Game Change: Monitoring Large Particles in Undiluted Slurry
Agenda

- Vantage SlurryScope™ principles
- Comparison to SPOS methods
- Tales from the sub-fab
- Implications for fab operations & yield
- Conclusions
Vantage Technology SlurryScope™

- Continuous, real-time measurement @ 15 ml/min
- Detection range 1-12 μm in 0.2 μm increments
- Undiluted CMP slurry, all types
SlurryScope Typical Data

Particle Size Distribution

Particles vs. Time by Size

Particles/ml

Total Particles >1 micron

Particle Size (microns)

Particles/ml

Particles vs. Time by Size

Particles/ml
<table>
<thead>
<tr>
<th>SPOS* Methods</th>
<th>SlurryScope System</th>
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<tr>
<td>Periodic sampling</td>
<td>Continuous monitoring</td>
</tr>
<tr>
<td>Sample size 0.25-1 ml</td>
<td>Sampling rate 15 ml/min</td>
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<td>Offline / near line</td>
<td>Real-time</td>
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<td>Dilution to meet SPOS detector requirements</td>
<td>Undiluted at full POU concentration</td>
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<td>Integrates into SDS</td>
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<td>Integrates into polisher slurry lines at POU</td>
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*S*Single Particle Optical Sizing
SPOS: Agglomeration On Dilution

Ceria Slurry Dilution

Ref: Vantage Technology Corp., unpublished
SPOS: Agglomeration On Dilution

Normalized Ceria Slurry Dilution

Ref: Vantage Technology Corp., unpublished
SPOS Sample Size: Percent Deviation vs. Particle Count

Low counts
Large particles
CMP scratches

Ref: M. Fury, NCCAVS CMPUG May, 2012
Several examples of live sub-fab data taken from SlurryScope qualifications
Both silica & ceria slurries are represented
No simulations, no staged events, no chicanery of any kind
Wafers were probably harmed during the making of this data set

What’s going on in your slurry?
Spikes in particle counts every 30 minutes
*while flow rate remains constant*

![Graph showing particle counts and flow rate over time.](image-url)
SlurryScope tales from the sub-fab

LPC Shifts Due to Filter Changes

Ref: ASMC May, 2012; A. Kim, Mega Fluid Systems & M. Parkin, Vantage Technology Corp.
SlurryScope tales from the sub-fab

Periodic LPC Spikes Due to Sub-fab Equipment Cycling

8 Minutes
SlurryScope tales from the sub-fab

Square wave caused by shift between tank A & tank B in SDS

4 Hours
Point excursion observed in >12μm range

*with no evidence of same in 1-12μm range*
SlurryScope tales from the sub-fab

- Point excursion observed across full size range (*typical*)
- Unknown LPC excursion at small particles only
Implications for Fab Operations

- Periodic slurry monitoring *can* assist *post-mortem* diagnosis of wafer scratching
  - Cannot prevent wafer scratching from occurring
  - Low probability of capturing brief LPC excursions
  - Low probability of capturing LPC periodicity

- Continuous online slurry monitoring can identify patterns and practices that contribute to LPC excursions
  - Identify and eliminate root causes of LPC shifts
  - Reduce the incidence of slurry-induced wafer scratching
  - Applies 6σ principles to prevent wafer scratching
Vantage / Ebara experimental data shows a quantitative relationship between LPC and wafer scratches.

Customer feedback corroborates quantitative correlation across a variety of fab conditions and slurry types.

Periodic sampling does not reflect the dynamic behavior – *and misbehavior* – of slurry systems in a fab environment.

Continuous monitoring of undiluted slurry provides *new information* that allows LPC sources to be traced and eliminated, bringing CMP in line with 6σ process defect control principles.

You won’t know what’s happening in your slurry line until you look…
Additional Information

- Semicon West 2012: Malema Booth 625
- Semicon West 2012: Levitronix Booth 1440
- NCCAVS CMPUG May, 2012; M. Fury
- ASMC May, 2012; A. Kim, Mega Fluid Systems & M. Parkin, Vantage Technology Corp.
- ICPT 2011
- Solid State Technology, July 2011