Microelectronics

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

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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

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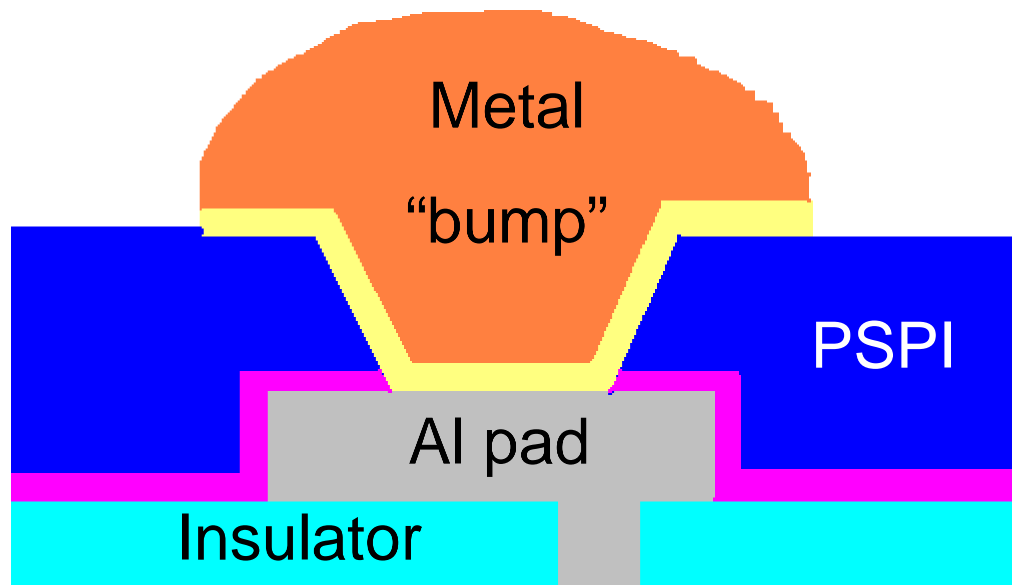
Polyimide Background – “Bumping”



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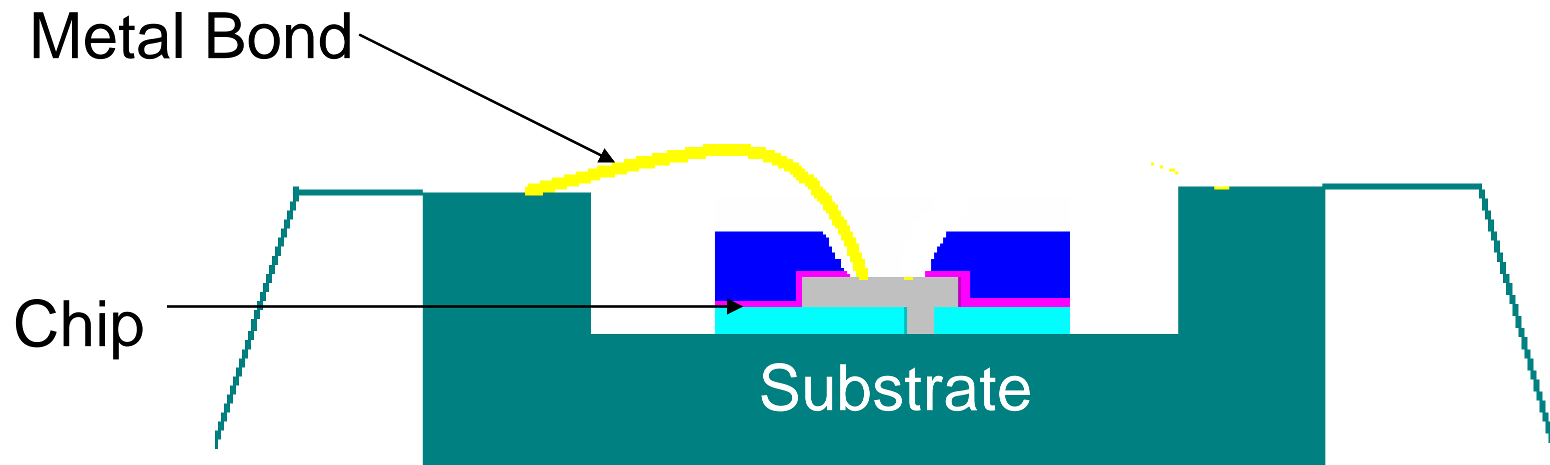
Polyimide Background – Wirebonding



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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

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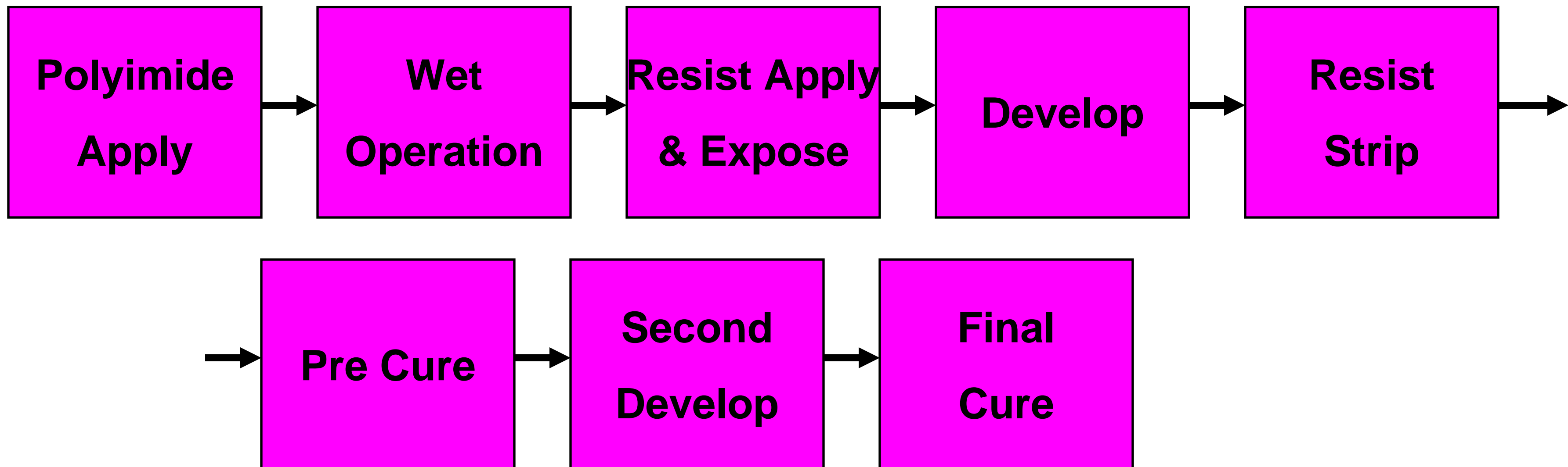
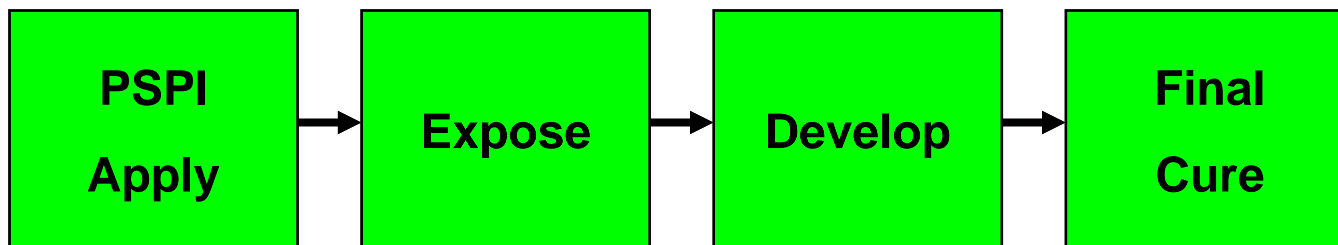
HD4004 Benefits in Manufacturing – Fewer Processes

Non-photosensitive Polyimide



Photosensitive Polyimide



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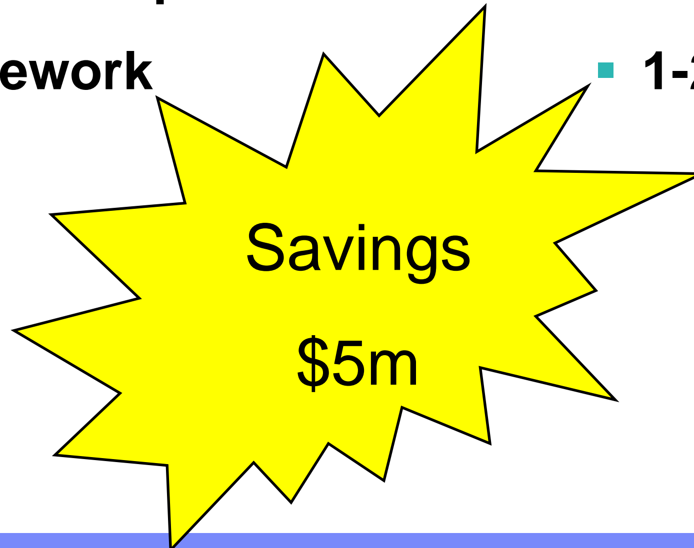
HD4004 Benefits in Manufacturing – Less Cost

POLYIMIDE

- **8 operations**
- **10 chemicals**
- **5 tools**
- **14 hours raw process time**
- **5-10% rework**

HD4004 PSPI

- **4 operations**
- **4 chemicals**
- **3 tools**
- **10 hours raw process time**
- **1-2% rework**



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Integration Difficulties in Manufacturing

- **Thickness**
- **Sidewall slope**
- **Corner**

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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

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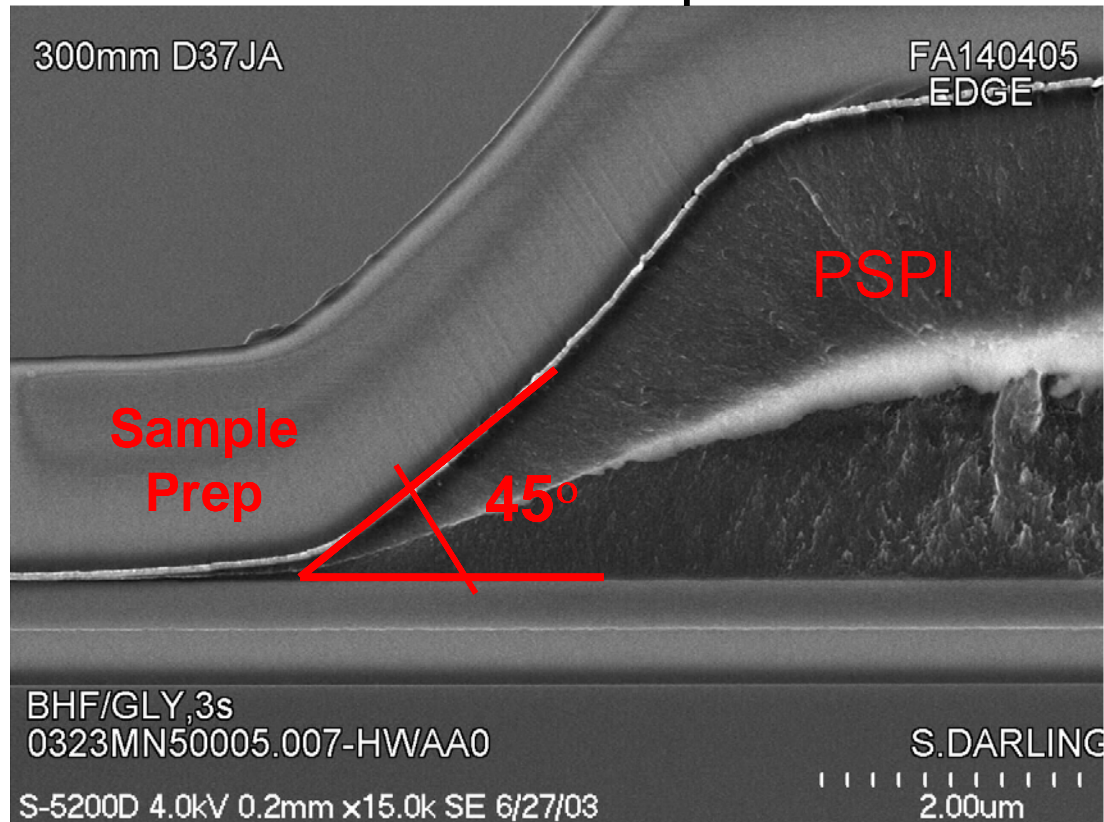
Integration Difficulties in Manufacturing – Sidewall Slope

Good slope



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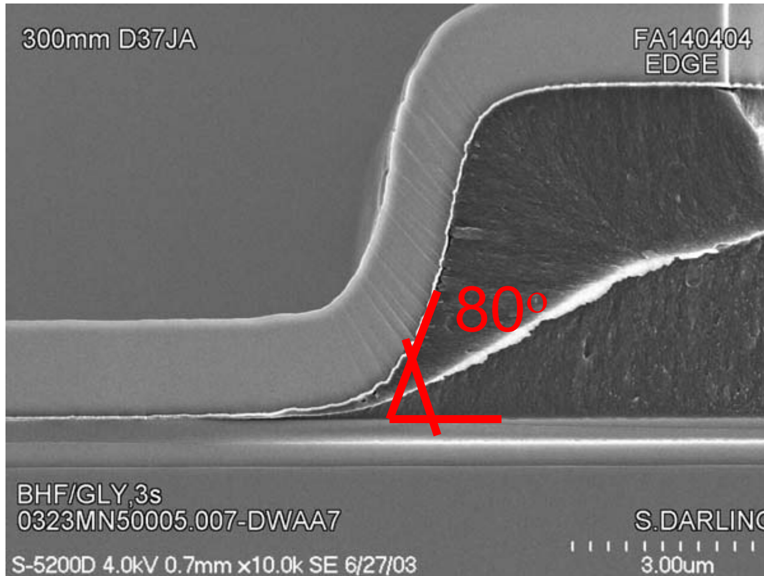
Integration Difficulties in Manufacturing – Sidewall Slope



Steep Slope Fix

1) Optimized post apply bake (PAB) temperature
2) Decreased PAB time
3) Increased expose focus

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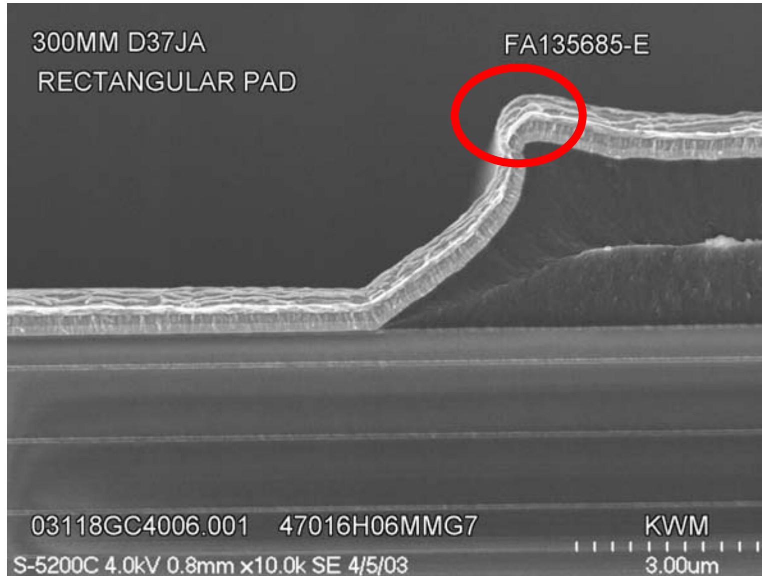
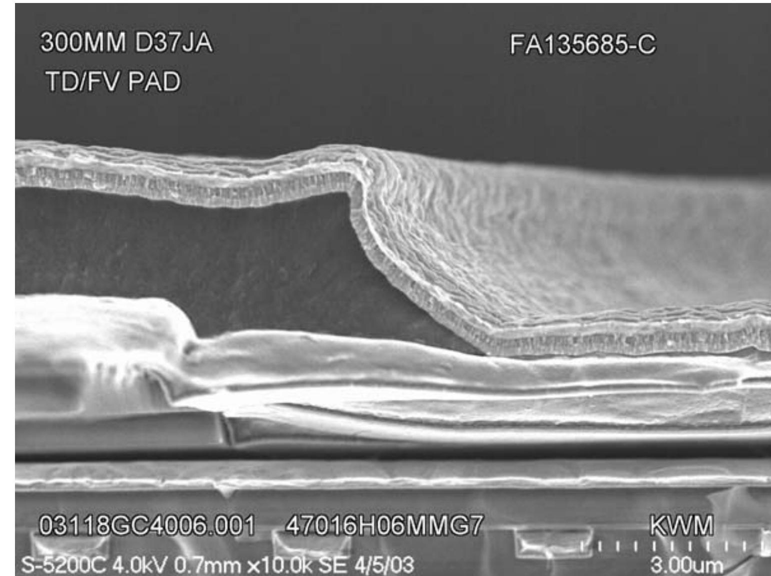
Integration Difficulties in Manufacturing – Pinched Corner





Pinched Corner Fix

1) Increased post develop bake (PDB) temperature
2) Increased PDB time

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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**

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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**

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