CONSOLIDATION TRENDS IN THE CMP CONSUMABLE SUPPLY BASE

Michael Corbett
Linx Consulting
mcorbett@linx-consulting.com
+1 973 698 2331

2nd Annual CMPUG Meeting
SEMI CON West 2008
July 16-17, 2008
OUTLINE

1. Overview of Linx Consulting
2. Concentration in CMP Consumables
3. Comparison – CMP and Lithography
4. Current Market for M&A
5. Conclusions
6. Questions

NOTE: All data has been sourced from the following Linx Consulting reports:
1. CMP Markets and Technologies to the 32nm Node
2. Advanced Patterning, 2007 to 2012
OVERVIEW OF LINX CONSULTING
2007 MARKET ESTIMATES, $B

% TOTAL SEGMENT

Semi includes compound

Source: Linx Consulting

LI NX CONSULTING

SEE BEYOND THE HORIZON
1. We create knowledge and develop unique insights at the intersection of advanced thin film processes and the chemicals industry

2. We help our clients to succeed through our:
   • Experience in global electronics and advanced materials and thin film processing industries:
     - Semi
     - Packaging
     - Nano Technology
     - LCD
     - PV
     - Other
   • Experience in the global chemicals industry
   • Global network and capabilities
   • Advanced modeling capabilities
WE PROVIDE HIGH CONFIDENCE DECISION SUPPORT SERVICES - SINGLE CLIENT

<table>
<thead>
<tr>
<th>PLANNING</th>
<th>IDEAS TO MARKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Analysis</td>
<td>IP Development</td>
</tr>
<tr>
<td>M&amp;A / Due Diligence</td>
<td>Value Chain Analysis</td>
</tr>
<tr>
<td>Diversification / Expansion Planning</td>
<td>Technology Assessment and Commercialization</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OPERATIONS</th>
<th>MARKETING &amp; SALES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Benchmarking</td>
<td>Market Analysis/Monitoring</td>
</tr>
<tr>
<td>Competitive Intelligence</td>
<td>Market Forecasting and Modeling</td>
</tr>
<tr>
<td>COO Models and Assessment</td>
<td>Competitive Intelligence</td>
</tr>
<tr>
<td>Process Technology Assessment</td>
<td>Customer Perceptions</td>
</tr>
</tbody>
</table>

SINGLE CLIENT SERVICES
CURRENTLY AVAILABLE INDUSTRY ANALYSIS REPORTS

1. CMP Technologies and Markets to the 32 nm Node

2. Advanced Thin Films for FEOL and BEOL Applications

3. Advanced Materials and Chemicals for Photovoltaic Cells and Modules

4. Emerging Materials Opportunities for Advanced Semiconductor Devices

5. Advanced Cleaning and Surface Preparation: Technologies and Markets

6. Opportunities in Imprint Lithography

7. Specialty Abrasives in CMP

8. Advanced Patterning

9. Semiconductor Industry Direct Consumables Model
CONCENTRATION IN CMP CONSUMABLES
WHY LOOK AT CONSOLIDATION IN CMP?

CAGR Unit Operations - 07 to 11

Proportion of Unit Operations

$500 Mio. Market Size 2011
• The Herfindahl Index is used to measure the degree of concentration in a market.

• The HI is calculated as the sum of squares of share of all market participants:
  \[ HI = S_1^2 + S_2^2 + \ldots + S_N^2 \]

• The HI is a maximum of 10,000 for a market with one supplier with 100% share.

• The lower the HI, the more competitors with relatively equal market share.

• DOJ/FTC perspectives:
  - HI values < 1,000 – market considered to be unconcentrated.
  - HI values between 1,000 and 1,800 are considered to be moderately concentrated.
  - HI > 1,800 – markets are considered to be concentrated.
HERFINDAHL INDICES BY MARKET

Barrier slurry
Copper slurry
Tungsten slurry
DSTI slurry
Oxide slurry
All slurry
Pads

LINX CONSULTING
SEE BEYOND THE HORIZON
HERFINDAHL INDICES & TOP 3 SUPPLIER SHARES

![Graph showing slurry types and their shares.]

- Barrier slurry
- Copper slurry
- Tungsten slurry
- DSTI slurry
- Oxide slurry
- All slurry
- Pads

Legend:
- HI
- Column1
- % share top 3 suppliers
WHY CONSOLIDATE?
THERE ARE NOT TOO MANY SUPPLIERS

- Market is also considered to be concentrated
  - The top 3 suppliers have ~75% of the total pad and slurry market
  - The top 8 suppliers have ~95% of the market
  - The bottom 15 suppliers have ~5% of the market
- Leading suppliers of slurries and pads in 2007 are illustrated below:
### WHY CONSOLIDATE?

**STRENGTH OF EXISTING & NEW PARTICIPANTS**

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>KEY MARKET(S)</th>
<th>PARENT /CONSIDERATIONS</th>
</tr>
</thead>
</table>
| Rohm and Haas      | 1. Leading pad producer  
2. Has a position at all end-users | Parent is highly focused in all segments of electronic materials                      |
| Cabot Micro        | 1. Leading slurry supplier  
2. Has been successful with new pad | Strategically focused in CMP                                                          |
| Hitachi            | 1. Leader in STI  
2. Well positioned in Korea | Parent is $6 billion company                                                          |
| JSR                | 1. Leader in photoresists | Parent is highly focused in all segments of electronic materials                      |
| Fujimi             | 1. Leader in wafer polishing | Scale from wafer polishing activities. Preferred position in abrasives                |
| DA Nano            | 1. Strength in advanced copper processes in logic  
2. Integrated in abrasives | Parents are highly focused on electronic materials                                    |
| Planar Solutions   | 1. Leading position in barrier | FFEM is investing in electronics. Wacker is making $$ in polysilicon                 |
| Asahi Glass Chemicals | 1. Leading position in DSTI for advanced nodes (≤ 45nm) | Parent is $10 billion company                                                          |
WHY CONSOLIDATE?
FINANCIALS ARE STRONG

- Industry financial performance remains strong
- Reference 2007 annual report of Cabot Microelectronics:

<table>
<thead>
<tr>
<th></th>
<th>CCMP %, 2007</th>
<th>Estimated Industry Totals ($ Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>100.0%</td>
<td>1,200</td>
</tr>
<tr>
<td>COGS</td>
<td>52.7%</td>
<td>650</td>
</tr>
<tr>
<td>Gross profit</td>
<td>47.3%</td>
<td>584</td>
</tr>
<tr>
<td>Operating expenses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D</td>
<td>14.8%</td>
<td>182</td>
</tr>
<tr>
<td>SGA</td>
<td>19.0%</td>
<td>234</td>
</tr>
<tr>
<td>Operating Income</td>
<td>13.5%</td>
<td>167</td>
</tr>
</tbody>
</table>

- ROE > 10%
WHY CONSOLIDATE?
THE INDUSTRY IS NOT MATURING
WHY CONSOLIDATE?
NEW ENTRANTS COMPETE ON TECHNOLOGY

Slurries
- On the slurry side, we are seeing several new entrants looking to compete based on technology:
  - BASF
  - ATMI and Anji Micro (dispense systems)
- Cost based suppliers can come from integrated particle positions or from wafer polishing. To date, there is little evidence of success of this strategy. This will likely hold true as supplier requirements increase down the roadmap.

Pads
- On the pad side, we are seeing both new technology and me-too products:
  - New technologies:
    - 3M – Fixed abrasive
    - JSR and Innopad – water soluble components
    - Neopad and Semiquest – variations in surface hardness and COF
    - CCMP – Thermoplastic with continuous manufacturing process
  - Me-too products are usually encouraged by leading end-users to put pressure on Rohm and Haas. Suppliers in this category include:
    - SKC
    - IVT
    - KPC
  - Fujibo seems to have improved upon soft pad designs and will be implemented at 45 nm.
**WHY CONSOLIDATE?**

**BUYER & TOOLS ARE CONSOLIDATING**

**BUYERS**
- Fewer companies developing 32nm platforms
  - Samsung
  - Hynix
  - TSMC
  - UMC
  - Elpida/Rexchip/PSC
  - Qimonda/NTC/Inotera
  - Intel (and Micron)
  - IBM and partners
  - Toshiba/NEC
- More power to consortia
- However, there are many different variations on interconnect and FEOL processing

**TOOL PRODUCERS**
- Applied Materials and Ebara are only major tool suppliers remaining
- Ebara is gaining ground on high throughput copper tools
- Tool producers still have major impact on BKM, which becomes increasingly important as end-users are increasingly tied up in other activities, including:
  - Memory transitioning to copper and end-users have bigger integration challenges
  - New FEOL challenges including HKGD, strain and non-planar structures
  - Investigation of new materials
COMPARISON - CMP AND LITHOGRAPHY CONSUMABLES
WHY LOOK AT LITHO?

CAGR Unit Operations - 07 to 11

Proportion of Unit Operations

$500 Mio. Market Size 2011
• Herfindahl Indices by market

Several single supplier markets
• High concentrations in most markets
• Resists are among the least concentrated markets, and are ripe for consolidation
REASONS WHY LITHO HAS NOT CONSOLIDATED

• At any given time, there can be upwards of 50 individual product requirements under evaluation, each with its own unique needs

• For example, on an advanced logic device for each node and shrink, there can be:
  1. Active area / SDI – 1 critical layer
  2. Gate – 1 critical layer
  3. Contact – 1 critical layer
  4. M1 – 1 critical layer

• Multiply this by 4 or 5 logic companies as well as DRAM, NAND, NOR, at Samsung Hynix, Micron, Elpida, etc.

• A litho materials supplier will need a team of about 3 to 5 people for each qual. The team will require support from chemists, technicians, metrology, lithographers, client managers, etc.
  - Each team will cost about $3 to $5 million in labor per year PLUS capex required for latest exposure tool
  - A leading supplier may be able to do about 10 quals per year

• Viable segment and niche strategies still exist
CURRENT MARKET FOR M&A
M&A ACTIVITIES

• **Have A Strategy In Place:**
  – Need to develop a strategic operating plan and budget that incorporates managements’ thinking on the best and most efficient path to success
  – Understand the funding requirements of your growth plan before you begin, and make sure that the needed financial resources are available to your company

• **Available Financing:**
  – Although lenders are more disciplined than before, there is still debt funding available to rational leverage ratios and at very low interest rates
  – In addition, there is a tremendous amount of private equity available to well managed companies seeking to expand in the current market
M&A ACTIVITIES

• **Tremendous Market For Acquisitions:**
  - Valuations for acquisitions are no longer at the bottom unless a distressed company is involved
  - Pricing is rational and even large companies that previously overpaid significantly for businesses are working hard not to make that mistake again
  - Privately owned and smaller market cap companies are in a position to compete effectively for acquisitions, and can usually win out if a personal relationship between buyer and seller already exists or can be developed
  - For all acquirers, the keys for a successful acquisition are to understand the company you are buying, negotiate a fair deal, ask the right questions in due diligence and have a post-acquisition integration plan in place the day the transaction is closed

• **Bottom Line:**
  - We expect a significant amount of strategic M&A over the next 2 years
  - Need to get there first will be critical to succeed
CONCLUSIONS
CONCLUSIONS

• Lithography case study proves that a broad number of suppliers can survive and invest in the business
• Strategic M&A to drive consolidation, not necessarily driven by high number of suppliers or industry competitive forces
• We do not expect to see the number of major/leading suppliers change significantly, in slurries due to:
  – Growth market
  – Strong financial performance
  – Strength of incumbent suppliers
  – Need for development work at new nodes
  – Continued success of new entrants i.e. Asahi Glass Chemical

• The industry is still looking for a second strong viable competitor to Rohm and Haas – consolidation (of technologies) may be a mechanism to establish a second supplier to Rohm and Haas
  – End-users are still putting potential suppliers in business, but there have been issues with IP
  – Several companies have emerged/shown promise in the past, but have not been able to “make it happen”
  – Cabot Microelectronics is emerging as a strong second alternative and has been successful, so far

• Copper growth in DRAM and NAND can shake up the market going forward
QUESTIONS?

• Please feel free to contact us:

  Mike Corbett
  mcorbett@linx-consulting.com
  +1 973 698 2331

  www.linx-consulting.com