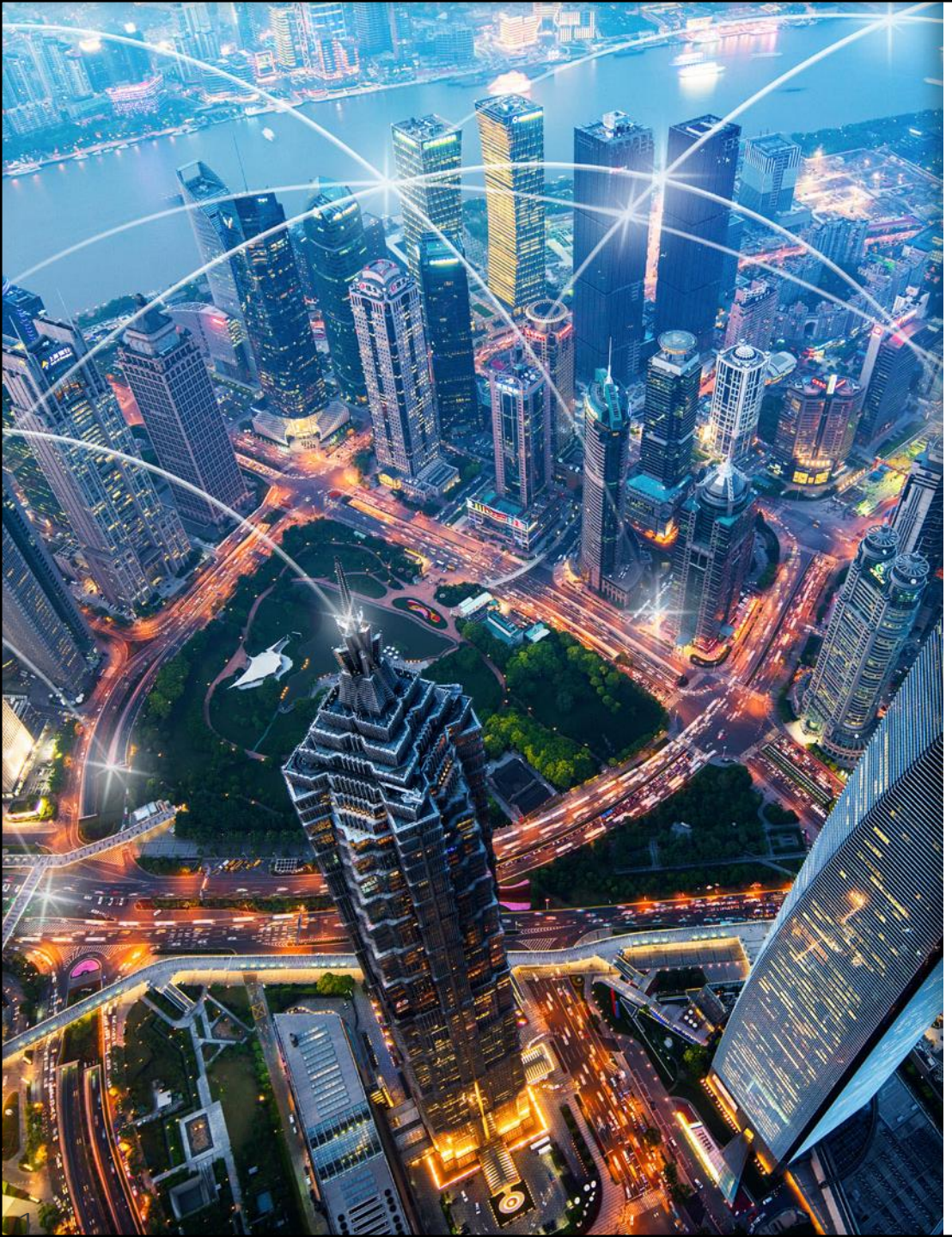

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NCCAVS CMP Users Group Fall Meeting

October 2021

Utilizing Advanced POU Filters for Two-Stage Filtration in Slurry Distribution Systems

Bradley Wood

Applications Engineering Manager, CMP Filtration

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Agenda

	Topic
1	About Entegris
2	Background on CMP Filtration
3	Experimental Procedure
4	Results/Discussion
5	Conclusions and Future Work

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Entegris at a Glance

A world-class supplier of advanced materials and process solutions for the semiconductor, life sciences, and other high-tech industries

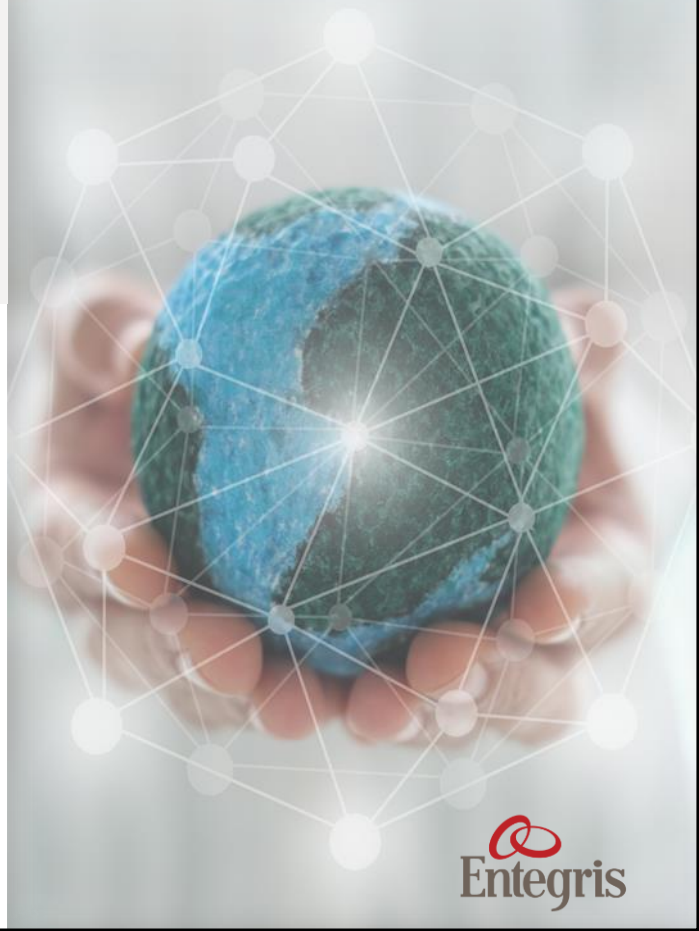
FOUNDED	HEADQUARTERS	EMPLOYEES	2020 REVENUE	PATENTS
1966	Billerica, MA	~5,800	$1.9B	2,550+

Business Divisions

- Advanced Materials Handling (AMH)
- Microcontamination Control (MC)
- Specialty Chemicals & Engineered Materials (SCEM)

Our Mission

To help our customers improve their productivity, performance and technology by providing enhanced materials and process solutions for the most advanced manufacturing environments



CMP Filtration

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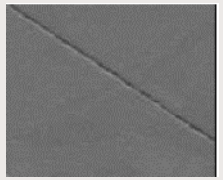
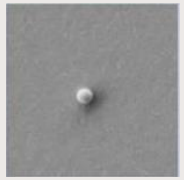
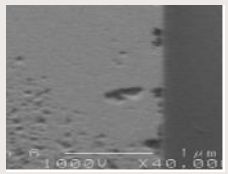
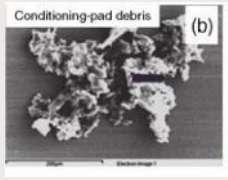
Role of Filtration in Addressing CMP Defects

- Agglomeration of slurry abrasive can lead to large particles or aggregates in the slurry during slurry distribution
- These particles can lead to scratches, which are one of the most important yield killers and require continuous improvement
- Filters facilitate scratch reduction, but scratches can come from various sources
- Filtration can address scratches and the particles that create scratches

	 Scratches	 Particles	 Pitting	 Organics	Fall On	Others
Abrasive	FILTRATION	FILTRATION				
Slurry formation						Uniformity, topography, roughness
Post-clean						
Pad and conditioner						Type and lifetime
Facility						
Wafer						Roughness and uniformity

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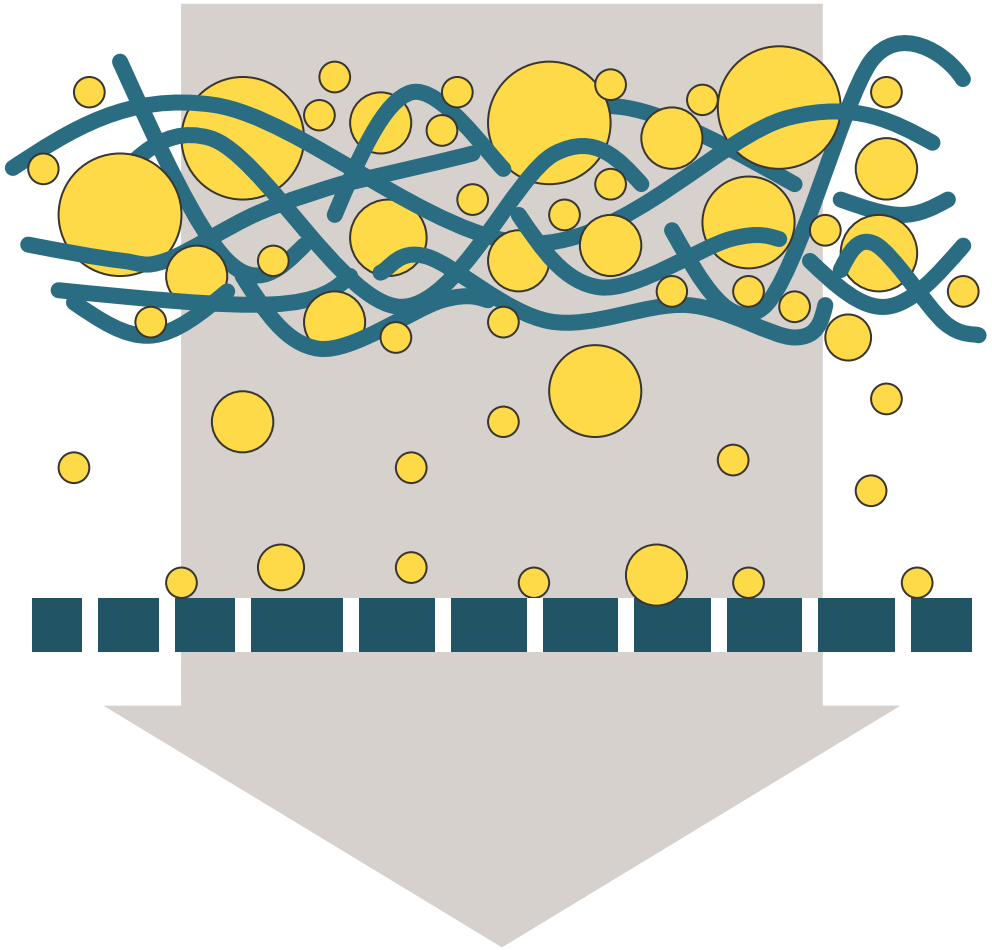
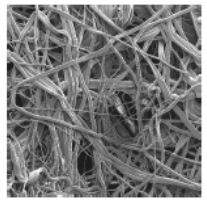
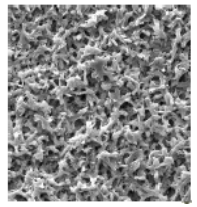
Depth vs. Membrane Filtration



	Depth	Membrane
Media		
Form	Interlock fibers	Continuous polymer sheet
FM holding capacity	Higher	Lower
Retention	Lower	Higher
Shedding	Can be high with pulsation	Low
Application	• Pre-filtration • Slurry filtration • Chemical recirculation	Impurity removal from: • Ultrapure chemicals • Photoresists • UPW

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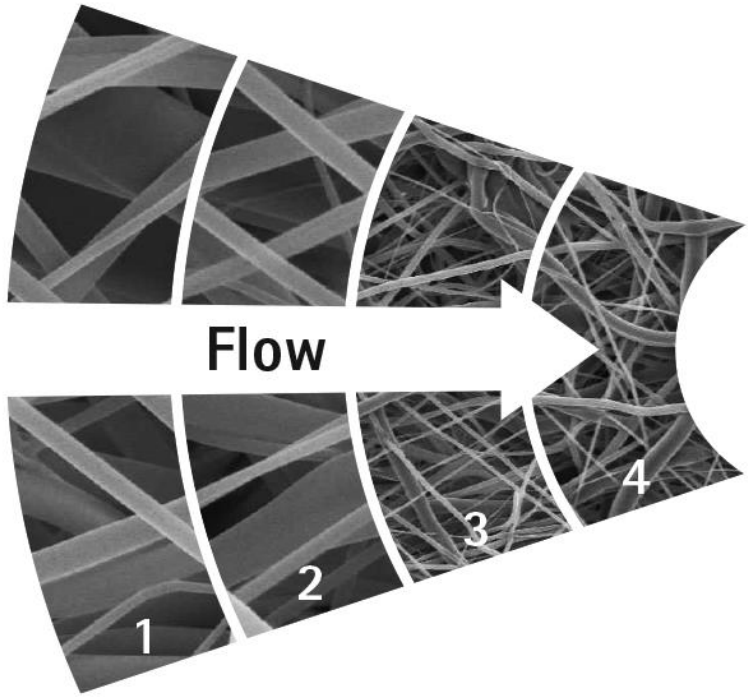
Slurry Filter Mechanisms for Large Particle Removal



- Slurry filters are traditionally depth-graded with polypropylene (PP) fibers
- Slurry filters are available in different retention ratings
- Nano-melt blown technology can reduce shear force during filtration, which has a strong impact on large particle counts (LPC)

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Experimental Procedure

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Test Setup and Parameters

Utilized two filter types for this testing

- 5″ disposable (POU* 70 nm, 50 nm, 30 nm)
- 10″ cartridge (CDS or global loop 0.1 µm)

Constant parameters

- 2.7 LPM loop recirculation flow
- 300 mLPM POU single pass flow
- Acidic silica slurry (15 L per test)
- Test time ~2 hours
- Sampling time
  - Pre-test (baseline sample)
  - T1 (1 tank turn over)
  - T20 (20 tank turn overs)

*POU (Point of Use)

CMP Filter Test Stand

- Recirculation high-flow and low-flow test loops
- High-flow loop is Chemlock® compatible (Chemgard™ housing shown)
- Two low-flow loops for Solaris® or Planarcap® style filters
- Single tank system
  - DIW or slurry compatible
  - Single process chemistry at a time
  - Constant stir mixer integrated with tank
  - Single pass to drain or recirculation flow paths configurable

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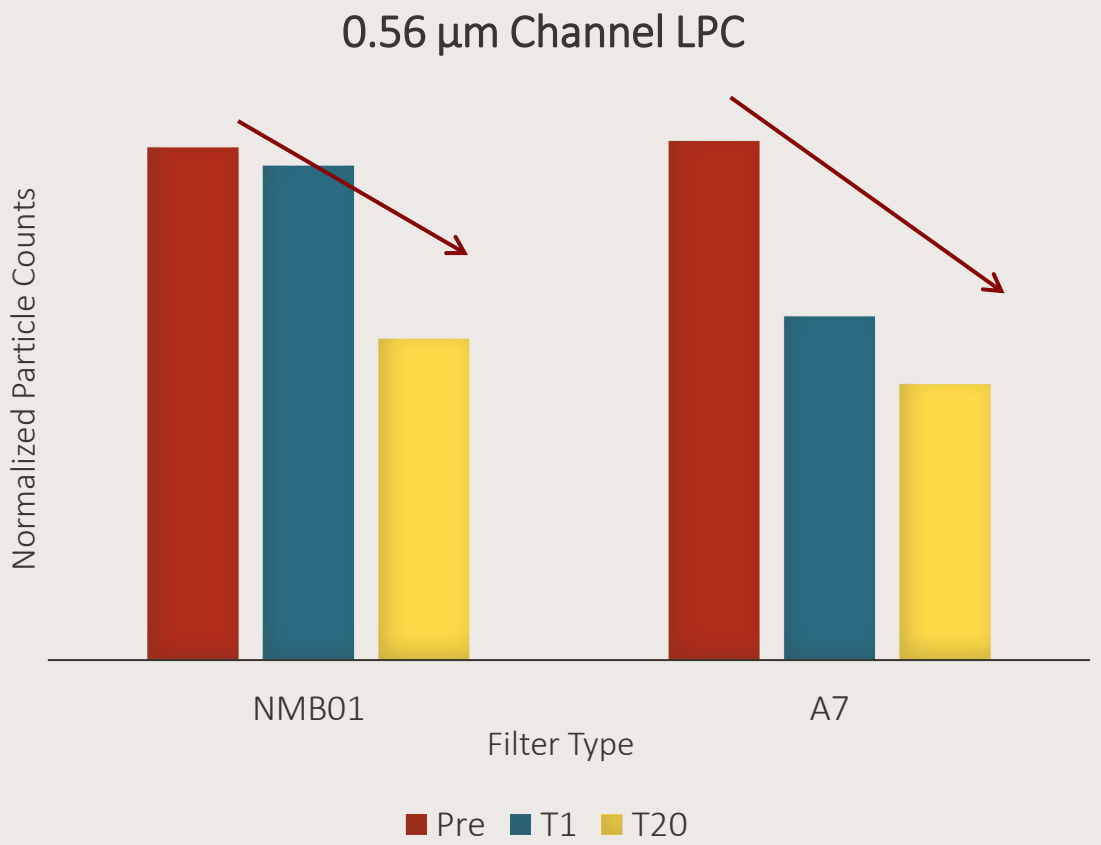
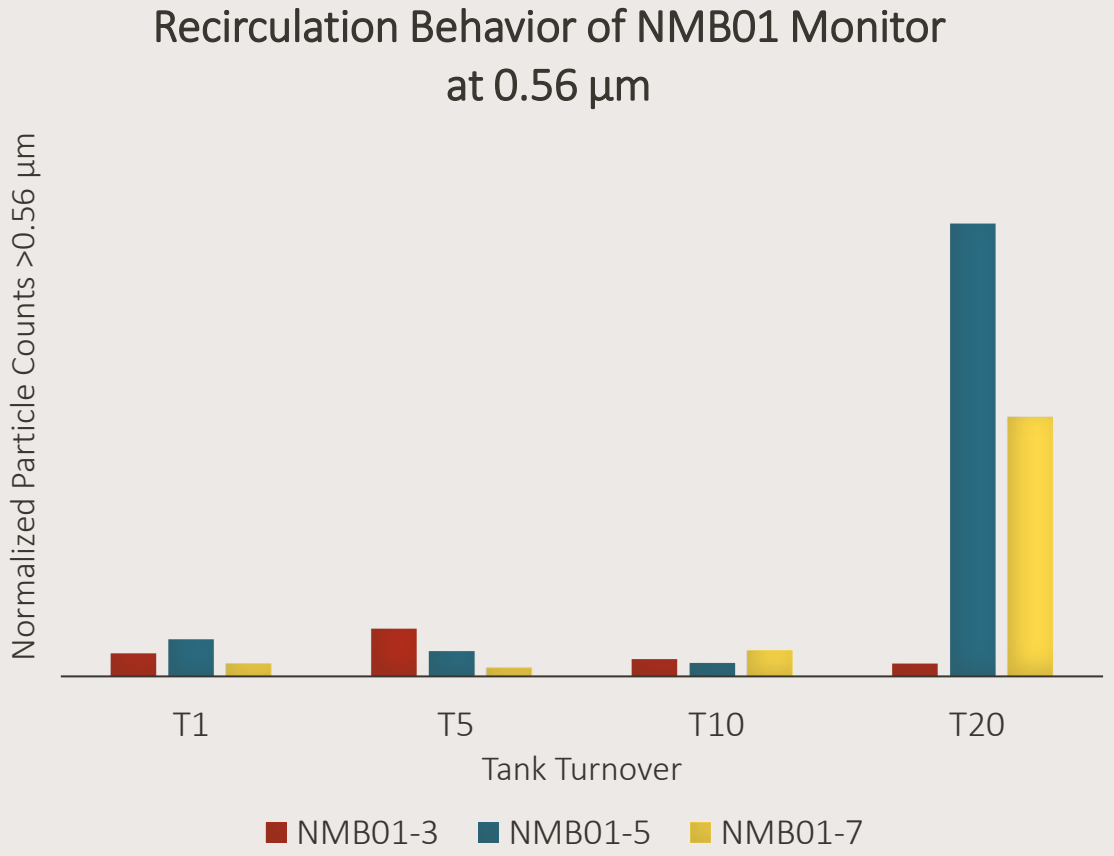
Example of Recirculating System Filtration Behavior

- Typical trend seen in recirculation systems
- Examples of recirculation with 2 different pore rating cartridge filters with batch-to-batch slurry variation
- Can be described as slurry clean-up or filter polishing of the slurry



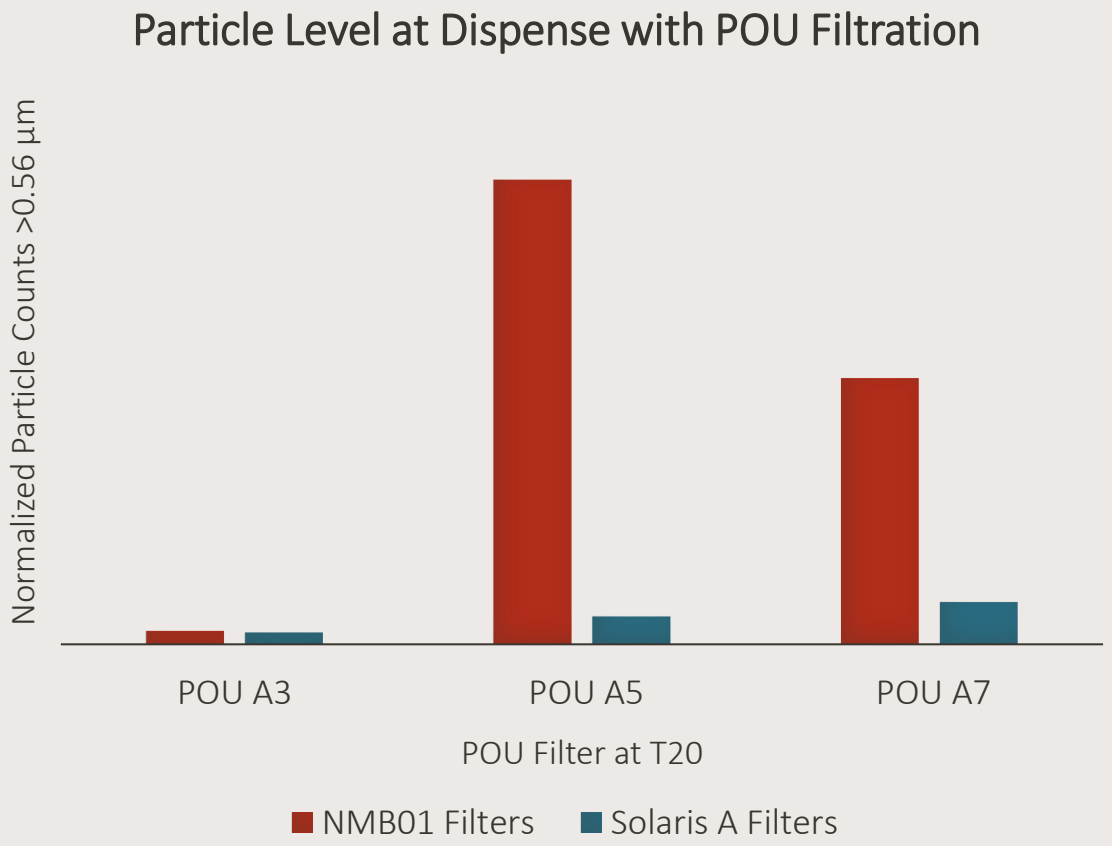
Experimental Results

- Typical scenario pictured on previous slide
- What if the loop filter doesn't perform optimally?
- Data shown here represents excursion at 20 tank turnovers
- How does one protect the wafer from such excursions?



Experimental Results

- As indicated above, Solaris 30 nm, 50 nm, and 70 nm filters were employed as POU filtration options for this testing
- Significant improvement of LPC counts shown with utilizing a POU/POD or guard filter
- Additional filtration step can safeguard the end-user process against premature loop filter excursions
  - In the case of the A3 testing, the loop filter did not experience an issue, but the POU filter still maintained a lower than loop level of particle counts



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Entegris Solution

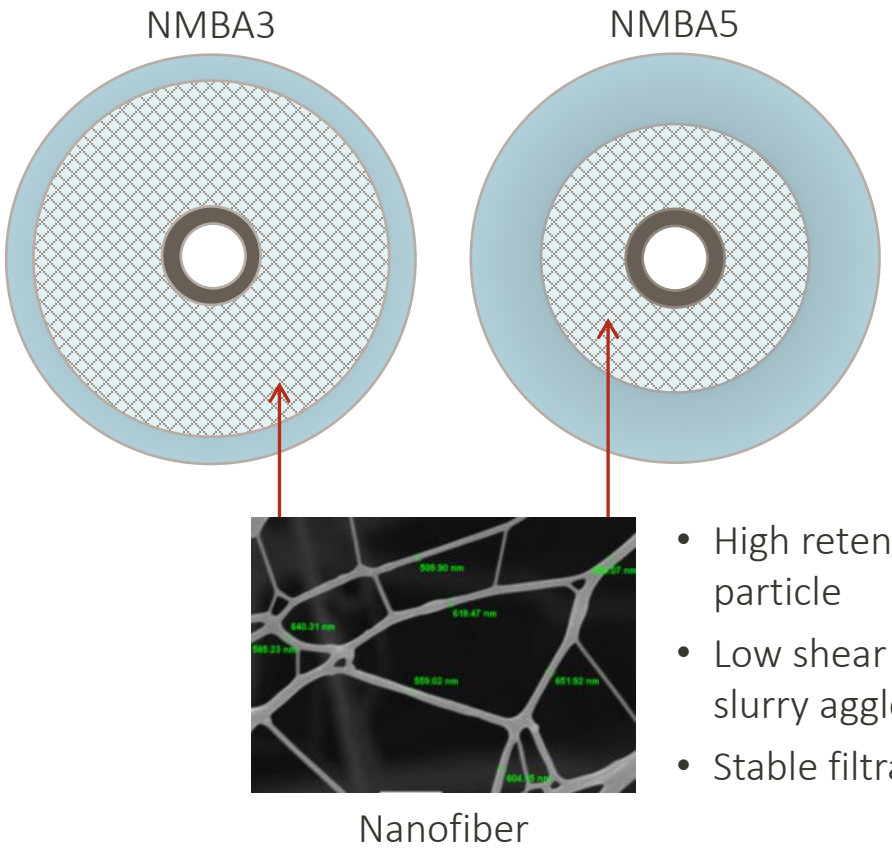
NMB A3 depth media features and benefits

Features

- Entegris NMB technology offers low shear force filtration
- More nanofibers in both volume and thickness
- Optimized pore gradient

Benefits

- Reducing slurry agglomeration
- Improve overall retention
- Stabilize retention under high-flow/ high-concentration condition



Cross-section of filter media (top view)

- High retention for large particle
- Low shear stress reduces slurry agglomeration
- Stable filtration efficiency

Conclusions

- CMP slurry filtration can aid in scratch reduction via large particle removal
- It is typical that loop filtration is employed as a safeguard against high LPC in a slurry batch
- In the event of batch-to-batch slurry variation, the loop filter will control most of the LPC
- If the variation induces a filter excursion, the only way to safeguard the process is a point-of-use filter
- Advanced filtration can also aid in the case of a stable process with a more open loop filter
- The POU filter will further polish the slurry to ensure stable performance on wafer

Thank you!

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