Effective Clean in 450mm Scrubber Tool for Throughput and Defect Removal Improvement

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Abstract

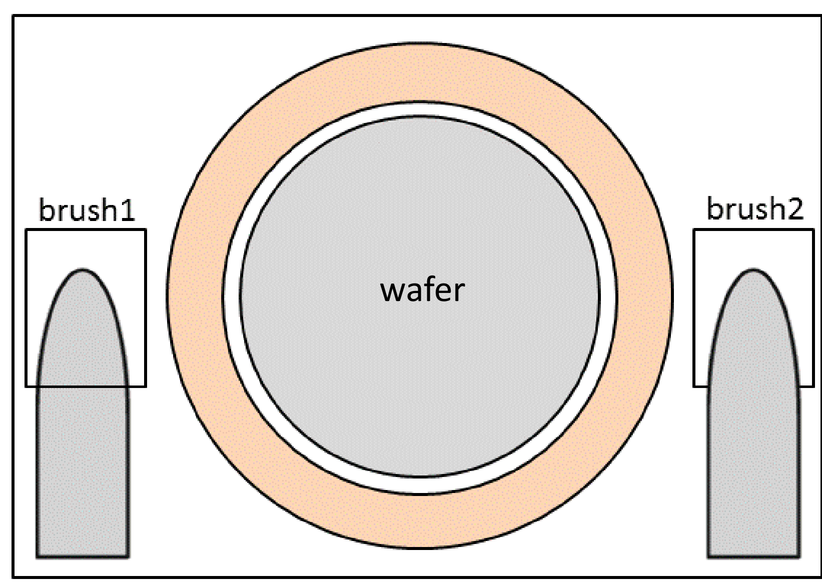
– An effective brush clean method was demonstrated on a 450mm scrubber tool.

– 450mm equipment development is a challenge in both technology and throughput to fulfill sub 10nm process requirements and cost reductions compared with a 300mm tool.

– The new brush clean method can significantly improve the particle removal efficiency and achieve higher process throughput than 300mm tools.

New Design Concept

- 450mm scrubber tool implemented “Dual brush” as standard configuration.
- Both brushes move simultaneously for wafer cleaning during process.

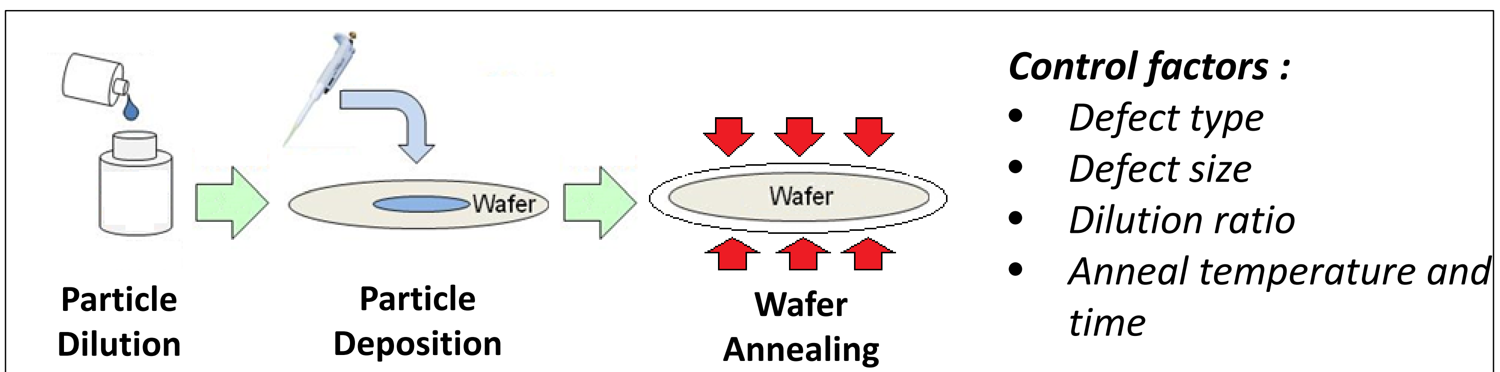


Process tuning factors :

- *Cleaning time*
- *Wafer rotation speed*
- *Flow rate*
- *Brush start/stop position*
- *Brush speed*
- *Brushing method*

Experiment

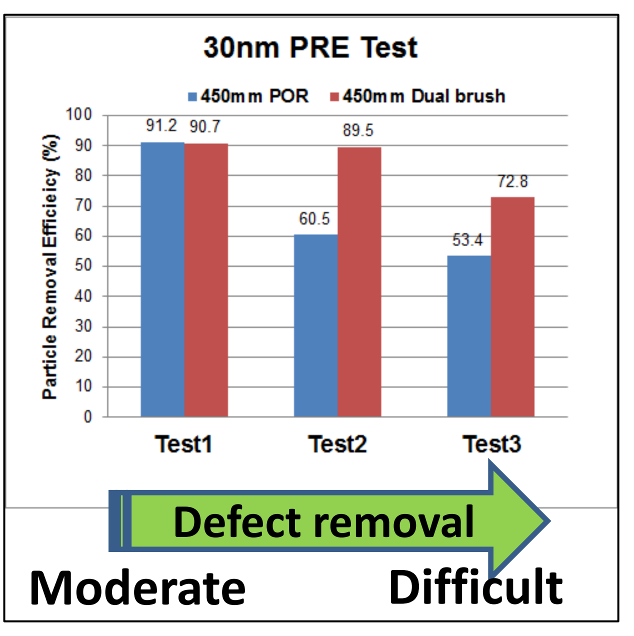
- Particle removal efficiency (PRE) has been evaluated to identify wafer cleaning capability.
  - 3 tests were performed with variable defect deposit conditions from easy to tough removal.

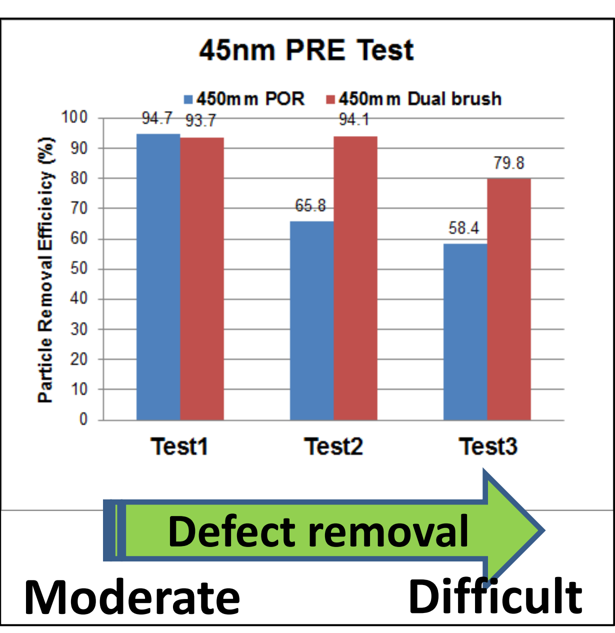


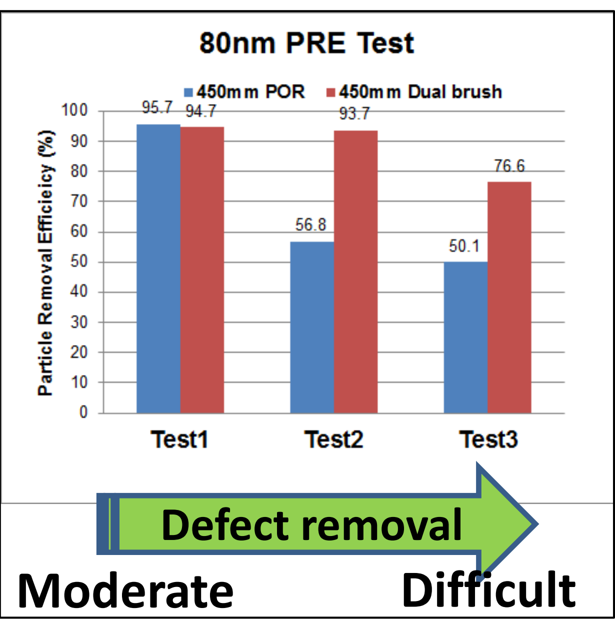
- Long term particle performance has been collected to verify process stability.

Experiment Result

– **Particle removal efficiency evaluation :**
  - **Dual brush process shows +20% PRE improvement in tough defect samples compared with 450mm POR.**
  - **450mm POR has benchmarked with 300mm in process performance, which indicates dual brush is potentially +20% better than a 300mm standard process.**







Experiment Result

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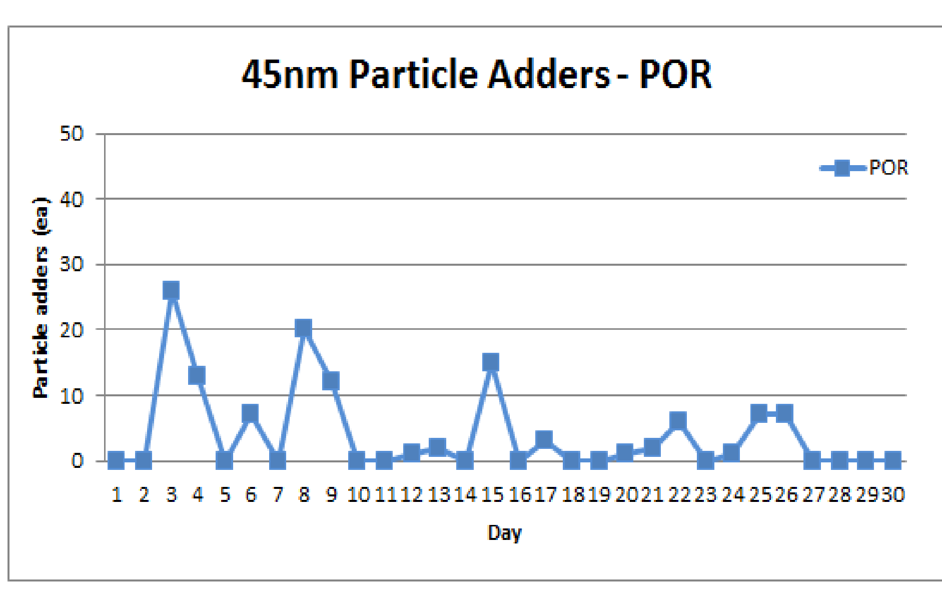
– **Defect map for analysis:**
  - **Dual brush process performed better particle removal on wafer edge area compared with POR.**
  - **Overall PRE for the dual brush process are higher than POR, but dual brush process also found less particle removal in wafer center compared with the wafer edge area. Some process parameters need to be optimized for further improvement.**

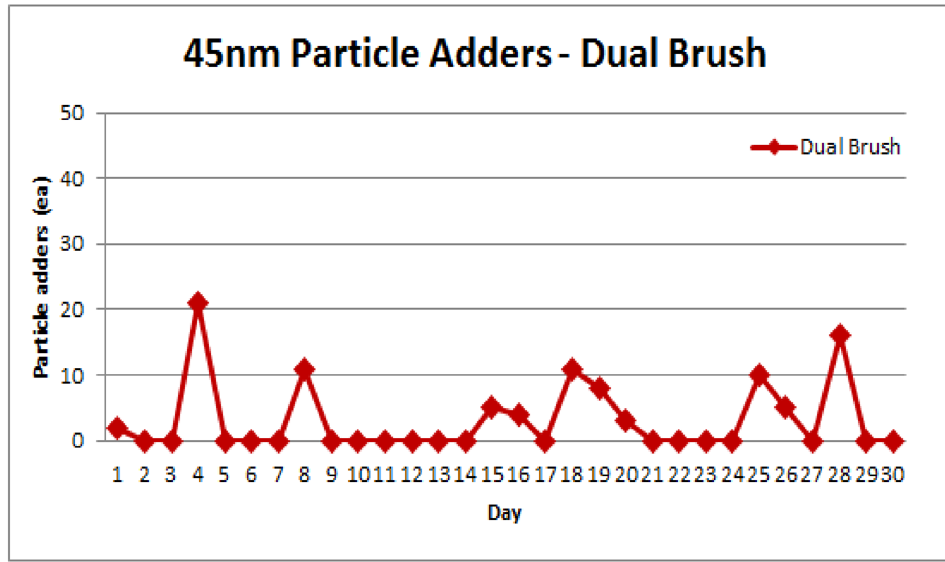
	Defect map after deposition (Before clean)	Defect map after clean
450mm POR		
450mm Dual Brush		

※ : Defect map on the tough removal sample

Experiment Result

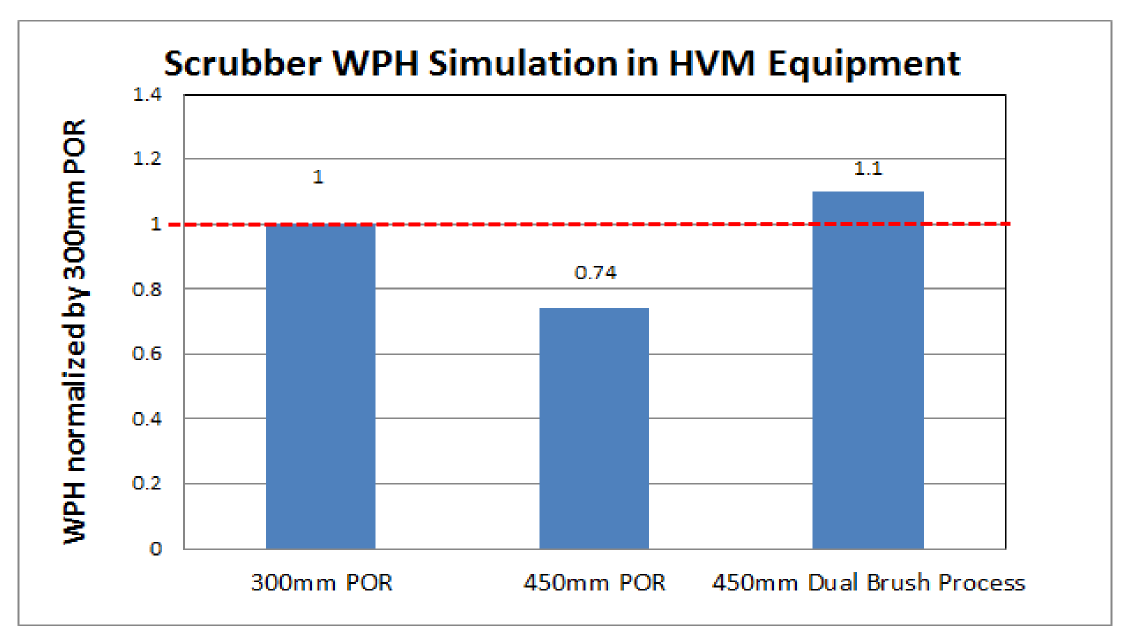
– **Long term particle performance show comparable results between POR and dual brush process in 45nm particle adders.**





Throughput Assessment

- **Wafer Throughput Evaluation:**
  - **Dual brush can significantly shorten process time with better process performance due to simultaneously brushing in both arms.**
  - **WPH simulation on a 450mm HVM production tool (multi chambers) was performed based on real process time.**
    - **Dual brush can be 10% higher than 300mm POR and 50% better than 450mm POR.**



Conclusion

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- Dual brush scrubber clean has demonstrated great potential for defect removal and wafer throughput improvement on 450mm tool.
- Further process tuning will be needed to optimize the particle removal in wafer center.