

# Cost Reduction

## PVA brush technology for next generation post-CMP cleaning applications

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With integrated chip (IC) industry's transition from 32 nm to 22 nm and smaller technology nodes, and introduction of advanced devices and new materials such as copper/ultra low-k dielectric, chemical-mechanical planarization (CMP) processes are becoming much more demanding. CMP use is expanding in Front End processing, especially in the manufacturing of memory devices.

This paper presents recent developments in the design and characterization of chemical-mechanical planarization (CMP) consumables, with specific emphasis on post-CMP (PCMP) cleaning polyvinyl alcohol (PVA) brushes. It is essential to understand the effects of cleaning chemistries on the brush PVA and any changes in the PVA properties over useful lifetime of the brush.



Entegris Planarcore® PVA brushes with molded PP core

### Post-CMP cleaning applications requirements

A good PCMP clean chemistry should effectively:

- remove organic residues,
- provide corrosion protection,
- minimize CuO formation post cleaning,
- remove trace metal ions from the wafer surface,
- avoid scratches due to metallic particle removal,
- provide excellent cleaning performance on TEOS/OSG/CDO dielectrics and excellent film wetting properties,
- avoid biological growth.

### Molded through the core (MTTC) brushes design, benefits and advantages

Compared to slip-on-the-core (SOTC) brushes, MTTC brushes are bringing several advantages as listed hereunder:

- ▶ **Installation benefits (ease of use)**
  - Eliminates core-mounting errors and mounting time
  - Most consistent (lot-to-lot) and fastest gapping by best-in-class dimensional consistency and concentricity
- ▶ **Brush break-in**
  - Lower particle shedding and reduced break-in with proprietary cleaning / break-in process ( $H_2O_2$  or  $NH_4OH$ )
  - Consistent and equal water flow across the length of the brush
- ▶ **Wafer-to-wafer consistency**
  - Aligned, concentric brush with industry-leading OD tolerance
  - Low extractables with custom manufacturing cleaning process and PP core
  - Absolute adhesion of PVA to core for no slip
- ▶ **Lifetime**
  - Non-slip and aligned brush wears more slowly
  - Increased lifetime

### Next generation PVA brush development

PVA brush technology is part of the next generation PCMP cleaning process. Advanced PCMP cleaning processes would require lower particle concentration PVA brushes and improved PVA with lower extractable levels for cleaner processes. Demanding applications may require modified charge, modified brush design, and/or CMP slurry specific brush designs.

- ▶ Modified charge PVA brushes can provide enhanced PCMP cleaning performance in specific applications, when employed with fine-tuned advanced cleaning chemistries.
- ▶ Modified nodule shape brushes in place of the regular cylindrical nodules, can provide better brush-wafer contact and cleaning efficiency in the near edge region of the wafer.

- The **T1 design brushes** (Entegris Planarcore® T1 Edge) provide more contact force as well as contact area in the wafer near edge region. It results in enhanced cleaning action in the outer region of the wafer.

- The brushes with **T2 design nodules** (Entegris Planarcore® T2 Edge) provide less continuous contact in the wafer edge region but still enough increased contact force to provide effective cleaning performance. Other researchers have demonstrated that in some applications PVA brushes can remove large amount of Cu film if the brush is touched for a long time, especially on isolated patterns. T2 nodule brushes may be useful in such high sensitivity PCMP cleaning applications.



T1 and T2 design nodules

### Key considerations and best known methods for PVA brush cleaning

In general, it is essential to follow the complete brush installation protocol provided by the OEM during the installation and start-up of any new brushes. Also, it is important to check the brush parallelism during the installation for uniform brush gapping and initial compression in order to achieve consistent PCMP cleaning performance.

Key aspects for PVA brush installation and start-up:

- ▶ Proper mounting and alignment of the PVA sleeve on the core for the SOTC brush designs (not needed in the MTTC brushes),
- ▶ Check brushes parallelism and gapping to match the POR specifications,
- ▶ Adjust DI water according to POR recipe
- ▶ Follow the brush break-in operation and qualification steps.

Planarcore MTTC PVA brushes are addressing current and future needs in post CMP cleaning applications. Contact us for additional information.

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