FOUP (Pod) contamination control solutions for 200 mm, 300 mm and 450 mm substrates

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Agenda

• Entegris introduction
• FOUP (Pod) Contamination Control Solution
  – Advanced Purge
  – EBM Material
• Purge test results
• M200 SMIF pod
• Summary
Entegris at a Glance

- Market leader in contamination control, critical materials handling and advanced process materials for semiconductor and other high-tech industries
- Fiscal 2013 pro forma sales of $1.1 billion
- 3,500 employees worldwide
- 618 U.S. patents and 1073 patents in other countries
- Headquartered in Billerica, MA with a global infrastructure of manufacturing, service and research facilities in the U.S., Malaysia, Singapore, Taiwan, China, Korea, Japan, Israel, Germany and France
- Publicly traded on NASDAQ under ENTG

Entegris Milestones

1966  Founded as Fluoroware, Inc.
2000  IPO
2005  Merges with Mykrolis, previously part of Millipore
2007  Acquires Surmet’s Semiconductor Coatings Business
2008  Acquires Poco Graphite
2009  Acquires PureLine
2012  Acquires EPT
2013  Acquires Jetalon Solutions
2014  Acquires ATMI, a leading provider of advanced materials
Wafer and reticle handling solutions have kept pace with each advancement in IC manufacturing.
Why is Microenvironmental Control Critical?

• Faster chips, greater performance
• New processes and materials
• 45 nm and below processes
• New requirements:
  – Achieve very low contaminant levels (AMCs, O₂, RH)
  – Maintain low levels for extended period of time (w/o maintenance purge)
  – Better purge uniformity across wafer slots
  – Maintain low level when FOUP door is open

• Advantages:
  – Higher yield
  – Smaller wafer-to-wafer variation
  – Higher tool throughput
  – More flexible WIP management (extended queue time)
Why H₂O and O₂ Control are Critical

Copper Corrosion*

Cu + O₂ + H₂O → Oxidized Cu → Removed by following wet cleaning (Cu-loss)

F⁻ as catalyst

Defect / Crystal Growth

AMC + H₂O → Chemical reaction

Excessive Etch

- F₂ and Cl₂ are common gases used for etching
- Residual F₂ and Cl₂ will react with H₂O and form HF and HCl that will lead to attack of the edge profile

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Crystal Defects

- Using EBM FOUPs and purge can effectively help with defect reduction

PC FOUP without purging
- Wafers are dirty and can outgas
- AMC will react with moisture
- Moisture reacts with contaminant in FOUP and deposit/condense on wafers

Entegris barrier material FOUP with snorkel purge
- Snorkel purge can remove AMC/moisture away from wafers and FOUP
- Even if there is still AMC inside FOUP, barrier material can maintain FOUP within a low moisture environment for a few hours
- No moisture, can ensure wafers are clean

Defect Free
Is Queue Time Control Enough?

Wafers are idling longer on load port during process! So, LP purge is needed to protect your wafers

1. Wafers can be idle for 1–2 hours on single processing tool and defects can be formed during this time on load port.
2. Therefore, N$_2$/CDA protected environment is strongly recommended.
Advanced Purge Technology

For an effective purge
Traditional purge cannot meet your advanced process needs

*1 inlet/1 outlet (front purge)*

- Some purge gas will either flow directly from inlet to outlet or leak out from door, some dead zones are created
- Purge gas is difficult to go into the space between wafers, where RH/O$_2$ control is most needed

- Do you have particle issues?
  - On top wafer
  - Back of FOUP
Traditional purge cannot meet your advanced process needs

*Improved Design: 2 inlets/2 outlets (rear purge)*

- Flow is smoother → less particle trap
- 2 inlets/2 outlets can meet most of the application need
Basic Purge versus Advanced Snorkel Purge

No snorkel = 2 inlets from the back

• $N_2$ will not easily fill the spaces between wafers

With snorkel

• $N_2$ can fill in the space between wafers faster

Snorkel can help drive purge gas into the space between wafers
Preliminary Door open Purge test results with XCDÄ® 50 L/min per diffuser

Data for slot 13, front left

XCDÄ® is a trademark of Entegris, Inc.
Four Port vs. Two Port Door Off Purging

Slot 1

Slot 13

Slot 25
EBM Material FOUP for High End Processes

Maintain the purge results and extend queue time
EBM Material – Water Absorption Of Different Polymer Materials

• Materials that can absorb excessive amounts of water (PC, PEI or PEEK™), will heavily impact moisture recovery in a FOUP

• As a result, for purge application, constant or frequent purge is required if you want to keep the FOUP environment dry

PEEK™ is a trademark of Victrex plc.
How EBM can help = low moisture and low AMC

- EBM FOUP + purge can effectively extend queue time due to:
  - Moisture level can be maintained low (<15%) for more than 18 hrs after purge
  - HF/HCl/AMC absorption/desorption is much less in EBM FOUP than PC FOUP

Queue time can be extended and defect level can be kept low

Moisture

EBM desorbs much less HCl than PC
M200 SMIF pod update
200 mm SMIF pods EBM and purge options

Standard 200 SMIF pod developed in 1985 using PC material

- M200 style SMIF pod
- A200 style SMIF pod

- Advanced EBM/CNT dome
- EBM Amber dome (M200 SMIF pod)

- E200 purgeable SMIF pod door (EBM inner door)

Inlet  Outlet
RH and Purge test setup
Results – POR (PC) vs. EBM SMIF pod
Summary contamination control solutions

EBM material and purge

• Advanced (EBM) Entegris Barrier Materials
• Purge options standard or advanced diffuser
• Purge application using N₂, CDA or XCDA
  – Extend low moisture and low AMC environment control
  – Critical process steps/control wafer environment/yield
  – Proposed FOUP and pod environment control solution for your high end process
Thank you for listening