Engineered Surface Finishing of HVOF Tungsten Carbide
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26th Replacement of Hard Chrome and Cadmium Plating Program Review Meeting, January 24-26, 2006, San Diego, CA. Sponsored by SERDP/ESTCP.
Introduction to Cabot Microelectronics

Cabot Microelectronics’ History

- 1983 – CMP technology invented
- 1990 – Cabot Microelectronics established a division of Cabot Corporation
- 2000 – Initial Public Offering and Spin-off to a fully independent company

Chemical Mechanical Planarization (CMP)

Non-planarized IC product

Planarized IC product
CMC’s Operations Worldwide

Customer Support
- Technical Marketing
- Applications Support

Manufacturing
- Aurora, IL USA
- Hammond, IN USA
- Barry, Wales UK
- Geino, Japan

Research & Development

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<tr>
<th>PRODUCT</th>
<th>PROCESS</th>
<th>ENABLING</th>
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<tr>
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<td>Pilot Plant</td>
<td>Particle</td>
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<td>Tungsten</td>
<td>Cleanroom</td>
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<td>Dielectric</td>
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<td>Data Storage</td>
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Cabot Microelectronics

- World Leader in Chemical Mechanical Polishing (CMP) for semiconductor manufacturing
- Substantial investment in fundamental science of surface finishing and formulation design
- All facilities have ISO 9001 and ISO 14001 registration
- Solutions for Si, SiO₂, W, Cu, Al, Ni, Ti, TiN, Si₃N₄, Ta, TaN, Ru, Pt, Ir
Chemical Mechanical Polishing

- Process using slurry (chemical and mechanical), pad (mechanical) and equipment to produce a surface with the desired attributes.

- Slurry – colloidally stable, aqueous solution of ceramic abrasive particles and chemistry.

- Pad – Working surface, generally polymeric.

- Equipment – means of combining the slurry, pad and process parameters to provide consistent results.
CMP Polisher

- Pad Conditioner
- Slurry Dispense
- Carrier
- Wafer
- Pad
Why CMP?

Advantages:
- Process Simplification
  - Can eliminate need for separate grind, hone and lapping steps
  - Could be combined with other process steps to improve overall process efficiency
- Does not create sub-surface damage to material
- Ability to polish multiple materials simultaneously
- Overall range of surface finish

Drawbacks:
- Time
- Equipment compatibility
Solutions for
- Industrial & Medical applications
- Optics
- Optoelectronic (FPD, microelectronics, photovoltaic, LED)

www.ensurfin.com
Tungsten Carbide Before & After Polishing

**Before Polishing**
Surface Roughness (Ra) = 94.5 nm

**After Polishing**
Surface Roughness (Ra) = 16.3 nm

**Results:** Improved wear, cut quality, service life, less friction
CMP Polished HVOF Tungsten Carbide

Surface Data

Surface Statistics:
Ra: 5.96 nm
Rq: 7.81 nm
Rz: 128.76 nm
Rt: 223.90 nm

Set-up Parameters:
Size: 736 X 480
Sampling: 415.64 nm

Processed Options:
Tensile Removed:
Tilt
Filtering:
None

- Part courtesy of J. Devereaux, Naval Depot
**Additional Capabilities**

- State-of-the-Art Polishing
  - λ/20 Precision
  - Reference Flats
- Diamond Machining
- Custom Lapping
- Submicron Finishing
- Prototyping
- Contract Manufacturing
- Cleanroom/Metrology Services

[www.surfacefinishes.com](http://www.surfacefinishes.com)
## Sample List of Materials

<table>
<thead>
<tr>
<th>Existing Capability</th>
<th>Under Development</th>
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</thead>
<tbody>
<tr>
<td>♦ Tungsten Carbide</td>
<td>♦ Fused Silica</td>
</tr>
<tr>
<td>♦ Aluminum</td>
<td>♦ Fused Quartz</td>
</tr>
<tr>
<td>♦ Stainless Steel</td>
<td>♦ AlON</td>
</tr>
<tr>
<td>♦ Copper</td>
<td>♦ Silicon Carbide</td>
</tr>
<tr>
<td>♦ Molybdenum</td>
<td>♦ Sapphire</td>
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<tr>
<td>♦ Cobalt Chrome</td>
<td>♦ ZnSe</td>
</tr>
<tr>
<td>♦ Aluminum Nitride</td>
<td>♦ Germanium</td>
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<tr>
<td>♦ Polysilicon</td>
<td></td>
</tr>
<tr>
<td>♦ Silicon Nitride</td>
<td></td>
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<tr>
<td>♦ Silicon Dioxide</td>
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<tr>
<td>♦ Tungsten</td>
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