Outline

• Introduction

• aveni Product Portfolio

• Common Program with CEA-Leti
  – Rhea Cu Seed for TSV
  – Kari Co Fill for Damascene & Packaging

• Summary
• Headquarter in Massy + International presence

• Wet metallization for advanced features regardless of topography
  ➢ Electroplating & Electroless

• Long-term partnership with CEA Leti
## Product Portfolio – Released

<table>
<thead>
<tr>
<th>Copper</th>
<th>Cobalt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sao™</strong>&lt;br&gt; &amp; <strong>Rhea™</strong></td>
<td><strong>Kari™</strong></td>
</tr>
</tbody>
</table>

### Applications:
- **Copper**
  - Damascene-critical metal levels
  - Through Silicon Via (TSV)
- **Cobalt**
  - Damascene-critical metal levels
  - Contact plugs
  - Memory stacking
## Product Portfolio – Development

<table>
<thead>
<tr>
<th>Nickel Boron Barrier</th>
<th>Polymer Isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Atlas™</strong> &amp; <strong>Neso™</strong></td>
<td><strong>Titan™</strong></td>
</tr>
<tr>
<td><img src="image" alt="ni-b molecule" /></td>
<td><img src="image" alt="pyridine ring" /></td>
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</tbody>
</table>

### Applications:

**Nickel Boron Barrier**
- Memory stacking
- Advanced TSV (Through Silicon Via)

**Polymer Isolation**
- Bonding Permanent / Temporary
- Advanced TSV
Common Program with Leti: Rhea Wet Cu Seed for TSV
Many Types of TSV are Targeted

**TSV Last**
- Diameter: 40-90 µm
- Aspect Ratio: 5:1
- Temp < 200°C

**TSV Mid-process**
- Diameter: 2-10 µm
- Aspect Ratio: 10:1
- Temp < 400°C

**Advanced TSV**
- Diameter: 2-10 µm
- Aspect Ratio > 15:1
- Temp < 400°C

**HD TSV**
- Diameter: 1 µm
- Aspect Ratio > 10:1
- Temp < 400°C

Increasing Technical Challenges
12:1 Electrical Results

Cumulative Resistance of 754 TSV Daisy Chain

- **Standard PVD**
- **Flash PVD**
- **Rhea**
- **Continuous seed**

12:1 aspect ratio mid-process TSV integration and electrical tests using advanced metallization processes, C. Aumont & al., IMAPS 2018
Rhea Cu Seed Ready for 15:1

Rhea in 10 x 150 µm TSV (15:1)

- 400 nm
- 130 nm
- 57 nm
- 50 nm

Step coverage: 13%

Void-free fill

Rhea in 0.7 x 10 µm TSV (15:1)

Advanced barrier and seed layer deposition enabling multiple type of TSVs integration, T. Mourier & al., IMAPS 2019
Cu Seed Extends PVD Cu Capability for Advanced TSV

MoCVD TiN + PVD Cu

Rhea Cu seed

ECD Fill

PVD Cu seed discontinuity

Continuous Rhea Cu seed repair

Void-free fill

Rhea Cu seed is compatible with challenging TSV topology

Advanced barrier and seed layer deposition enabling multiple type of TSVs integration, T. Mourier & al., IMAPS 2019
Common Program with Leti:
Kari Wet Co Fill for Damascene & Packaging
Cobalt Offers Multiple Paths to Extend Moore’s Law

Damascene

- BEOL (N5 and below)
  - Cu replacement
- MEOL (contact, Mo)
  - W replacement

- Co Advantages:
  ✓ Contact and line resistance
  ✓ Reliability and electromigration

Packaging

- Memory stacking
- Advanced TSVs

- Co Advantages:
  ✓ Could overcome Cu limitations in TSVs
  ✓ Alternative metal when Cu is prohibited
Irregular seam; open space voids cannot be annealed out.

Tight seam is easily removed with anneal.
Crystallographic study shows perfectly healed seam
Summary

**Rhea™: Copper Seed Solution**
- Polyvalent solution
- Excellent electrical results
- Extendibility to TSV > 15:1

**Kari™: Cobalt Zip Fill Technology**
- Superior film purity (Sulfur free)
- High Co conductivity
- High throughput
THANK YOU

METALLIZING TOMORROW’S DIMENSIONS™

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