Handling, Filtration and Polishing Performance Characterization of Next Generation CMP Slurries

Rakesh K. Singh†, Christopher R. Wargo†, Bill Mullee* and Benno Milmore‡
Entegris, Inc.†, Silco Electronic Materials* and ON Semiconductor‡
Overview

- Motivation and Objectives
- Why Characterize CMP Consumables?
- CMP Slurry Health Management Challenges
- Slurry Characterization, Blending and Distribution
- Slurry Filtration: Trends, Methodology and Mechanisms
- Typical Slurry Handling and Filtration Characterization Data
- Characteristics of New High-Purity Colloidal Silica Slurry
- Filtration, Polishing and Wafer Defectivity Performance Data
- Summary and Conclusions
Motivation and Objectives

- This paper reviews key considerations and challenges for CMP slurry characterization, blending, metrology, handling and filtration management, and explores characteristics of new, relatively smaller abrasive, high-purity colloidal silica slurries designed specifically for ULK dielectric layers.

- Above next generation slurries (Silco EM-5530K & EM-7530K) provide precise and consistent removal rates, minimal wafer defectivity, and maximum planarity across the wafer surface. Present study evaluates comparative performance of above slurries polishing rate, NU and particle defectivity using different CMP pads and other similar slurry products.

- Selective removal of large defect causing particles without affecting the mean particle distribution is key to effective slurry filtration. This study aimed to evaluate a series of tighter graded density depth filters (Entegris Planargard®) to determine optimum filtration scheme for the slurries bulk filtration during manufacturing as well as point-of-use applications.
Why Characterize CMP Consumables?

- **Changing requirements of Chemical Mechanical Planarization**
  - More complex and demanding CMP solutions for 45 nm, 32 nm and smaller nodes
  - Introduction of larger wafers, copper, ultra low-k (ULK), high-k, and noble metals
  - Improved planarity and metrology specifications in Cu/low-k, STI, and poly-si CMP

- **Emerging applications/devices, new consumables and refined processes in CMP**
  - Each IC solution might have unique optimized CMP and PCMP clean requirements
  - MEMS, power devices, hard disk, SOI, GaAs, 3-Dim, photonic bandgap devices
  - Changed operating parameters (much lower polishing pressures in Cu/low-k CMP)
  - Innovative PCMP clean methods (laser, gaseous aerosols, supercritical CO₂)

- **Slurry vendors, system suppliers and end users more interested in collaboration**
  - Ability to evaluate and fine-tune complicated CMP slurry new formulations quickly
  - Reduce CoO and minimize development/optimization time and repetition of efforts
  - Improve understanding of CMP process needs and share cost of development

- **Evaluation of CMP disruptive technologies by the end users and tool suppliers**
  - Fixed abrasive, Electro-CMP (ECMP), and Chemically Enhanced Planarization (CEP) may offer advantages for productivity, low stress for ULK dielectrics, and Cu loss
  - Reduced need for CMP processing, PCMP cleaning, and slurry and chemical filtration
CMP Slurry Management Challenges

- **Challenges:**
  - Tighter purity and blend accuracy requirements of next generation slurries
  - Quick settling abrasive characteristics and limited post-blending useful life
  - Variability in slurry and blend chemical properties of different lots and over time
  - Uncertainties of oxidizer and additives decay and adjustments needs with time
  - More stringent particle counts, size distribution, and filtration requirements
  - Detection and selective removal of hard large particles at small concentrations
  - Newer slurries not well defined and require fine-tuning for specific processes
  - Requirements of reducing cost of ownership of CMP process and consumables
  - Continued collaboration and consolidation, and introduction of new products

- **Slurry health or quality monitoring parameters:**
  - Large (≥ 0.56 or 1.01 micron) particle counts (LPC)
  - Mean particle size distribution (PSD) and zeta potential
  - pH, ORP (oxidation reduction potential), conductivity, viscosity and refractive index
  - Total dissolved solids (TDS), weight % solids and density (or specific gravity)
  - Oxidizer and additives concentration and ionic contamination
  - Oxide slurries: agglomeration, filtration, wt % solids, LPC and PSD
  - Tungsten, copper and STI slurries: quick settling, oxidizer level, density, LPC and PSD
CMP Slurry Benchtop Characterization

- Slurry components and blend properties
  - Conductivity, pH, density, weight % solids
  - Assay, viscosity, refractive index
  - Particle size distributions (mean PSD and LPC), zeta potential
  - Incoming, normal mix ratio

- Sensitivity analysis of blend consistency measurement parameter
  - pH, density, conductivity, viscosity, assay

- Recommended mix ratio ± 20%

- Effect of DI water dilution

- Settling characteristics of abrasive particles
  - Incoming, source drum or pail, sample bottles
CMP Slurry Handling Characterization

- Settling behavior and redispersion effort
  - Incoming, storage tank or daytank, global loop settling
  - Loop shutdown, minimum flow rates
- Lifetime testing
  - Test slurry properties daily one week: day 0, 1, 2, 3, 4, 7
  - Chart properties in individual and composite form
  - Extend testing if appropriate: day 10, 14, 21, 28
- Replenishment
  - Decay of volatile/decomposing components and replenishment rate
- Filtration
  - Point-of-use (POU), point-of-dispense and global distribution loop
- Cleaning protocol
  - CDMs/PVVVs, global loop
Common blend monitoring and control parameters:
  - Density or specific gravity, Wt % solids, and oxidizer level

Limitations of other parameters:
  - pH – slurries are chemically buffered, insignificant variation with changes in blend ratio
  - ORP (Oxidation-reduction potential) - does not change with mix ratio in most CMP slurry blends
  - Conductivity or TDS - usually has good sensitivity to blend ratio, often cannot be used as an independent control parameter, conductivity values vary in different lots of the same slurry, may also vary with aging of the same slurry lot during recommended storage life

Silica based Oxide slurry: blends are controlled using density

Tungsten and Copper slurry: blends controlled using an autotitrator or other concentration analyzer (ultrasonic, RI, or NIR based) - for monitoring and replenishment of the oxidizer level

Silica slurries: slow settling characteristics

Alumina- and Ceria-based slurries: usually have quick settling behavior

Settling rate: can help in estimating the required minimum flow velocity of slurry in global loop
### Sensitivity of Measurement Parameters to H$_2$O$_2$ Wt % Concentration in a CMP Slurry and H$_2$O$_2$ Blend

<table>
<thead>
<tr>
<th>H$_2$O$_2$ % Wt</th>
<th>Density</th>
<th>Density Wt % Change Solids</th>
<th>Conductivity $\mu$S/cm</th>
<th>pH</th>
<th>H$_2$O$_2$ % Vol. Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4</td>
<td>1.03429</td>
<td>0.00026 3.036</td>
<td>14357</td>
<td>7.598</td>
<td>7.426 0.311</td>
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<td>2.5</td>
<td>1.03455</td>
<td>0.00026 3.025</td>
<td>14313</td>
<td>7.591</td>
<td>7.736 0.311</td>
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<td>2.6</td>
<td>1.03481</td>
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<td>14270</td>
<td>7.584</td>
<td>8.047 0.311</td>
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<td>2.7</td>
<td>1.03508</td>
<td>0.00026 3.003</td>
<td>14227</td>
<td>7.577</td>
<td>8.359 0.311</td>
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<td>2.8</td>
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<td>0.00026 2.992</td>
<td>14183</td>
<td>7.570</td>
<td>8.670 0.311</td>
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<td>2.9</td>
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<td>8.982 0.312</td>
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<td>14096</td>
<td>7.557</td>
<td>9.293 0.312</td>
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<td>3.1</td>
<td>1.03614</td>
<td>0.00026 2.959</td>
<td>14052</td>
<td>7.550</td>
<td>9.605 0.312</td>
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</table>
Handling and Filtration of CMP Slurries
Levitronix CMP Users Conf., Feb. 11, 2008

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Silco Electronic Materials
The materials integrity management company

- Large particles (>10x of \(d_{50}\)) in slurries can cause defects (microscratches) and yield losses. Slurry suppliers employ filtration to eliminate those particles in manufacturing. Large particles tend to slowly reform due to instabilities in chemistry and handling.

- **Objective of CMP Slurry Filtration: Defect Reduction and Yield Improvement**
  - To remove large particles and agglomerates from slurry that can cause defects, without changing slurry polishing performance.

![Graph showing bulk particle concentration and particle size distribution.](image)

- **Graph Description:**
  - **X-axis:** Particle Size (nm)
  - **Y-axis:** Relative Number of Particles
  - **Legend:**
    - Bulk Particle Concentration
    - \(>10^5\) Particles/ml
    - \(10^4\) to \(10^6\) Particles/ml
  - The graph illustrates the relative number of particles at different sizes, highlighting the importance of filtration in reducing large particles that can cause defects.
CMP Slurry Filtration: Changing Process Needs

- Next generation slurry filtration targets:
  - Tighter retention of large particles at much smaller large-particle cut-off (e.g., 0.2 or 0.2 μm)
  - More consistent flow rate and pressure drop behavior, and longer filter lifetime
  - Minimal effects on the mean working particles for better local and global planarity, and consistency in the CMP processing

<table>
<thead>
<tr>
<th>Particle size</th>
<th>Earlier</th>
<th>New Target</th>
<th>Typical Next Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>D50 (mean size)</td>
<td>0.20 μm</td>
<td>0.07 μm</td>
<td>0.04 μm</td>
</tr>
<tr>
<td>D99</td>
<td>1 μm</td>
<td>0.3 μm</td>
<td>0.2 μm</td>
</tr>
</tbody>
</table>
Slurry Filtration Process

- CMP filtration is actually a separation process
- Filters have difficulty separating particles that are less than 1 order of magnitude different in size
- Don’t think of filters as strainers working only by size exclusion, there are other important mechanisms
  - Inertial impaction, Interception, Adsorption/Adhesion, Diffusion, and Settling
- There are also effects tied to how the media is arranged in the filter

![Retention vs. Particle Size Diagram]

**Ideal filter with sharp cut-off**

**Typical retention curve**
Handling and Filtration of CMP Slurries
Levitronix CMP Users Conf., Feb. 11, 2008

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**Slurry Filtration Characterization**

- **Retention/Flow and Pressure Drop Test**
  - Retention test conducted with PSL beads solution and CMP slurries and pressure drop tests at 0, 1, 2, 3, 4 GPM using a differential pressure unit

- **Lifetime Test**
  - Testing with CMP slurries and pressure drop and flow rate measurements till pressure drop reaches a specified limit

- **Recirculation Loop Test**
  - Evaluation of global loop and POU filters using a vacuum-pressure dispense system as well as bellows, diaphragm, a magnetically levitated centrifugal pumps

- **Collaborative Testing with Slurry Vendors and Customers**
  - Field returned filter analysis and troubleshooting
  - Extent of filter plugging/remaining lifetime by Δp and weight gain
  - SEM and ESEM (environmental SEM, for wet sample imaging) analysis

- **Filter Related Troubleshooting at Site**
Slurry and Filter Characterization in CMP Laboratory
Simulated Recirculation Loop

Schematic of Slurry Recirculation Loop Test Set-Up
Example 1 - LPC data for Silica Slurry-A under extensive handling in a magnetically levitated centrifugal pump and a diaphragm pump

8000 rpm, 28 psi back pressure, 8 lpm, 63.4 turnovers/hr, 20 hr test, BPS-3 pump

28 psi back pressure, 8 lpm, 63.4 turnovers/hr, 24 hr test, diaphragm pump
Example 2 - LPC data for Silica Slurry-B under extensive handling in a vacuum-pressure dispense system and a bellows pump loop

LPC data for Silica Slurry 1 in a vacuum-pressure dispense system at 17.1 turnovers/hr

LPC data for Silica Slurry 1 in bellows pump recirculation loop at 60 turnovers/hr
LPC data for different abrasive slurries under single-pass tighter filtration using Entegris Planargard® CS05 (0.5 μm) depth filter.

LPC for 0.5 μm (CS05) nominal rating depth media filters in single-pass filtration experiments. (a) Silica-1, (b) Ceria-1, and (c) Alumina-1 slurry.
### LPC data, pressure drop and flow rate for different slurries with Entegris Planargard® CS05 (0.5 μm) and Planargard® CMP1 (1 μm) depth filters

<table>
<thead>
<tr>
<th>Slurry / Challenge Solution</th>
<th>CS05 (Cumulative % LPC reduction for particles ≥0.56 μm)</th>
<th>Pressure Drop Δp (psi)</th>
<th>Flow Rate (ml/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica-1</td>
<td>78</td>
<td>40</td>
<td>127</td>
</tr>
<tr>
<td>Ceria-1</td>
<td>56</td>
<td>12.7</td>
<td>469</td>
</tr>
<tr>
<td>Alumina-1</td>
<td>88</td>
<td>19</td>
<td>450</td>
</tr>
<tr>
<td>Silica-2</td>
<td>90</td>
<td>28</td>
<td>275</td>
</tr>
<tr>
<td>Alumina-2</td>
<td>83</td>
<td>14</td>
<td>458</td>
</tr>
<tr>
<td>PSL Bead Solution</td>
<td>62</td>
<td>11.8</td>
<td>500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Slurry / Challenge Solution</th>
<th>CMP1 (Cumulative % LPC reduction for particles ≥1.01 μm)</th>
<th>Pressure Drop Δp (psi)</th>
<th>Flow Rate (ml/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica-1</td>
<td>63</td>
<td>7.8</td>
<td>423</td>
</tr>
<tr>
<td>Ceria-1</td>
<td>53</td>
<td>5.2</td>
<td>519</td>
</tr>
<tr>
<td>Alumina-1</td>
<td>71</td>
<td>3.5</td>
<td>535</td>
</tr>
<tr>
<td>Alumina-2</td>
<td>69</td>
<td>5.2</td>
<td>531</td>
</tr>
<tr>
<td>PSL Bead Solution</td>
<td>36</td>
<td>4.4</td>
<td>535</td>
</tr>
</tbody>
</table>

Table 1. Filters show large slurry dependent variations in performance.
Characteristics of a New Colloidal Silica Slurry

- Unique pH-Stable Colloidal Slurry Products
- Consistent Particle Size Distribution
- More Stable CMP Process Window
- Very High Purity… < 10 PPM Sodium
- Very Low Metals, No Chlorides
- Excellent Product Stability
- Monodisperse Low-pH Particles
- Lower Defect Counts!
Typical Colloidal Silica Particles
pH Stabilization Process

Low-pH Slurry Feed → Lev 1 pump → CMP Mix Tank → Lev 2 pump → Cleanroom Filtering & Packaging

KOH
pH Stabilization Study

75nm High Purity Colloidal Slurry

Spec. Limits

Silco Process

Industry Standard

DAYS

pH

8.5 9 9.5 10 10.5 11 11.5 12 12.5 13

0 15 30 45 60 75 90 105 120 135 150 165 180
# Effect of Trace Metals on ILD Polish Performance

<table>
<thead>
<tr>
<th>Slurry</th>
<th>[Al]</th>
<th>[Ca]</th>
<th>[Cr]</th>
<th>[Fe]</th>
<th>[Ni]</th>
<th>[Na]</th>
<th>Normalized Defects &amp; Microscratches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silco</td>
<td>&lt;1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;1</td>
<td>&lt;0.1</td>
<td>&lt;10</td>
<td>198</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>164</td>
</tr>
<tr>
<td>Standard</td>
<td>&lt;100</td>
<td>&lt;1.8</td>
<td>NA</td>
<td>&lt;6.5</td>
<td>&lt;10</td>
<td>&lt;50</td>
<td>588-658</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>268-316</td>
</tr>
<tr>
<td>Supplier X</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>233-277</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>451-533</td>
</tr>
<tr>
<td>Typical</td>
<td>&lt;50</td>
<td>&lt;5</td>
<td>&lt;1</td>
<td>&lt;20</td>
<td>&lt;100</td>
<td>&lt;100</td>
<td>NA</td>
</tr>
</tbody>
</table>

- Experiments run by a volume IC Fab
- All metals are specs and units in ppm
- All slurries are based on colloidal silica particles
- Comparable removal rate and uniformity
# Silco 75nm ILD Slurry Performance

<table>
<thead>
<tr>
<th>Slurry</th>
<th>Down Force (psi)</th>
<th>Uniformity</th>
<th>Normalized Defects &amp; Microscratches</th>
<th>Polish Rate (A/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silco</td>
<td>7.0</td>
<td>6.0%</td>
<td>198</td>
<td>3800</td>
</tr>
<tr>
<td>Standard</td>
<td>7.0</td>
<td>7.4%</td>
<td>588-658</td>
<td>3700</td>
</tr>
<tr>
<td>Alternative</td>
<td>7.6</td>
<td>5.5 to 8.0%</td>
<td>233-277</td>
<td>3650</td>
</tr>
</tbody>
</table>

- Experiments run by a volume IC Fab
- All slurries are based on colloidal silica particles
- All slurries have same solids content of silica
ILD Polish Objectives

- Compare defect performance of Silco EM products vs POR slurry and alternate slurry in qualification using blanket furnace TEOS wafers
- Perform 1000A HF etch to highlight and provide insight into microscratch performance
- Compare blanket polish rates and non-uniformity using Silane based oxide film
- Tests performed on Novellus Momentum and Applied Materials Mirra platforms
Results

– Scratch Monitor: Control, HF Highlight without a polish

HF Highlight added 3 particles
Results Cont.

- Scratch Monitor: Slurry 1, Novellus w/ IC1000 Pads, Wafer #1

Particle count post polish

Particle count post 1000Å HF highlight for micro-scratches
Results Cont.

– Scratch Monitor: Slurry 2, Novellus w/ IC1000 Pads, Wafer #1

Particle count post polish

No defects found

Particle count post 1000Å HF highlight for micro-scratches
Results Cont.

- Scratch Monitor: Silco EM-7530K, Novellus w/ IC1000 Pads, Wafer #1

Particle count post polish

Particle count post 1000Å HF highlight for micro-scratches
Results Cont.

- Scratch Monitor: Slurry 1, AMAT w/ IC1010 Pads, Wafer #1

Particle count post polish

Particle count post 1000Å HF highlight for micro-scratches
Results Cont.

- Scratch Monitor: Slurry 2, AMAT w/ IC1010 Pads, Wafer #1
Results Cont.

- Scratch Monitor: Silco EM-7530K, AMAT w/ IC1010 Pads, Wafer #1

Particle count post polish

Particle count post 1000Å HF highlight for micro-scratches
## EM-5530K and EM-7530K Wafer Polishing Rate, NU and Particle Data Summary

<table>
<thead>
<tr>
<th>Platform</th>
<th>Pad</th>
<th>Slurry</th>
<th>Rate</th>
<th>NU</th>
<th>Particles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novellus</td>
<td>IC1000</td>
<td>EM-5530K</td>
<td>2496</td>
<td>3.8</td>
<td>2.67</td>
</tr>
<tr>
<td>Novellus</td>
<td>IC1000</td>
<td>EM-7530K</td>
<td>2221</td>
<td>1.5</td>
<td>1.33</td>
</tr>
<tr>
<td>Novellus</td>
<td>IC1000</td>
<td>Slurry 1</td>
<td>2364</td>
<td>6.8*</td>
<td>14.67</td>
</tr>
<tr>
<td>Novellus</td>
<td>IC1000</td>
<td>Slurry 2</td>
<td>2366</td>
<td>6.9*</td>
<td>0.67</td>
</tr>
<tr>
<td>AMAT</td>
<td>IC1010</td>
<td>EM-5530K</td>
<td>3143</td>
<td>6.38</td>
<td>16</td>
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<tr>
<td>AMAT</td>
<td>IC1010</td>
<td>EM-7530K</td>
<td>2862</td>
<td>6.57</td>
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<tr>
<td>AMAT</td>
<td>IC1010</td>
<td>Slurry 1</td>
<td>2990</td>
<td>5.37*</td>
<td>19.67</td>
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<td>AMAT</td>
<td>IC1010</td>
<td>Slurry 2</td>
<td>3098</td>
<td>5.01*</td>
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<tr>
<td>AMAT</td>
<td>PPG</td>
<td>EM-5530K</td>
<td>3243</td>
<td>4.43</td>
<td>4</td>
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<tr>
<td>AMAT</td>
<td>PPG</td>
<td>EM-7530K</td>
<td>3066</td>
<td>4.66</td>
<td>4.67</td>
</tr>
</tbody>
</table>

Green = Silco  
Yellow = Slurry 1  
Blue = Slurry 2
ILD Polish Observations

- Defect performance of Silco EM-7530K is favorable compared to alternate colloidal slurries on both the Novellus Momentum and Applied Materials Mirra platforms.

- Removal rate and non-uniformity are comparable on both Novellus and Applied platforms.

- Silco EM-5530K exhibited slightly higher removal rate relative to EM-7530K.
Results of Filtration Study with Entegris High-Retention Graded Density Depth Filters

Figure 1. Schematic of Filter Test Set-Up.

Figure 2. Colloidal Silica Dispersion source and Planargard® high retention filters LPC distribution.
Results of Filtration Study with Entegris 1 μm Nominal Rating Graded Density Depth Filters

Figure 3a. Colloidal Silica Dispersion source and Planargard® 1 micron filters LPC distribution.

Figure 3b. Colloidal Silica Dispersion source and Planargard® 1 micron filters LPC distribution.
Results of Filtration Study with Entegris High-Retention Graded Density Depth Filters

Figure 4a. EM-5530HP oxide silica slurry source and Planargard® high retention filters LPC distribution.

Figure 4b. EM-5530HP oxide silica slurry source and Planargard® high retention filters LPC distribution.
### Results of Filtration Study with Entegris High-Retention Graded Density Depth Filters

<table>
<thead>
<tr>
<th>Filter Type (2” sample)</th>
<th>Pr. Drop (\Delta p ) (psi)</th>
<th>Flow Rate ( Q ) (mL/min)</th>
<th>#/mL Part. Conc. ( \geq 0.56 \mu m ) size</th>
<th>#/mL Pt. Retention ( \geq 0.56 \mu m ) size (%)</th>
<th>Weight % of Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Silica Dispersion (Filtrate Properties)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planargard® CS0.2</td>
<td>44</td>
<td>466</td>
<td>41312</td>
<td>99.3</td>
<td>32.0</td>
</tr>
<tr>
<td>Planargard® CS0.5</td>
<td>16</td>
<td>474</td>
<td>62764</td>
<td>98.9</td>
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<td>Planargard® CL0.3</td>
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<td>114332</td>
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<td>Planargard® CL0.7</td>
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<td>123110</td>
<td>97.8</td>
<td>32.3</td>
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<td>Planargard® CL1.0</td>
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### Results of Filtration Study with Entegris High-Retention Graded Density Depth Filters

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<th>Filter Type (2” sample)</th>
<th>Filtrate Mean Particle Size, μm</th>
<th>pH</th>
<th>Conductivity (μS/cm)</th>
<th>TDS (ppm)</th>
<th>ORP (mV)</th>
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**Source Silica Dispersion and EM-5530HP Slurry Properties**

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<th>pH</th>
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<th>TDS (ppm)</th>
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Summary and Conclusions

- Effective CMP slurry management should consider abrasive type and composition, oxidizer and chemical additives, LPC, mean PSD, pH, conductivity, wt % solids, viscosity, filter particle retention, pressure drop, flow-rate and lifetime, slurry usage schedule and turnover rate, and the blending and distribution system “the pump” characteristics. Slurry characterization and metrology studies help in identification of sensitive parameters to blend slurry accurately and monitor its health during usage and replenishment.

- Diaphragm and bellows pump handling tests show that silica-based CMP slurries are shear sensitive and generate significant number of large particles under extensive pump turnovers. A magnetically levitated centrifugal (MLC) pump generated far fewer large particles (size > 1 micron) as compared to double diaphragm pumps in silica slurry under comparable turnovers.

- Present study evaluates comparative performance of Silco EM-5530K & EM-7530K slurries in terms of polishing rate, NU and particle defectivity using different CMP pads and other similar slurry products. These next generation slurries provide precise and consistent removal rates, minimal wafer defectivity, and maximum planarity across the wafer surface.

- This study aimed to determine the optimum filtration scheme for Silco Electronic Materials EM-5530 silica slurry. A series of Entegris Planargard® graded density depth filters were tested to quantify their effectiveness in removing defect causing large particles from the slurry.

- Planargard® CS0.5 and Planargard® CL0.3 (nominal ratings 0.5 and 0.3 micron, respectively) filters provided the required reduction in the cumulative LPCs ≥ 0.56 micron. This study shows the importance of CMP consumables comparative laboratory and fab evaluations to generate optimum slurry quality/health management information.
Acknowledgments

- Dr. Peter Burke for his support and valuable insights
- Clint Jones for his contributions in polishing experiments
- Slurry manufacturers for providing CMP slurry samples
- Levitronix GmbH for providing a MLC pump for this study
- Contaminations Control Solutions Team at Entegris, Inc.
- Levitronix CMP Users Conf. Organizers for the opportunity

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