CMP MARKETS & VALUE CHAIN PERSPECTIVES

MICHAEL CORBETT
MANAGING PARTNER
LINX CONSULTING
MCORBETT@LINX-CONSULTING.COM

A PRESENTATION FOR THE CMP USERS GROUP

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LINX CONSULTING
1. Introduction to Linx Consulting

2. Developments Impacting CMP

3. CMP Markets and Key Value Chain Components

4. Conclusions
LI NX CONSULTING IS FOCUSED IN ELECTRONIC CHEMICALS AND MATERIALS

% TOTAL SEGMENT

% TOTAL ELECTRONIC CHEMICALS

Notes:
1. Units are $ billion
2. PCB chemicals and materials are estimated at $10.5 billion
3. Compound semi including in semiconductor
LINX CONSULTING

SEE BEYOND THE HORIZON
CURRENTLY AVAILABLE INDUSTRY ANALYSIS REPORTS

1. CMP Technologies and Markets to the 45 nm Node
2. Advanced Cleaning and Surface Preparation: Technologies and Markets
3. Opportunities in Imprint Lithography
4. Semiconductor Industry Direct Consumables Model
5. Specialty Abrasives in CMP
6. Advanced Patterning

UPCOMING INDUSTRY ANALYSIS REPORTS

1. Advanced Thin Film Processes & Materials (in-process)
2. Electronic Materials in Photovoltaics (in-process)
3. CMP Technologies and Markets to the 32 nm Node
4. Advanced Cleaning and Surface Preparation to 32 nm Node
1. EXECUTIVE SUMMARY
   Growth in CMP Operations
   Growth in Slurries and Pads
   Suppliers
   Regional distribution of polishes

2. METHODOLOGY

3. BACKGROUND AND MODEL DRIVERS

4. CMP APPLICATIONS
   Aspects covered for each of the following applications:
   - Challenges
   - Typical POR
   - Consumables
   - Key IP
   - Activities of leading users
   - Markets (65 nm and above)
   Bulk Copper 65, 45 & 32nm
   ECMP technology
   Copper end point 65, 45 & 32nm
   Copper barrier 65, 45 & 32nm
   Tungsten 65, 45 & 32nm
   STI 65, 45 & 32nm
   Oxide 65, 45 & 32nm
   Emerging applications

5. CMP TOOLS & EMERGING TECHNOLOGIES
   Leading tools/platforms
   Tool supplier characterization
   Impact of new technologies
   Consumable selection

6. MARKET ASSESSMENT AND FORECASTS
   Total consumables market
   Slurries
   Pads
   CMP operation forecasts
   CMP by applications
   CMP by device segment

7. SUPPLIER ASSESSMENT
   Leading suppliers
   Slurry suppliers
   Pad suppliers
   Conditioner suppliers

8. BUSINESS ANALYSIS AND OPPORTUNITIES
   CMP consumables
   Customer considerations
   Influence of tool producers
   Sustainability of suppliers
   Interviewee comments
DEVELOPMENTS IMPACTING CMP
WAFER STARTS - 2006

Total = 120,939

- Digital Bipolar
- Optoelectronics
- Discrete
- Analog
- GateArray
- Std Cell
- PLD
- Oth ML
- Communication
- Computing
- DSP
- MCU
- MPU
- Oth NV
- NOR
- NAND
- NOR
- NAND
- SRAM
- DRAM
Cleans
CMP
i-line resist
248nm resist
193nm resist
ARC
Implant
FSG
ALD
ECD Cu
SiCOH

0.065
0.09
0.13
0.18
0.25
0.35
0.5
0.8
1
>1

100%
80%
60%
40%
20%
0%
WAFFER STARTS – 2010

Total = 204,226

- Digital Bipolar
- Optoelectronics
- Discrete
- Analog
- GateArray
- Std Cell
- PLD
- Oth ML
- Communication
- Computing
- DSP
- MCU
- MPU
- Oth NV
- NOR
- NAND
- DRAM
- DRAM
- Analog

LINX CONSULTING  SEE BEYOND THE HORIZON
CMP MARKETS AND VALUE CHAIN
SLURRY MARKETS - $875 MILLION IN 2006
TUNGSTEN AND WAFER POLISH MARKETS

**TUNGSTEN**

- Slurry
- Slurry Growth

**WAFER POLISHING**

- Wafer
- GROWTH
COPPER AND BARRIER MARKETS

COPPER

BARRIER
SLURRIES - AAGR(%) 2006 TO 2010
LEADING SLURRY SUPPLIERS - CONCENTRATION

% share

HITACHI  CCMP  CCMP  CCMP  PLANAR  FUJIMI

STI  Oxide  Tungsten  Copper  Barrier  Wafer
VALUE CHAIN - ABRASIVES - $225M IN 2006
### Changes in Abrasives Mix

<table>
<thead>
<tr>
<th>Application</th>
<th>Current Nodes in Production</th>
<th>65 NM</th>
<th>45 NM</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>OXIDE</td>
<td>FS CS</td>
<td></td>
<td>FS CS Ceria</td>
<td>FS will slow down after 45 nm</td>
</tr>
<tr>
<td>TUNGSTEN</td>
<td>FS CS FS CS HPCS</td>
<td></td>
<td>FS CS HPCS</td>
<td>FS will slow down after 45 nm</td>
</tr>
<tr>
<td>STI</td>
<td>Ceria</td>
<td></td>
<td></td>
<td>FA likely for advanced logic</td>
</tr>
<tr>
<td>BULK COPPER</td>
<td>Alumina CSI</td>
<td></td>
<td>CSI HPCS</td>
<td>ECMP not seen as likely to impact forecasts</td>
</tr>
<tr>
<td>BARRIER</td>
<td>FS CS FS CS HPCS</td>
<td></td>
<td>CS HPCS</td>
<td>HPFS slow down at 45 nm</td>
</tr>
<tr>
<td>FINAL WAFER POLISH</td>
<td>HPCS</td>
<td></td>
<td></td>
<td>HPCS will remain dominant material due to purity</td>
</tr>
<tr>
<td>STOCK POLISH</td>
<td>CS</td>
<td></td>
<td></td>
<td>No major changes</td>
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</table>
ABRASIVES MARKET, 2006 - 2010

<table>
<thead>
<tr>
<th>Abrasive type</th>
<th>CAGR (%), 2006 – 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colloidals</td>
<td>23.5</td>
</tr>
<tr>
<td>Fumed</td>
<td>2.5</td>
</tr>
<tr>
<td>Others</td>
<td>12.4</td>
</tr>
</tbody>
</table>
LEADING ABRASIVES SUPPLIERS (%)
RATIO OF ABRASIVES TO SLURRY ($ BASIS)
CONCLUSIONS
CONCLUSIONS

• Increased proportion of wafer starts are for DRAM and NAND -> new slurry demand drivers

• Change in abrasives mix from more commodity to more engineered products may lead to increases in slurry prices

• The chemo effect will continue to remain of critical importance, however, slurry producers with an integrated position in or preferred access to engineered abrasives may become advantaged

• Limited influence of emerging technologies on slurry demand
  – ECMP, fixed abrasives and novel barriers

• DRAM AND NAND conversion to copper complete at 45 nm – drives copper growth and limits future growth in oxide and tungsten

• Conversion to 300 mm slows down growth of wafer polishing