

CMP Process Optimization for DIW Conservation and metal loss reduction

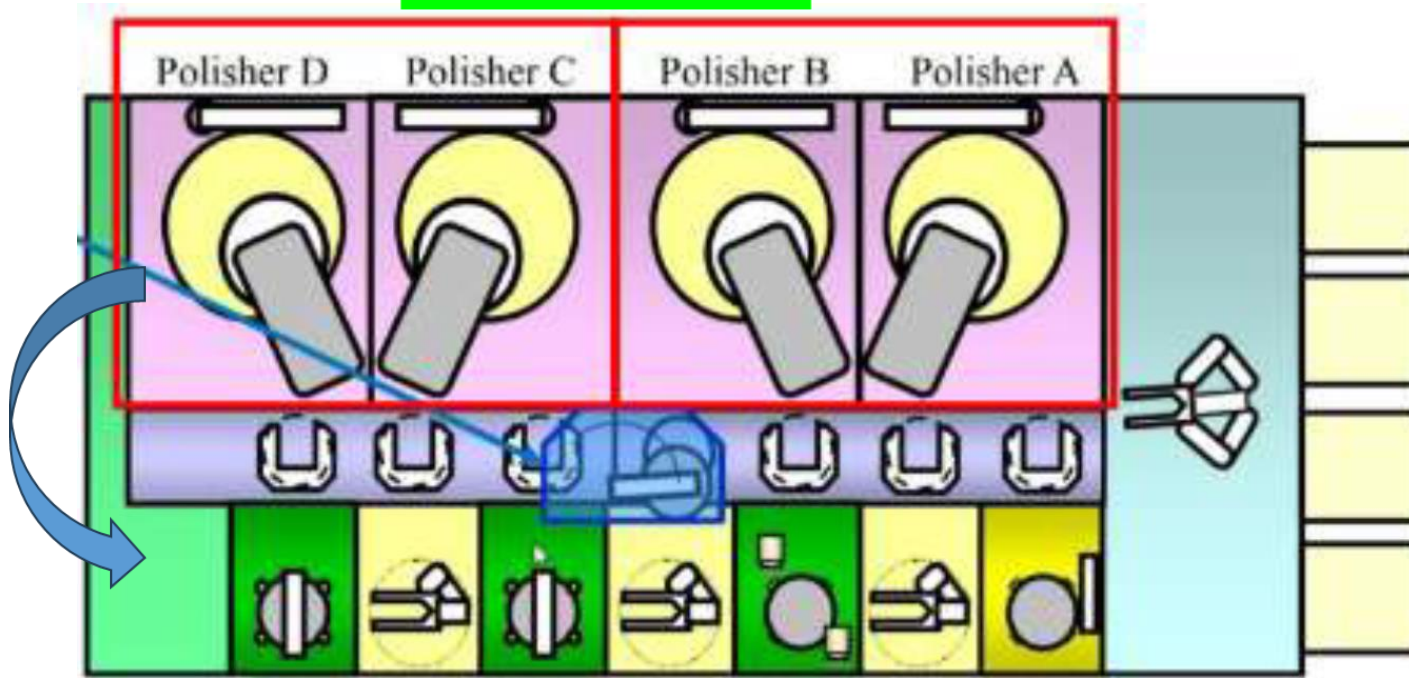
Arunkumar G V, Wei-Tsu Tseng, Emiko Motoyama, Pinlei Chu, Donald Canaperi

IBM Semiconductor Research, 257 Fuller Road, Albany, NY 12203 , USA

arunkumargv@ibm.com

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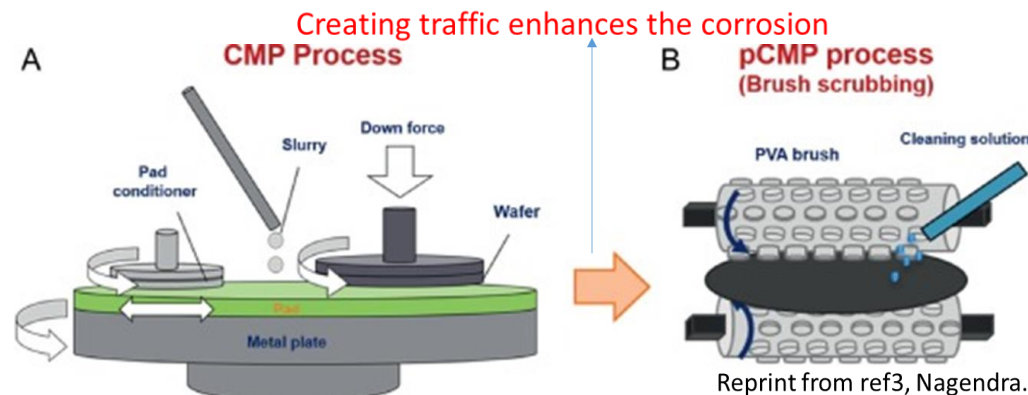
Polisher Module



Process step	Time
Buff polishing	30s
Chem Clean	60s
DIW rinse	80s

Cleaner Module

S. Lee, CAMP CMP Symp. (2018)



Reprint from ref3, Nagendra. P Y.

- By reducing the DIW rinse time at cleaner from 80s to 25s will helps to save 1283ml of DIW.
- DIW is not helping to reduce the particles and organic residues, they are being mechanically removed during the brush contact. Moreover, brush cleaning will have an impact on Cu loss.

Diagram: CMP tool and process Steps

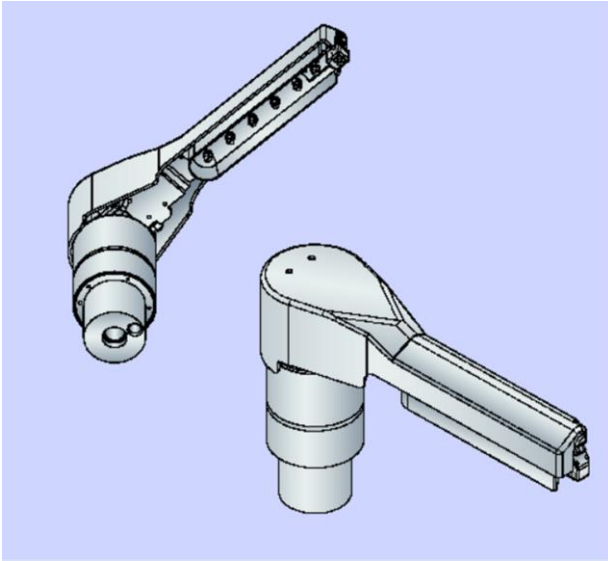
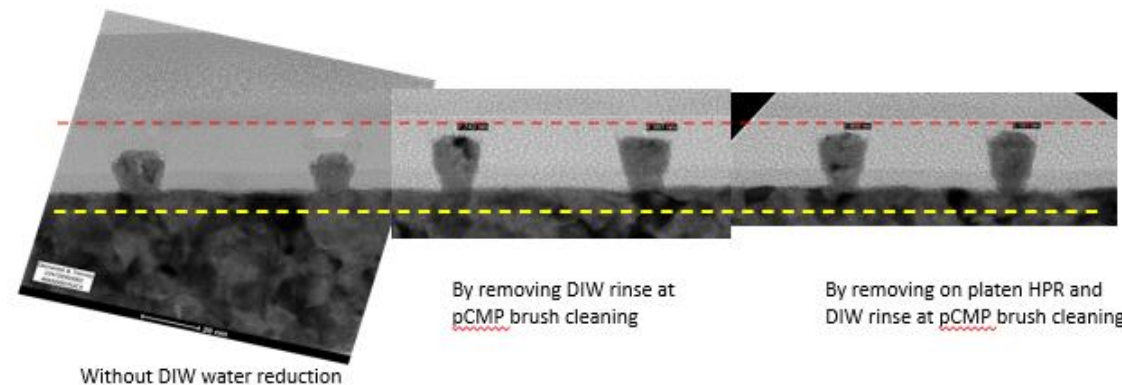


Diagram: High Pressure Rinse on Platen

Flow rate of DIW at HPR :
5000ml/min
Rinse time: 15secs
DIW Usage for HPR : 1250ml

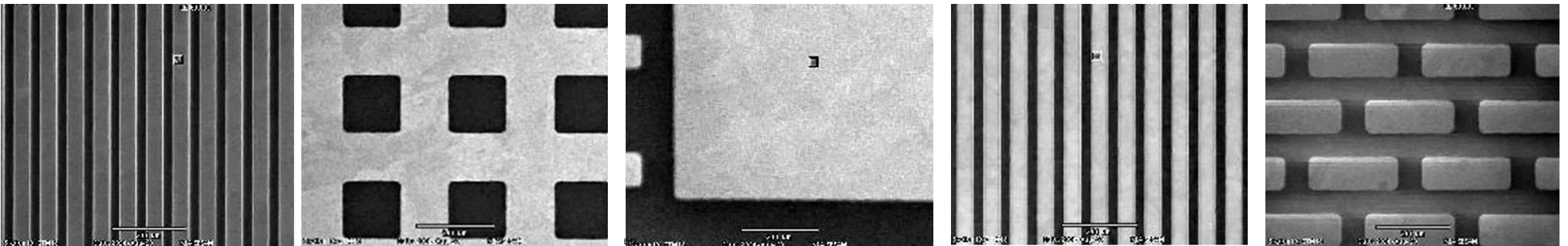
High Pressure rinse is used on the polishing platen to rinse the wafer with DIW for few seconds after the main polishing step. During W metal Polishing, the exposure to DIW can lead to Corrosion, since W is not Passivated at $\text{pH} > 4$.



By removing the DIW rinse step at pCMP brush cleaning, we could reduce the DIW usage by 42%., and with additional removal of HPR on platen helps to reduce by 66%.



Chart: Foreign materials and Adders



SEM images after CMP step

- **Conclusion**

- Exposure to DIW immediately after the main polish step will lead to corrosion and metal loss in MOL and BEOL CMP Process.
- By removing the HPR step on platen during W polishing, and pCMP rinse step will help us to mitigate corrosion.
- With this process optimization, we can minimize the usage of DIW by up to 10 L in MOL, and 23L in all layers of the BEOL. Overall, we will save about 33L of DIW for a single wafer.
- Reducing the DIW rinse step also helps to save overall process time and improves throughput.

- **Future Work**

- Reduce the flow rate of HPR on all the possible layers in CMP process.
- Optimize to eliminate DIW high pressure rinse steps and pCMP rinse steps in different layers and process steps.
- Minimizing the wet idle time and flow rate of DIW during the wet idle.