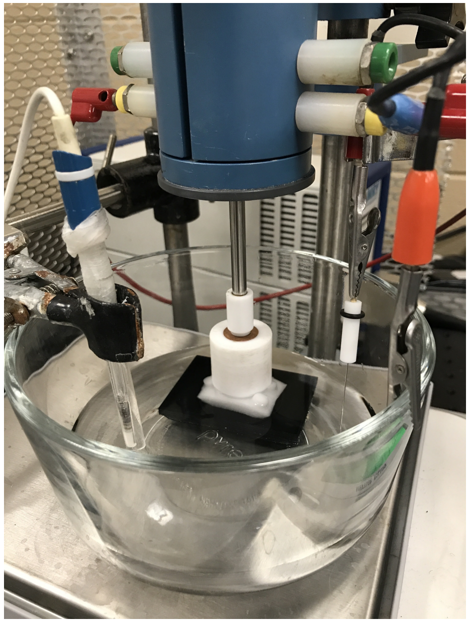




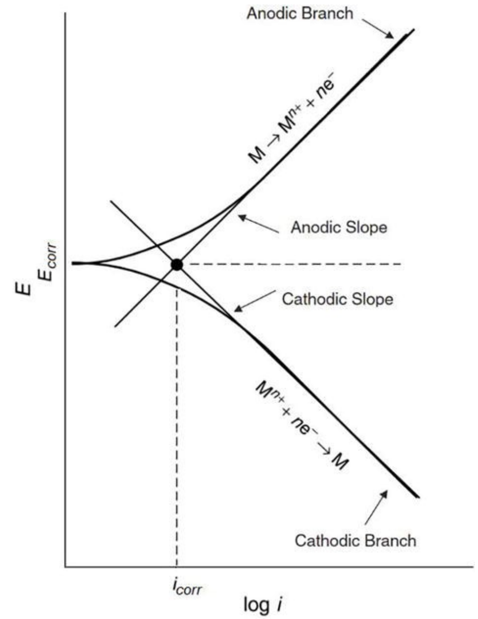


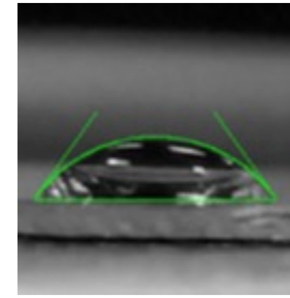


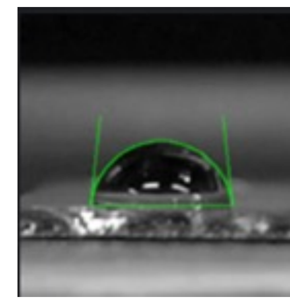
How can we probe brush/chemistry using electrochemistry?



1.0 psi
50 RPM



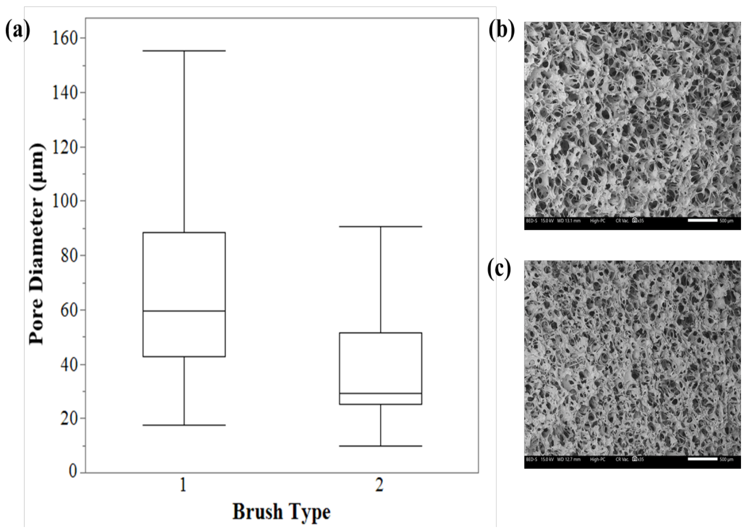


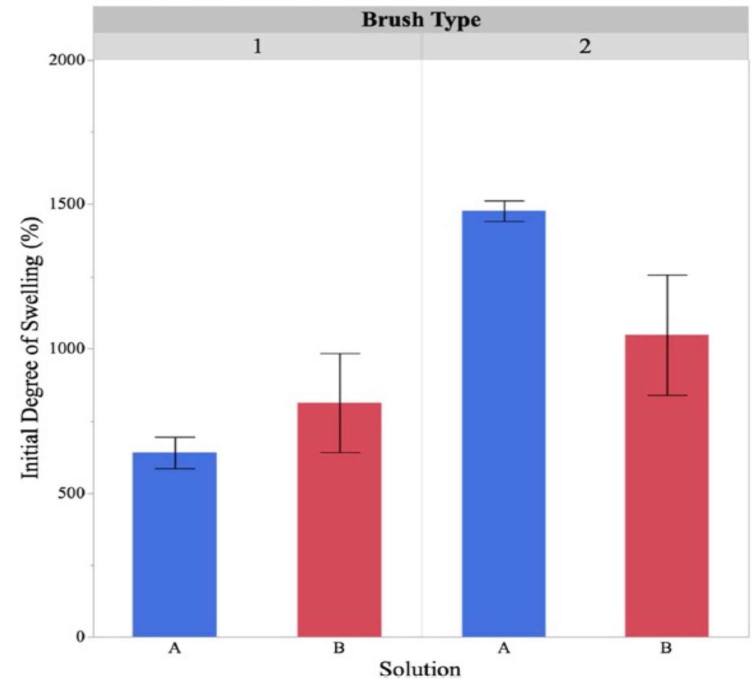


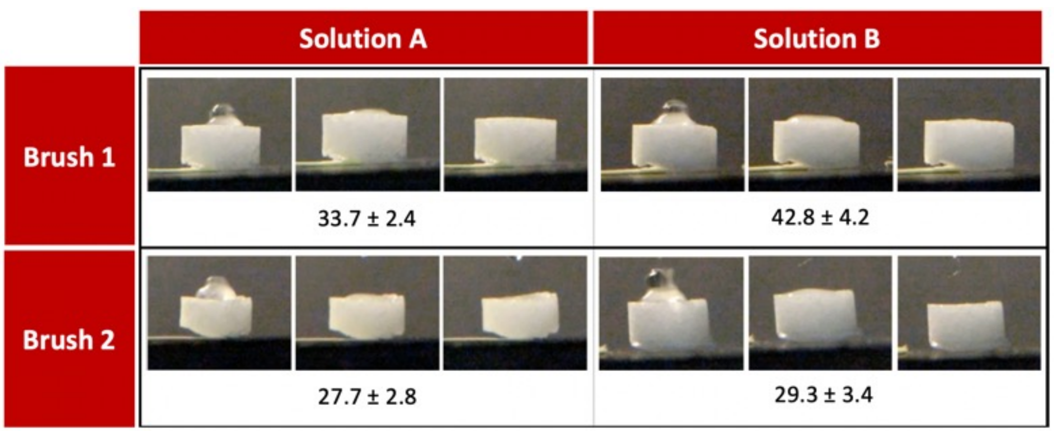
	I_{corr} (µA)	
	Brush 1	Brush 2
Solution A	7.5 ± 1.1	10.8 ± 1.9
Solution B	3.3 ± 1.1	20.5 ± 3.9

Does this argument of surface interactions correlate or even hold true?

Results show Brush 2 has lower SF and significant reduced defects in HVM marathon.







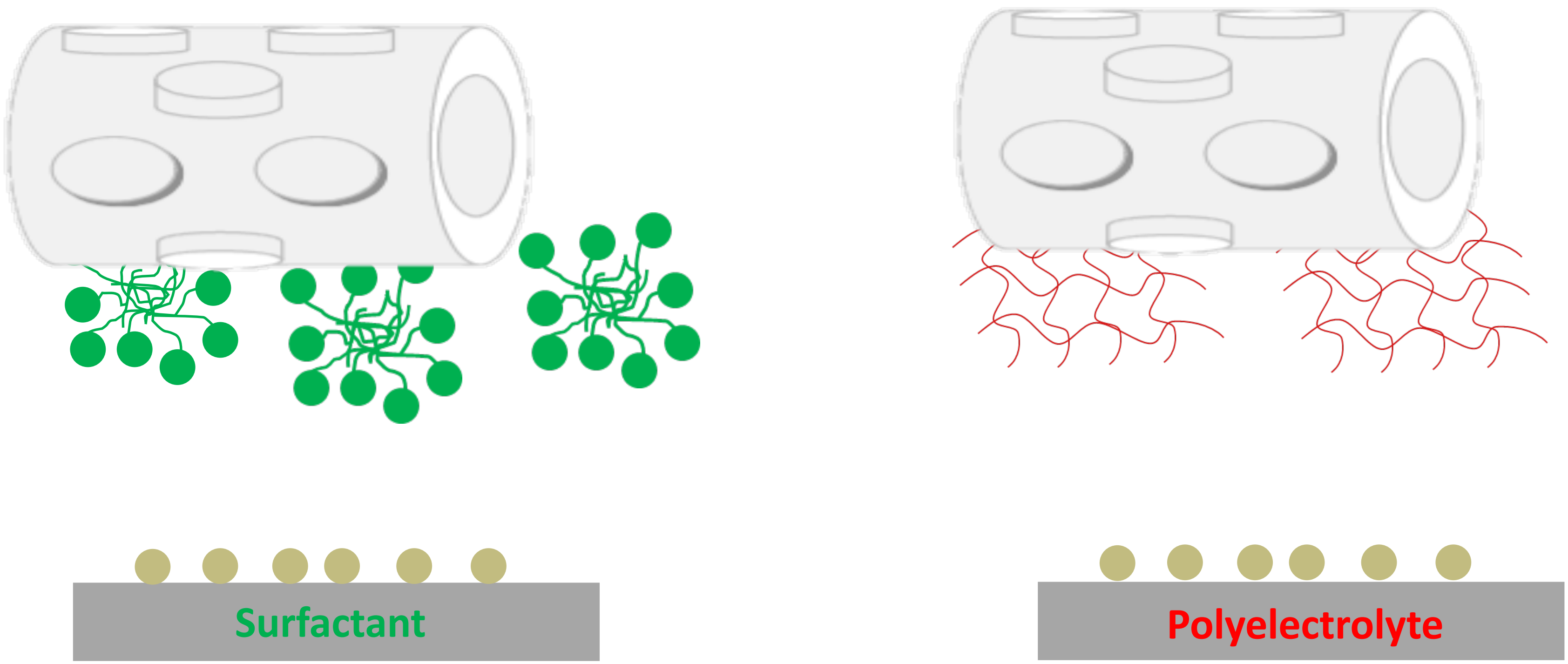
Brush 2 shows smaller pores, slower diffusion of chemistry into the brush matrix, and increased surface chemical activity. All of this is believed to improve particle/defect removal albeit with lower SF.

Supramolecular Cleaning Chemistries with PVA Brush Scrubbing

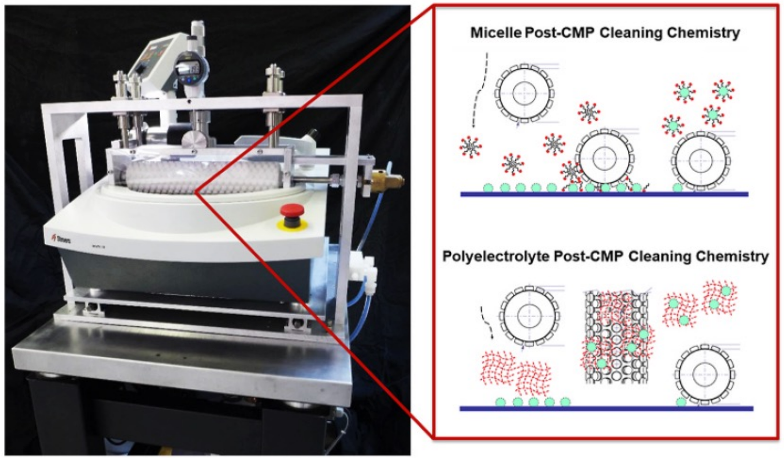
Striking a balance: Role of supramolecular assemblies on the modulation of the chemical and mechanical contributions during Post-STI CMP cleaning

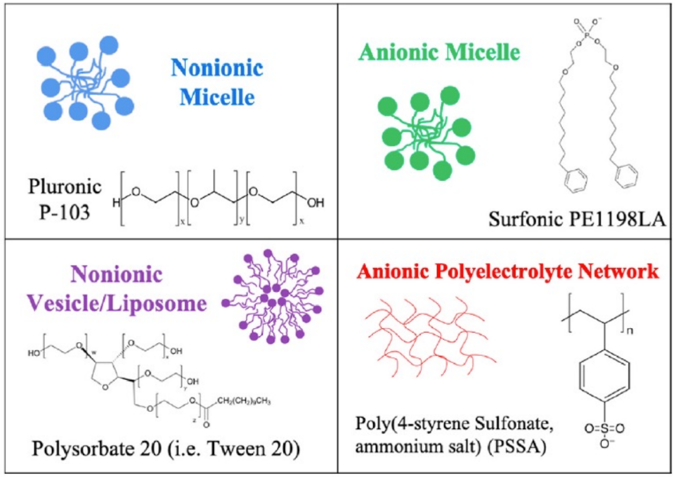
Carolyn F. Graverson [a], Katherine M. Wortman-Otto [a], Abigail N. Linhart [a], Yasa Sampurno [b], Ara Philipossian [b], Jason J. Keleher [a,*]

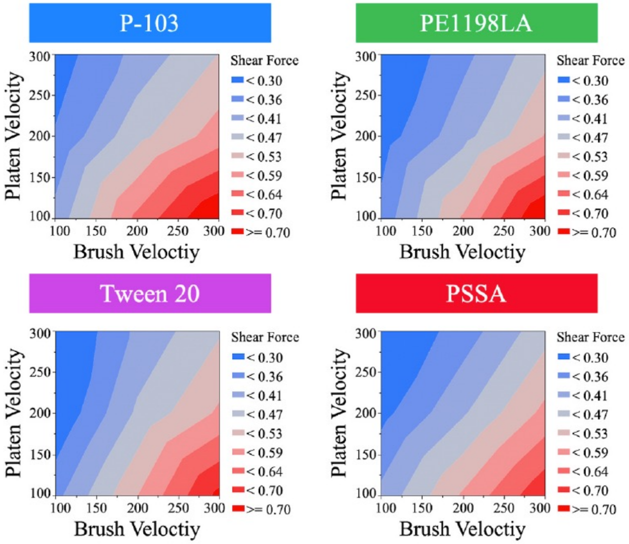
[a] *Department of Chemistry, Lewis University, Romeoville, IL, 60446, USA*
[b] *Araca, Inc, Tucson, AZ, 85718, USA*

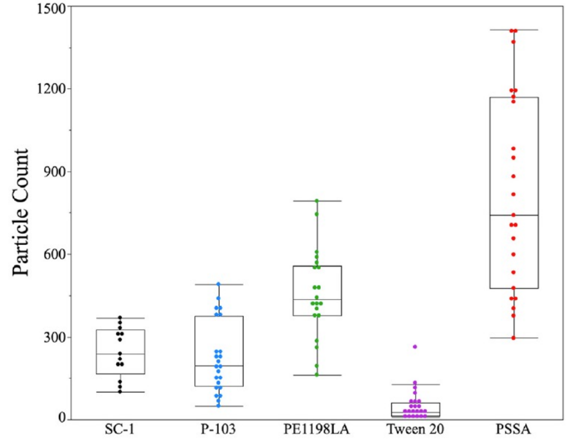


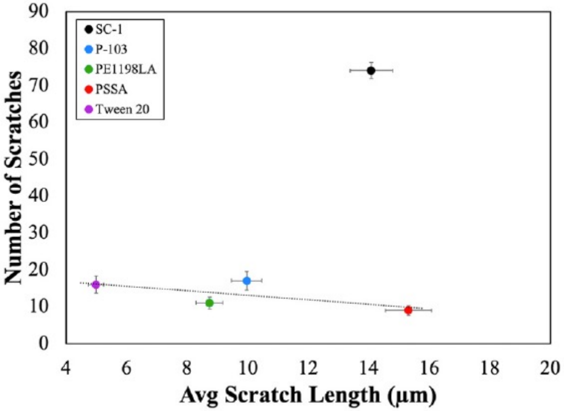
Structure Performance Correlation

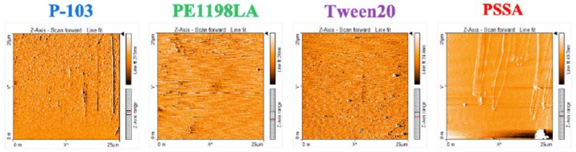












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