VANTAGE TECHNOLOGY CORPORATION

Field Validation of Sub-Micron Defect Correlation with ≥1 Micron Particle Behavior in Undiluted POU CMP Slurry

Michael A. Fury, Ph.D.
Director of Market Development
MFury@VantageTechCorp.com

Vantage Technology Corporation, 1731 Dell Avenue, Campbell, CA 95008 USA

NCCAVS CMPUG
July 09, 2014

Outline

- Groundrules
- Production Conditions
- Principles Confirmed

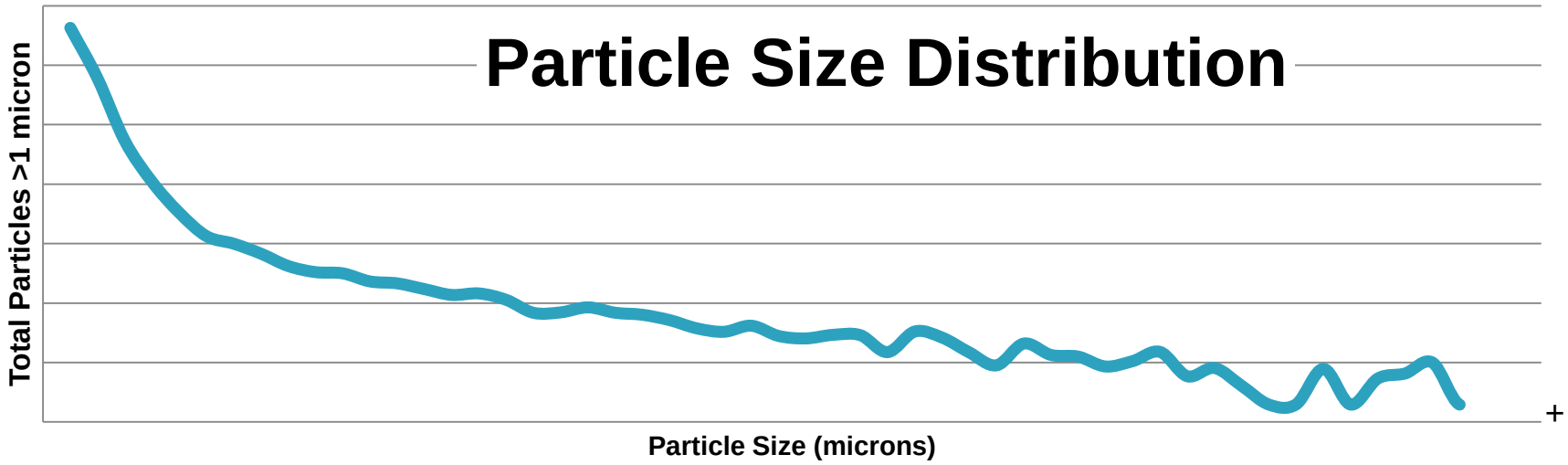
Groundrules

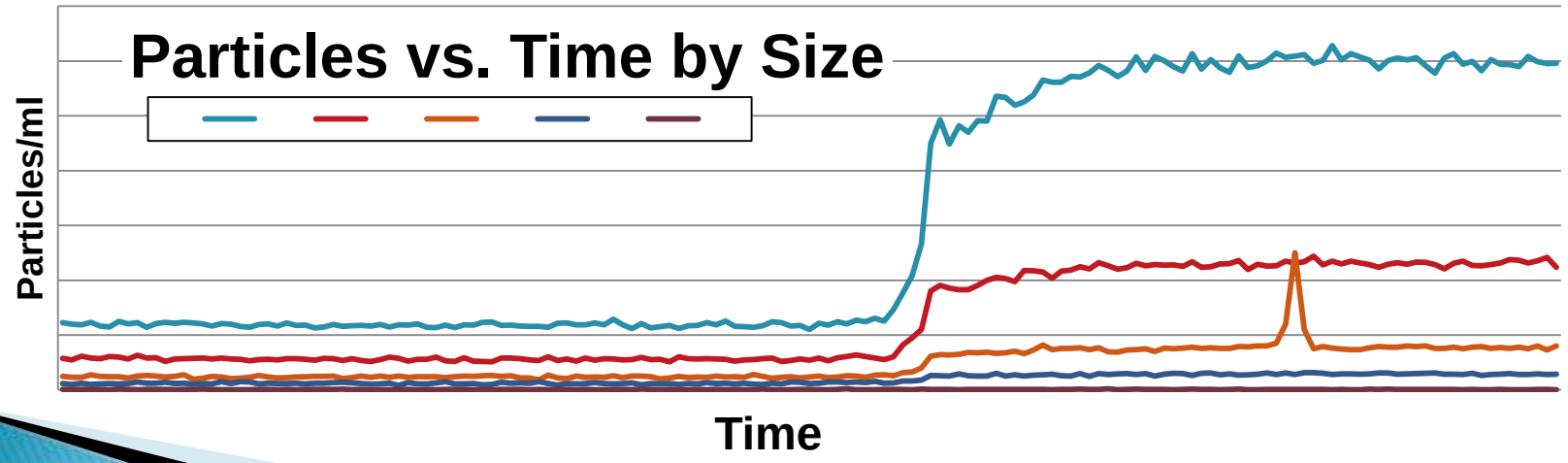
- ICPT 2014 abstract acceptance pending
  - Customer management has approved release
  - Details of fab correlation data will be released at that time
- Metadata: data about data
  - The lessons learned from this customer fab experience, combined with others, are the subject of this presentation

Production Conditions

- Chip manufacturing operation, fab floor
- Ceria slurry
- SlurryScope measuring inside the CMP tool *before* the POU slurry filter
- Continuous monitoring for 3 weeks during each wafer polish operation
- Correlation of LPC data to subsequent physical and electrical defect data for each wafer
- Standard statistical methods for complex data sets

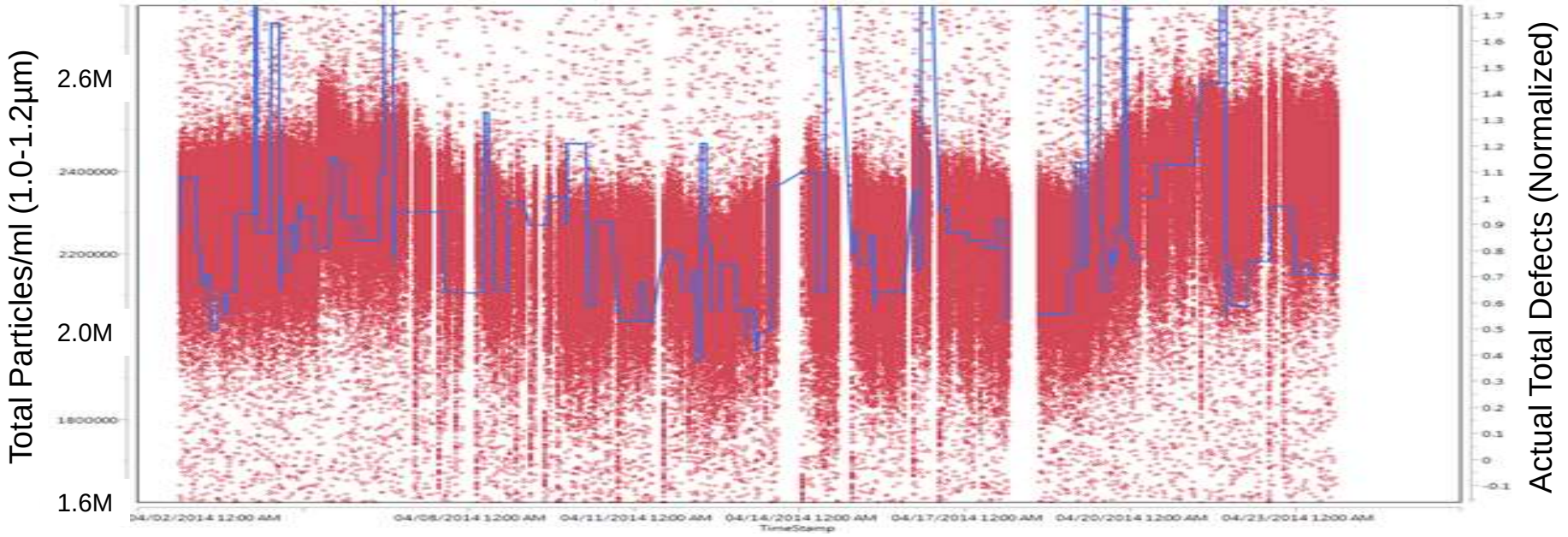
SlurryScope Data Modes





VANTAGE TECHNOLOGY CORPORATION

Current Customer Data - Preview



- Expanded LPC vertical scale
- Normalized total defect data in blue
- 3 weeks of data along X-axis
- Blank spaces in data when not polishing

VANTAGE TECHNOLOGY CORPORATION

Principle #1 Confirmed

- Particle counts in the 1.0-1.2µm size bin are a good proxy for what is happening in the majority sub-micron particle size distribution
  - For systemic slurry issues, large particles track the behavior of sub-micron particles
  - Continuous, real-time measurement of particles >0.8µm in undiluted slurry is well demonstrated by SlurryScope
  - Comparable measurement <0.8µm by any method remains an unsolved technical challenge

Principle #2 Confirmed

- There is signal in the noise
  - Small variations in stable LPC are the data that correlates with defects
  - Correlations that can be established over extended periods (several days, weeks) may be *undetectable* over shorter periods (hours, few days)

- Offline dilution particle data are noisy
  - Small sample size, infrequent measurements
  - Correlation to SlurryScope can be established over extended periods

Principle #3 Confirmed

- Batch-to-batch and tote-to-tote LPC differences comprise a significant driver for defect trends
  - Customers are asking slurry vendors to adapt methods and report SlurryScope data for QC

- LPC excursion events are *not* the defect driver in a stable SDS operation
  - Excursions are operational, largely self-inflicted
  - Identify the root cause and *STOP DOING THAT*
  - Defects may be caused by LPC excursions, but these are a separate population from the defects caused by systemic slurry changes

Principle #4 Confirmed

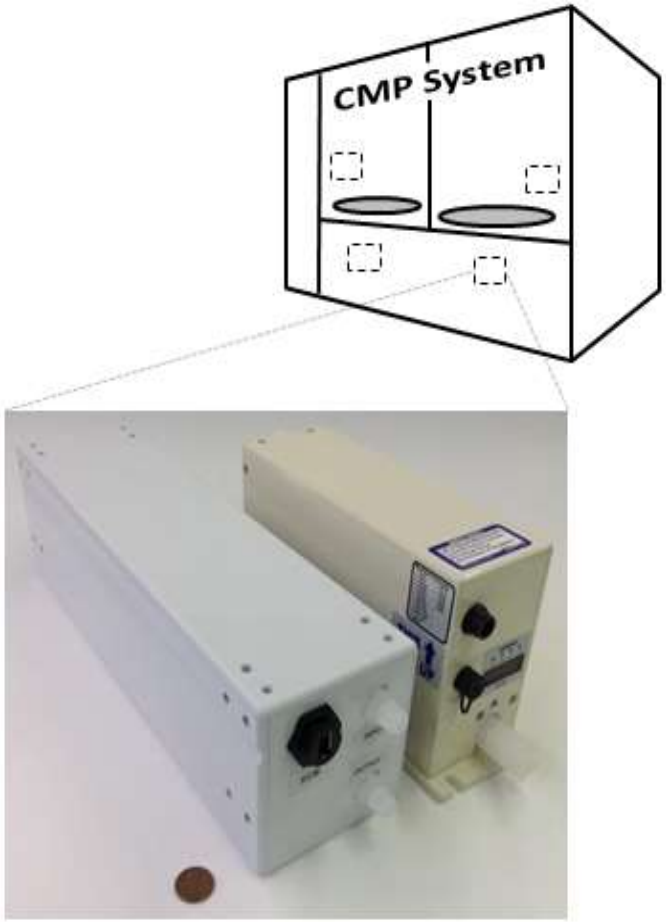
- The particles removed by filtration are not necessarily those that cause defects
  - SlurryScope measured >1.0µm
  - SlurryScope sampling was *before* the POU filter
  - After measurement, slurry passed through POU filter onto the polishing platen
  - *This is the SlurryScope data that correlated with defects*
- **Say it again:** LPC data for particles >1.0µm is a good proxy for monitoring behavior of the sub-micron majority

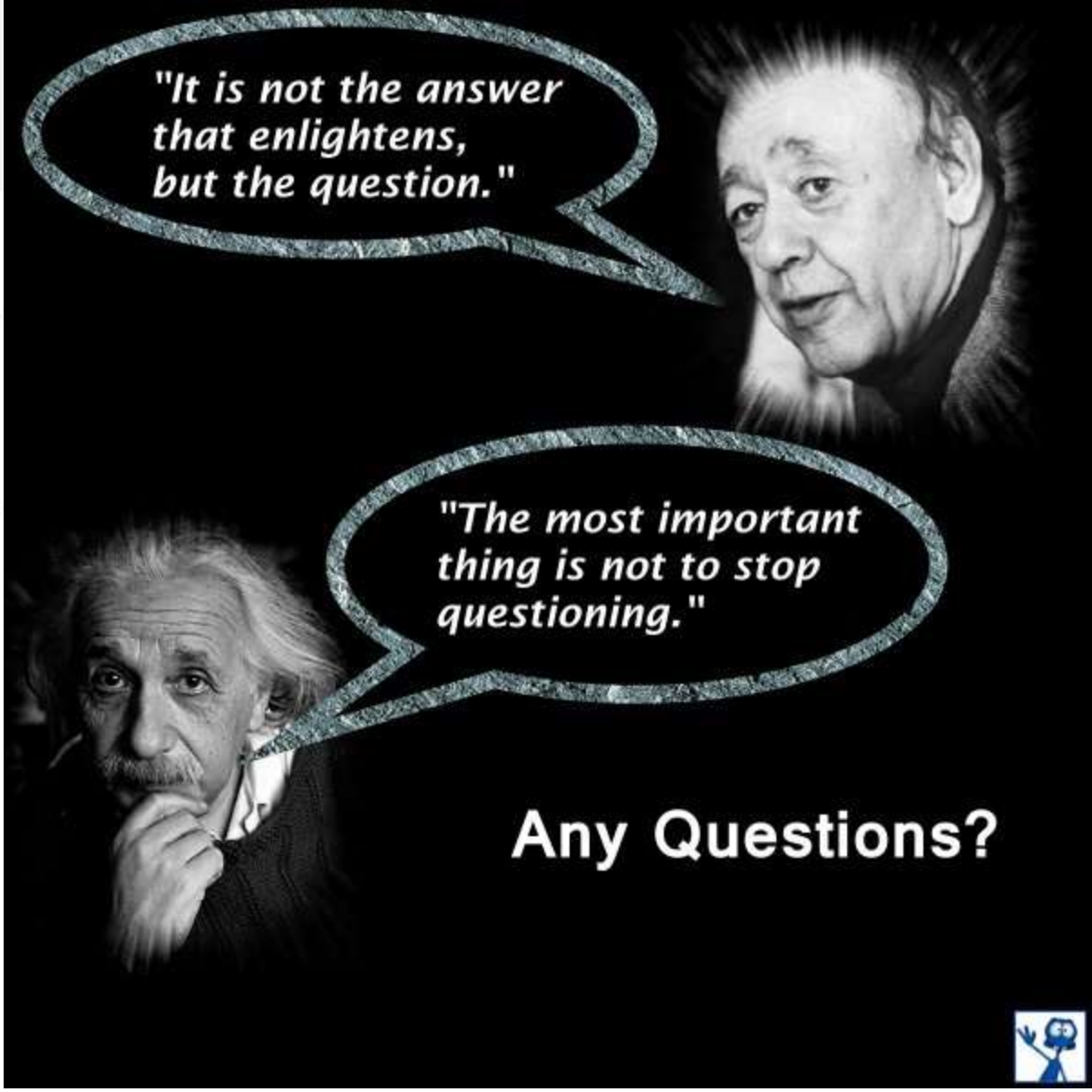
Principle #5 Confirmed

- The smallest particle size bin carries systemic slurry information
  - Correlates with defects
  - Slurry tote and lot changes
  - Slurry pot aging
- Larger particle size bin data can be used to concurrently monitor operational events
  - Day tank changes
  - Filter changes
  - Pump changes

Final Thoughts

- One engineer was responsible for fab process operations and sub-fab slurry management
  - No “Upstairs Downstairs” contention
- The statistical data analysis methods used must be as sophisticated as the data itself
  - Simplistic number crunching can be easily overwhelmed by normal noise levels in the data
- Once SlurryScope data behavior is characterized in retrospect, methods can be developed for better managing fab operations and reducing defects





VANTAGE TECHNOLOGY CORPORATION