Integration of a High Tg PSPI, HD4004, for 300mm Wafer Finishing for all Package Types

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Overview

- Polyimide Background
- HD4004 Material Properties
- HD4004 Benefits in Manufacturing
- Integration Difficulties in Manufacturing
- Reliability Benefits
- Summary
Polyimide Background

- The purpose of a final passivation level
  - Insulation
  - Protection
  - Stress relief

- Why is it universal?
  - Can be used for bumping and wirebond applications
  - Multiple substrates – organic and ceramic
Polyimide Background – “Bumping”
Polyimide Background – Wirebonding
HD4004 Material Properties

- Photosensitive Polyimide (PSPI)
- Negative tone
- High Tg (350 C) - good for bumping applications
- Resistant to copper migration
- CTE = 33 ppm
- Tensile = 200 MPa
- Elongation = 50%
- Modulus = 3.5 Gpa
HD4004 Benefits in Manufacturing – Fewer Processes

Non-photosensitive Polyimide

Polyimide Apply → Wet Operation → Resist Apply & Expose → Develop → Resist Strip

Pre Cure → Second Develop → Final Cure

Photosensitive Polyimide

PSPI Apply → Expose → Develop → Final Cure
## HD4004 Benefits in Manufacturing – Less Cost

<table>
<thead>
<tr>
<th>POLYIMIDE</th>
<th>HD4004 PSPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 operations</td>
<td>4 operations</td>
</tr>
<tr>
<td>10 chemicals</td>
<td>4 chemicals</td>
</tr>
<tr>
<td>5 tools</td>
<td>3 tools</td>
</tr>
<tr>
<td>14 hours raw process time</td>
<td>10 hours raw process time</td>
</tr>
<tr>
<td>5-10% rework</td>
<td>1-2% rework</td>
</tr>
</tbody>
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**Savings**

$5m
Integration Difficulties in Manufacturing

- Thickness
- Sidewall slope
- Corner
Integration Difficulties in Manufacturing - Thickness

- **HD4000 → HD4004**
  - Needed one grade to support wirebonding and bumping integration plans
  - Ability to change processing conditions to achieve different thicknesses
Integration Difficulties in Manufacturing – Sidewall Slope

Good slope
Integration Difficulties in Manufacturing – Sidewall Slope

Steep Slope Fix

1) Optimized post apply bake (PAB) temperature
2) Decreased PAB time
3) Increased expose focus
Integration Difficulties in Manufacturing – Pinched Corner

**Pinched Corner Fix**

1) Increased post develop bake (PDB) temperature

2) Increased PDB time
Reliability Benefits

- Fewer operations that can cause corrosion
  - Polyimide adhesion promoter, develop rinse
- Tighter wiring for new technologies
  - 58% reduction in feature openings
- Fewer misprocessed wafers with fewer operations
- Wider wet etch window
Summary

- Polyimides are used for insulation, protection, and stress relief
- HD4004, a negative tone PSPI, is “universal”
  - Used with multiple substrates and applications
  - The high Tg, 350C, makes it a good material for bumping applications
- $5 million in savings from a reduction in operations, chemicals, process time, tools and rework
- Integrated into manufacturing after overcoming material and sidewall profiles
- Improved reliability by eliminating corrosive processing materials, reducing the number of operations, and widening the process window