The F450C Partnership within G450C: Program Overview and Key Activities

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M+W Group
9th October, 2013
Agenda

- M+W Group Introduction
- Motivation for 450mm Facility Focus
- G450C & F450C
- F450C Organisation
- Facility Programme Overview
- Next Steps & Activities
M+W Group in the Semiconductor Industry

Leading global engineering and construction company…

- More than 7,800 employees worldwide
- World-class Environmental Health & Safety standards
- Technical expertise in process and automation

… for semiconductor production facilities

- 70% of the world’s 300mm Fabs were designed by M+W Group
  - More than 200 semiconductor Fabs designed and built
  - Over 4 million m² of manufacturing area designed and built
- Installed over 11,000 tools since 2003
- Constructed NanoFab Xtension (NFX) facility for G450C programme operations
450mm Facility Considerations
A Limitation to Scaling Up

- Making 450mm a reality is a monumental task.

- Merely scaling up the new facility is not a practical option.

  “The size of the 450 mm facility infrastructure and associated utility consumption projections will simply exceed affordability realities or resource availability. Solutions to these challenges require collaboration with experts across the entire supply chain.”

  Al Ware, Semicon West, July 2013

- Related discussions in the industry have resulted in the formation of the Facility 450mm Consortium (F450C) partnership within the G450C Cooperative Model.

  A partnership of select facility experts working in consultation with G450C to bring their collective expertise to bear on the most pressing 450mm facility issues.
M+W Group is the selected G450C Associate Member to lead the F450C to direct the interface between the G450C and F450C member companies.

SEMI coordinates the interface between the process equipment vendors & G450C.
Facility 450 mm Consortium
Member Companies

F450C

M+W GROUP

EDWARDS

OVIVO

AIR LIQUIDE

Swagelok

CH2MHILL

CERES TECHNOLOGIES

MEGA FLUID SYSTEMS

Haws Corporation

CS CLEAN SYSTEMS
Participation in F450C
Key Motivators

- Streamlined communications with semiconductor manufacturers and their process tool vendors
  - Understand 450mm impact to the Fab facility infrastructure (from a 300mm baseline)

- Creative problem-solving among members and a collective voice for influencing industry
  - Attend G450C-sponsored industry forums & workshops

- Coordinated marketing efforts
  - Progress leveraged to identify members as the preferred competitive solution for 300mm renovations & 450mm upgrades

Leading edge participation in today’s facility innovations and positioning for 450mm
F450C Role in Supporting G450C
Four Major Focus Areas

- Environmental Footprint
  - Proactively develop solutions that reduce energy and water consumption and minimize generation of waste

- Facility Interface Requirements
  - Streamlined communications with semiconductor manufacturers and their tool vendors to optimize facility interface requirements

- Cost and Duration
  - Partner to establish standards enabling more efficient construction and install

- Safety and Sustainability
  - Design in safety by leveraging experts from facility conceptualization through to operation
Anticipating 450mm Impact on Fab Design
Targets & Challenges

- **Current IDM Targets**
  - Same process tool throughput rate for 450 mm as for 300mm (in wafers per hour)
  - Same utility consumption per wafer pass

- **Examples of Sustainability Challenges**
  - **Power Consumption**
    - Increased power demand by Lithography tools (especially in case of EUV)
    - Increased power usage by single wafer processing (RTP)
    - Development of idle mode solutions to lower power consumption
    - Overall increase anticipated
  
  - **UPW Consumption**
    - Trend to single wafer wet processing
    - Tool drain segregation challenges
    - Overall increase anticipated
# Anticipating 450mm Impact on Fab Design

## Tools & Facilities

(*) Increase is mainly driven by new processes and equipment technology, e.g. EUV, single wafer processing etc.

(**) Pending AMHS concept and preference for floor mounted or ceiling suspended maintenance cranes

(***) Mainly driven by simultaneous introduction of new lithography technology, not by wafer size transition

## Tool-Related Fab Design Guidelines – Change from 300 mm to 450 mm Technology

<table>
<thead>
<tr>
<th>Tool</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Equipment Footprint</td>
<td>+ 20 to 40%</td>
</tr>
<tr>
<td>Specific Utility Consumption per m² of cleanroom (*)</td>
<td>+ 0 to 20%</td>
</tr>
<tr>
<td>Cleanroom Height</td>
<td>+ 20 to 30%</td>
</tr>
<tr>
<td>Roof Truss Load (**)</td>
<td>May Increase</td>
</tr>
<tr>
<td>Waffle Table Floor Load Capability (***)</td>
<td>+ 20 to 30%</td>
</tr>
<tr>
<td>Waffle Table Stiffness (***)</td>
<td>May Increase</td>
</tr>
<tr>
<td>Vibration Classification</td>
<td>No Change</td>
</tr>
</tbody>
</table>

*Source: M+W Group, 2013*
Facilities Optimization Potential Through Cooperation with Process Equipment Vendors

- 10% decrease in process equipment power consumption would reduce Basebuild CAPEX by ~2%
  (~$20M for a $1B fab).

- 10% decrease in process equipment exhaust volumes would reduce HVAC costs by ~3% / Basebuild CAPEX by 0.2%
  (~$2M for a $1B fab).

- 10% decrease in process equipment UPW consumption would reduce UPW system cost by ~7% & Basebuild CAPEX by 0.3%
  (~$2.8M for a $1B fab).

PLUS: Reductions in Facility Operating Costs

Source: Sematech
F450C Development Programme
Current & Planned Activities

- Current:
  - Utility demand characterization and optimization
  - Component lift capability and dynamic loading
  - AMC monitoring technology and real time measurements
  - Pump system optimization

- Planned:
  - Overhead & under-floor space use allocation
  - Aisle/bay dimensions & related items (maintenance, predictive carrier logistics)
  - Installation enhancements (templates, reduced POCs, supports)
  - Health and safety-related items
  - He (Backside Cooling) & H₂ (EUV) gas recycling
F450C Actual Projects at CNSE
Tool Utility Demand Validation

- G450C + F450C has commenced installation of flow monitoring and recording devices for critical services on the first process tool for:
  - Power, UPW (and IW) and Exhaust & Drains (incl. constituents)

- Mapping of the instantaneous flows and waste constituents to the process tool’s against its operating condition (idle, peak & operational).

- The first tool being measured is a single wafer wet process tool.
  - Monitor 12 UPW POCs
  - Monitor 4 power POCs
  - Drain lines
  - Exhaust connections

- Preliminary results scheduled in 4Q13

Source: M+W Group, 2013
F450C Actual Projects at CNSE
Develop Bottoms-Up Tool Models for Utility Demand

- Continue the tool utility validation program on subsequent 450mm tool installed at CNSE.

- Identify opportunities where the tool vendor can modify their tool to reduce, reuse and/or recycle.

- Develop for and deliver tool specific consumption models to G450C member companies
  - Accurate idle, operational, peak, flows
  - Enable more accurate “bottoms up” estimates for next generation fab’s utility demands
  - Develop a model that considers tool utilization, # of chambers, process times, etc. as variables.
**F450C Actual Projects**

**Heavy Component Lifting & Handling**

- 450mm tool components (chambers, targets, etc.) will be large and heavy posing an ergonomic challenge to perform maintenance safely.

- To reduce cost and mean time to repair, member companies want a standardized solution across the tool set to left these heavy components.

- A joint 450mm Component Lift Task Force was formed in May 2013 to:
  - Define effective lift solutions without excessively loading the ceiling.
  - Develop a set of industry guidelines, including agreed solution concepts, and potentially the development of reference designs and/or relevant standards.

- Activities performed to date:
  - Overhead ergonomic support survey with process tool vendors
  - G450C member feedback on ceiling-mounted cranes
  - Definition of exclusion zones above/below process tools and AMHS systems
  - Several solutions proposed, evaluated, graded and ranked
F450C Actual Projects
AMC Monitoring and Real-time Measurements

- Improved AMC detection and faster excursion response time through in-situ monitoring and real time analysis was identified as a core F450C Focus Project.

- Focus group details & team members currently being defined by F450C Leadership.

- Objectives, roadmap, and deliverables will be rolled out at the scheduled F450C workshop on October 24, 2013.
F450C Planned Activities
Tool Install: Reducing Cost & Schedule

- 3D templates/adapter plates allow pre-facilitation ahead of tool arrival
- Although a known concept, implementation in the past was often unrealistic due to constant revisions of a tool’s design right up to its shipping date.
- Recent operational enhancements have converged to boost confidence in 3D templates this time around.

1. Leading tool vendors designing with fewer points of connection (POCs), along with incorporating standardized and integrated component frames

2. IDMs are building on this concept and achieving additional cost savings thru standardization of mainframe connection types and sizes.
F450C Planned Activities
Construction Efficiencies from Pre-Fabrication

- 3D/BIM Design

- Off-site assembly line efficiency, quality controls, and worker safety

- Modular components that take advantage of transportable size limits

- Structures designed to accommodate modular component access and assembly
Construction competition: Who has the biggest crane?

*The Oregonian, February 06, 2012*
Collaboration

- Effective collaboration is required beyond the G450C Cooperative Model in a consolidated industry.
- The formation of F450C addresses the challenges to optimizing facility requirements with respect to the environmental footprint, facility interfacing, cost & duration, and safety & sustainability.
- F450C activities have commenced utilizing the G450C Operations Platform available at CSNE NFX.
- Participation in the defined F450C working groups is increasing rapidly.

Collaboration is Optimizing 450mm Development in All Aspects

Consortium

Teamwork

Policy

Innovation
Thank You!

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