Rapid Cleaning Using Novel Processes With Coatings

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Surface Preparation and Cleaning Conference
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Washable Coatings

- Coatings that Clean
  - CoatsCleans\textsuperscript{TM} – emulsify PR
  - Washable Primers – lift off/protect from metal X-linking

- Washable Coatings/Adhesives
  - Laser processing
  - Temporary bonding
  - Dicing and polishing
  - Planarizing

FF Tape
Washable Safe
CoatsCleans™ vs. Immersion

Using Liquids (Solvents) to Clean Solids (Polymers)

- Long Time
- Ineffective
- Corrosion
- Solvent Intensive
- Hazardous

Treated Wafers → Solvent Immersion

Using Solids (Polymers) to Clean Solids (Polymers)

- Fast
- Multi-purpose
- Metal Safe
- Water Rinse
- EHS Approved

Coats/Cleans™

Treated Wafers → Coat & Water Wash
Stripping Neg-Acrylic PR (Bumping)

Coats/Cleans

Coating

Heat/Emulsify

H₂O Rinse

<table>
<thead>
<tr>
<th>Wafer ID</th>
<th>Before – PR Present</th>
<th>After &lt;15min Dissolve/Rinse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pos - Liq Merck AZ P4620 50-60um</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Neg - Liq JSR THB-151N 20-24um</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Neg - Liq DOW BPR-100 50-60um</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wafer ID</th>
<th>Before – PR Present</th>
<th>After &lt;15min Dissolve/Rinse</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Neg-DF DuPont WB100-series 100-120um</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Neg - DF TOK 100-120um</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Neg - DF Asahi Sunfort 100-125um</td>
<td></td>
</tr>
</tbody>
</table>
Washable Primer - Eliminates Residue

Process Cleans on Rubber Coating + Washable Primer

Wafer Cleans, temperature monitor during rotation

Rinsing, Drying

Hg-Probe Surface Measurement on Co, Following Treatment

Solvent + Rinse Coat

Solvent

Not Clean

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Improved Thermal Resistance

Thermal Resistance

• Chemical functionality
  • Phenyl
  • Polyester

DaeCoat™ Systems

• Phenyl silicones
• Polyphenylsulfones
• Salt conjugates
Thermal Resistant Washable Coatings

Thermal Exposure

<table>
<thead>
<tr>
<th></th>
<th>PVA</th>
<th>PVP</th>
<th>DaeCoat™</th>
</tr>
</thead>
<tbody>
<tr>
<td>200C</td>
<td><img src="200C_PVA.png" alt="Image" /></td>
<td><img src="200C_PVP.png" alt="Image" /></td>
<td><img src="200C_DaeCoat.png" alt="Image" /></td>
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<tr>
<td>250C</td>
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<td><img src="250C_DaeCoat.png" alt="Image" /></td>
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<tr>
<td>300C</td>
<td><img src="300C_PVA.png" alt="Image" /></td>
<td><img src="300C_PVP.png" alt="Image" /></td>
<td><img src="300C_DaeCoat.png" alt="Image" /></td>
</tr>
</tbody>
</table>

After RT Water Rinse

<table>
<thead>
<tr>
<th></th>
<th>PVA</th>
<th>PVP</th>
<th>DaeCoat™</th>
</tr>
</thead>
<tbody>
<tr>
<td>200C</td>
<td><img src="200C_PVA_Rinse.png" alt="Image" /></td>
<td><img src="200C_PVP_Rinse.png" alt="Image" /></td>
<td><img src="200C_DaeCoat_Rinse.png" alt="Image" /></td>
</tr>
<tr>
<td>250C</td>
<td><img src="250C_PVA_Rinse.png" alt="Image" /></td>
<td><img src="250C_PVP_Rinse.png" alt="Image" /></td>
<td><img src="250C_DaeCoat_Rinse.png" alt="Image" /></td>
</tr>
<tr>
<td>300C</td>
<td><img src="300C_PVA_Rinse.png" alt="Image" /></td>
<td><img src="300C_PVP_Rinse.png" alt="Image" /></td>
<td><img src="300C_DaeCoat_Rinse.png" alt="Image" /></td>
</tr>
</tbody>
</table>
Ex.: Wafer Temporary Bonding

**Process Demand**

- **Objective:** Wafer thinning, backside processing
- **Mechanical (e.g. grind):** Yes
- **Thermal resistance:** <300°C
- **Process/chemicals:** Yes
- **Uniformity:** ~2um

**Recommendation**

- **DaeCoat™ 355**
  - Green solvent washable, DaeClean™ 300
  - Broad chemical resistance
  - Thermal resistance: >300°C
- **Carrier:** Solid, due to small die, simple release/cleans
  - Chemical diffusion
  - Recycled
Singulation offers 1-2mm channel between devices to enable simple debond & wash.
Green Solvent Wash Adhesive

Immersion → Adhesive Dissolution → Carrier Release/Recycle

Device:
Capture/Further Processing

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# Ex.: Device Temporary Bonding

<table>
<thead>
<tr>
<th>Process Demand</th>
<th>Recommendation</th>
</tr>
</thead>
</table>
| • **Objective:** LTCC flip-chip bond & encapsulate | • **DaeCoat™ 535**  
  – Hot DIW washable  
  – RT chemical resistance  
  – Thermal resistance: >300°C  
| • **Mechanical (e.g. grind):** No | • **Carrier:** Porous  
  – chemical diffusion  
  – recycled  
| • **Thermal resistance:** ~275°C |  
| • **Process/chemicals:** limited, RT flux cleaner |  
| • **Uniformity:** <10% |  

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LTCC/HTCC

- Microelectronics on a ceramic substrate
- Multi-layer packaging
- MEMS, military, RF, wireless
- Thickness <50um to >250um
- Commonly 100-150um
- Green tape – several suppliers
- Extremely fragile – handling challenge!
DIW Wash Adhesive (LTCC)

UV tape film
Chemical Safe

Film Frame Attach to device front-side

Hot DIW Wash (<80C)

Porous Carrier Debond

UV Debond
Pick & Place

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**Ex.: Wafer Planarization**

<table>
<thead>
<tr>
<th>Process Demand</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective:</strong> Wafer planarizing coating for backside processing</td>
<td><strong>DaeCoat™ 357</strong></td>
</tr>
<tr>
<td><strong>Mechanical (e.g. grind):</strong> No</td>
<td>– Green solvent washable, DaeClean™ 300</td>
</tr>
<tr>
<td><strong>Thermal resistance:</strong> &lt;300°C</td>
<td>– Broad chemical resistance</td>
</tr>
<tr>
<td><strong>Process/chemicals:</strong> Yes</td>
<td>– Thermal resistance: &gt;300°C</td>
</tr>
<tr>
<td><strong>Uniformity:</strong> &lt;5%</td>
<td><strong>Carrier:</strong> desire FF tape</td>
</tr>
<tr>
<td><strong>Special:</strong> Desire to finish on FF tape</td>
<td>– Safe for DaeClean™ 300</td>
</tr>
</tbody>
</table>
Washable Planarization Coating

Sputtering Test

- Sputter deposition of 200nm Ti:W + 300nm Copper on 250µm thick DaeCoat™ 357 using LLS802 multi target tool

wafer with 100:1 mix ratio after sputtering

wafer with 50:1 mix ratio after sputtering

Chamber Capability:
24 x 4” - 6” wafers per batch
8 x 8” wafers per batch
4 x 300 mm wafers per batch
<table>
<thead>
<tr>
<th>Parameter</th>
<th>DaeCoat™ 355</th>
<th>DaeCoat™ 357</th>
<th>DaeCoat™ 515</th>
<th>DaeCoat™ 535</th>
<th>DaeCoat™ 615</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating Thickness</td>
<td>&lt;5-100 um</td>
<td>&lt;5-250 um</td>
<td>&lt;5-100 um</td>
<td>&lt;5-60 um</td>
<td>&lt;5-60 um</td>
</tr>
<tr>
<td>Cure</td>
<td>UV/Thermal</td>
<td>UV/Thermal</td>
<td>Thermal</td>
<td>Thermal</td>
<td>Thermal</td>
</tr>
<tr>
<td>Max temp</td>
<td>~300C</td>
<td>~300C</td>
<td>~300C</td>
<td>~300C</td>
<td>~200C</td>
</tr>
<tr>
<td>Application</td>
<td>Temp Bonding or Coating</td>
<td>Temp Planarizing Coating</td>
<td>Laser Processing</td>
<td>Temp Bonding or Coating</td>
<td>Temp Bonding or Coating</td>
</tr>
<tr>
<td>Resists RT DIW*</td>
<td>✔</td>
<td>✔</td>
<td>✖</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Resists Acids*</td>
<td>✔</td>
<td>✔</td>
<td>✖</td>
<td>✖</td>
<td>✔</td>
</tr>
<tr>
<td>Resists Litho Stripper Chemistries*</td>
<td>✔</td>
<td>✔</td>
<td>✖</td>
<td>✖</td>
<td>✖</td>
</tr>
<tr>
<td>Clean Conditions</td>
<td>DaeClean™ 300 (Safe Solvent)</td>
<td>DaeClean™ 300 (Safe Solvent)</td>
<td>RT DIW</td>
<td>80C, DIW</td>
<td>DaeClean™ 150 (Detergent)</td>
</tr>
</tbody>
</table>