BUILDING MOMENTUM IN SILICON SYSTEMS GROUP

Dr. Randhir Thakur
EXECUTIVE VICE PRESIDENT, GENERAL MANAGER

2013 ANALYST MEETING
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SSG STRATEGY
Earlier and deeper customer collaboration enabled by

Precision Materials Engineering (PME) leadership

Lead in TRANSISTOR inflections

Extend leadership in INTERCONNECT

Change the rules in PATTERNING and INSPECTION
# Mobility’s Implications for Semiconductor Equipment

<table>
<thead>
<tr>
<th>THEN</th>
<th>NOW</th>
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<tbody>
<tr>
<td>Litho-enabled 2D transistor</td>
<td>Materials-enabled 3D transistor</td>
</tr>
<tr>
<td>Litho-enabled 2D NAND</td>
<td>Materials-enabled 3D NAND</td>
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<tr>
<td>Conventional processes</td>
<td>Selective material processes</td>
</tr>
<tr>
<td>Bulk dominates</td>
<td>Interface engineering increasingly critical</td>
</tr>
<tr>
<td>Standalone tool</td>
<td>Integrated processes on same tool</td>
</tr>
<tr>
<td>END USER BENEFIT</td>
<td>CUSTOMER CHALLENGES</td>
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<td>----------------------------------</td>
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<td>Functions and features</td>
<td>Transistors</td>
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<tr>
<td>Battery life</td>
<td>Interconnect</td>
</tr>
<tr>
<td>Interface experience</td>
<td>3D NAND</td>
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<tr>
<td>Form factor</td>
<td>Patterning</td>
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<td>… at the right cost</td>
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Era of Precision Materials Engineering

NEW MATERIALS will be the driver of technology migrations in advanced nodes

2X INCREASE IN NEW MATERIALS
Major inflections grow our opportunity.
Leading in TRANSISTOR Inflections

Mobility → Longer Battery Life is Enabled by Our Products

#1 in All Market Segments*

► Selective Epi films deliver speed
► Integrated PVD Metal Gate lowers power consumption
► Implant and Annealing products improve drive current
► Transistor complexity favors our sweet spot of material innovation

~$800M Incremental Revenue in 2016 vs. 2012 (assumes 2016 WFE of $37B)

*Source: Gartner

Epi
Implant
Thermal
CVD
PVD
CMP

Incremental Revenue in 2016 vs. 2012 (assumes 2016 WFE of $37B)
Epi Delivers Transistor Speed With Low Leakage

- New Epi materials will be key driver for transistor speed beyond 20nm
- Revenue doubled in last 5 years with >80% share*
- >500 systems shipped and counting
- $250M incremental revenue in 2016

*Source: Gartner, Assumes 2016 WFE of $37B
Metal Gate Drives Low Leakage Transistors

- Industry’s only integrated PVD/ALD solution
- #1 in PVD with >75% share*
- >$600M cumulative revenue over next 3 years

Integrated process without air break improves performance

*Source: Gartner, Assumes 2016 WFE of $37B
Enabling the Transistor Roadmap

Selective Epi  High-k Metal Gate  FinFET  New Channel Materials


WHERE APPLIED HAS >70% MARKET SHARE*

Epi  Implant  Metal Gate  Transistor CMP

*Source: Gartner, Applied Materials
Extending Leadership in INTERCONNECT
Mobility → Low Resistance and Reliable Interconnect

#1 in CVD, PVD, CMP*
New wins in ETCH

► Integrated PVD/CVD/ALD processes lower wiring resistance and improve reliability
► Low-k dielectrics reduce power consumption and increase device speed

~$400M Incremental Revenue in 2016 vs. 2012 (assumes 2016 WFE of $37B)

CVD Barrier & Low-k Etch
PVD Copper
Metal ALD Barrier
Metal CVD Liner & Cap
Copper Plating
CMP

*Source: Gartner
# Interconnect Growth Drivers

## Growth in Wiring Levels

<table>
<thead>
<tr>
<th>Step</th>
<th>Local Interconnect</th>
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<tr>
<td></td>
<td>Intermediate</td>
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<tr>
<td></td>
<td>Semi-Global</td>
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<td></td>
<td>Global</td>
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</table>

<table>
<thead>
<tr>
<th>Step</th>
<th>Selective Metal Cap</th>
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<tbody>
<tr>
<td></td>
<td>Hardmask</td>
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<tr>
<td></td>
<td>Barrier-Seed</td>
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</table>

## New Process Steps

<table>
<thead>
<tr>
<th>Step</th>
<th>Barrier-Seed</th>
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<tbody>
<tr>
<td>Local</td>
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<tr>
<td>Global</td>
<td></td>
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</tbody>
</table>

## Transistor Density

## Reliability & Patterning

## Fill & Reliability

## Integrated Barrier/Seed Complexity

<table>
<thead>
<tr>
<th>Step</th>
<th>Reflow</th>
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<tbody>
<tr>
<td></td>
<td>Metal CVD Liner</td>
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<tr>
<td></td>
<td>ALD Barrier</td>
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<td></td>
<td>Advanced PVD</td>
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</table>
Interconnect: Selective Metal Deposition

+5 New Metal Deposition Steps in Production in 2014

- Industry’s first selective metal on integrated PVD/ALD/CVD system
- >5,000 Endura® systems
Strategy to Grow in Patterning and Inspection

Increasing investments in R&D and Talent

Defend core positions
Defect review | High Aspect Ratio Etch | Patterning films

Win head-to-head battles
Growing Foundry Etch and Inspection applications

Change the rules & win disruptive inflections
3D NAND | Selective Material Removal
Changing the Rules in PATTERNING & INSPECTION

Mobility → More Functionality; Faster Time to Market

#1 in Defect Review*

Gaining Brightfield share

Winning most 3D NAND

CVD and Etch DTOR

► Differentiated inspection tools accelerate yield ramp at advanced nodes

► CVD and Etch integrated processing enables patterning of dense structures

► Selective materials removal is a disruptive innovation

~$400M Incremental Revenue in 2016 vs. 2012

(assumes 2016 WFE of $37B)

*CSource: Gartner

CVD
PVD
Etch
Metrology
Inspection
Selective removal

#1

Gaining Brightfield share

Winning most 3D NAND

CVD and Etch DTOR

~$400M Incremental Revenue in 2016 vs. 2012

(assumes 2016 WFE of $37B)

*CSource: Gartner
Extending Defect Review Leadership

Sub-20nm nodes require new approaches to detect killer defects

New SEMVision® G6 system filters out nuisance defects to find the few that matter most to Device Performance and Yield

Industry Benchmark
Tool of Record at all leading edge customers

*Source: Gartner
Building Momentum in Brightfield Inspection

30% Increase in Qualified Layers at Leading Customers

- Earning customer trust and expanding 20nm applications
- Gaining share in $1.5B market* - the largest inspection segment
- Record orders in Q2’13

*Source: Gartner forecast (Optical Patterned Wafer Inspection market size)
3D NAND CVD and Etch Growth Opportunities

50% TAM INCREASE IN ETCH & CVD

Shift from Lithography to Deposition and Etch

>$500M Opportunity per 100k wspm

PATTERNING
- New Etch and Hardmask steps

CVD STAIRCASE DEPOSITION
- New and slow multi-layer deposition

SACVD and HDPCVD
- New greenfield opportunity in leadership areas

Planar NAND

3D NAND

ALD, CVD, PATTERNING FILMS
CVD STAIRCASE DEPOSITION
SACVD, HDPCVD

PATTERNING ETCH

$500M

19
Winning Staircase Patterning Etch
Precise Step-Width Control with High Productivity

HIGH VALUE PROBLEMS

UNLANDED CONTACTS
UNEVEN STEPS
TAPERED PROFILE

OUR ETCH SOLUTIONS

LANDED CONTACTS
EQUAL STEPS
STRAIGHT PROFILE

High Productivity Centris™ Mesa™

► Differentiated pulsed plasma etching

► Precise step width control with in-situ measurement

► ~$150M growth opportunity per 100k wspm
# 3D NAND Etch and CVD Momentum

<table>
<thead>
<tr>
<th></th>
<th>CUSTOMER A</th>
<th>CUSTOMER B</th>
<th>CUSTOMER C</th>
<th>CUSTOMER D</th>
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<tbody>
<tr>
<td>High Aspect Ratio Etch</td>
<td>![Green Dot]</td>
<td>![Green Dot]</td>
<td>![Blue Dot]</td>
<td>![Blue Dot]</td>
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<tr>
<td>Staircase Etch</td>
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<tr>
<td>Hardmask Deposition</td>
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- **Development Tool of Record**
- **Demo Engagement On-going**

**1st Gen 32 Pairs**

- **New Market Opportunity**
- **>$500M per 100k wspm**

**2nd Gen 64 Pairs**

- **New Market Opportunity**
- **>$800M per 100k wspm**
Selective Material Removal is a **Disruptive Innovation**

**PATTERNING CHALLENGE**

Line bending and pattern collapse

![Aspect Ratio 6:1 Post Etch: No issue](image)

![WET CLEAN](image)

![OUR SOLUTION](image)

- At small line width, wet clean causes pattern collapse and line bending
- Selective material removal displaces wet clean and enables patterning inflection
- Proven technologies to address up to **$1B** market in 2016

**Won Majority of Selections**
### Key Wins Ramping in Production Next Year

#### TRANSISTOR
- NMOS Epi
- Metal Gate PVD
- Flowable CVD
- Co-Implant Steps
- Metal Gate CMP

#### INTERCONNECT
- Metal CVD
- Low-k CVD
- Selective Treatment
- Foundry Etch

#### PATTERNING & INSPECTION
- Brightfield Inspection
- Selective Material Removal
- 3D NAND Patternning Etch
- CVD Multi-layer Stack
- CVD Hardmask

### Revenue Growth
- 20nm Foundry & 3D NAND
- Epi & PVD Growth
- Inspection & Etch Momentum
Winning with Precision Materials Engineering Innovation

**TRANSISTOR**
- #1 in Epi
- #1 in Implant
- #1 in RTP
- #1 in PVD
- #1 in CMP

~$800M

**INTERCONNECT**
- #1 in PVD
- #1 in CVD
- #1 in CMP
- New Metal CVD Steps
- New Dielectric Steps

~$400M

**PATTERNING & INSPECTION**
- #1 in Defect Review
- Gaining Inspection Share
- 3D NAND Etch DTOR
- 3D NAND CVD DTOR
- New Selective Removal

~$400M

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2016 INCREMENTAL REVENUE FROM 2012 BASELINE*

~$800M  ~$400M  ~$400M

*Assumes 2016 WFE of $37B

+2 to 4 pts WFE Share Gain by 2016
Silicon Business is Transforming for Mobility War

We are the clear leader in Precision Materials Engineering with tremendous opportunity for growth.

We are increasing investments in SSG, Products, Technology, and Customers.

We are excited and more confident than ever to grow 2 to 4 points of WFE share.