Materials and Conditions Used to Optimize Thinning, Processing, and Dismounting of GaAs Wafers

SEMICON-West
Innovations in Substrate Technology

John Moore
General Chemical Corp.
GaAs Wafer Backside Processing

Step 1: **Mounting** - Adhesive Application, Sapphire Bonding

Step 2: **Thinning** - Grinding, Polishing

Step 3: **Backside Processing** - Vias, Cleaning, Plating

Step 4: **Demount & Cleaning** - Immersion Clean
## Step 1 - Adhesive Materials
Mounting GaAs Wafer to Sapphire

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Manufacturer</th>
<th>Form</th>
<th>Bond Temp. (°C)</th>
<th>Requires Perf. Sapphire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ablefilm WF5801</td>
<td>Ablestik</td>
<td>Dry Film</td>
<td>140</td>
<td>Y</td>
</tr>
<tr>
<td>Staystik 432</td>
<td>Alpha Metals - Cookson</td>
<td>Dry Film</td>
<td>150</td>
<td>Y</td>
</tr>
<tr>
<td>Staystik 336T</td>
<td>Alpha Metals - Cookson</td>
<td>Thick Liquid</td>
<td>125</td>
<td>Y</td>
</tr>
<tr>
<td>Crystalbond 509</td>
<td>Aremco</td>
<td>Resin Stick</td>
<td>120</td>
<td>Y</td>
</tr>
<tr>
<td>Pentalyn-H</td>
<td>Hercules</td>
<td>Rosin Pellet</td>
<td>110</td>
<td>N</td>
</tr>
<tr>
<td>GenTak 230</td>
<td>General Chemical</td>
<td>Thin Liquid</td>
<td>150</td>
<td>N</td>
</tr>
</tbody>
</table>
Step 1 - Adhesive Application

- Stick
- Draw Coat
- Film - Peel Away
- Liquid Spin-On
**Step 1 - Adhesive Application**

**Thickness Uniformity**

- **Adhesive**
  - Wafer

- **Stick** - Irregular
  - Film: +/- 5%

- **Liq. (Pentalyn)**: +/- 15%

- **Liq. (GenTak)**: +/- 0.3%
Resin Application via Spin Coater
Thickness vs Spin Speed

GenTak Adhesive
Static Dispense, 1 min Spin
Hot Plate Cure 1 min @ 100°C

Thickness (µm)

Spin Speed (rpm)

v = viscosity

v = 3,600
v = 800
v = 300
v = 160
Step 1 (Cont.) - Bonding

Thermally Bond Wafer to Sapphire Substrate

• Adhesion
• Planarize Material
• Eliminate Voids
• Clarity - Identify Wafer ID

Courtesy of Sharon Vacuum Co.
Brockton, MA
Step 2 - Wafer Thinning

Backside Grinding and Polishing

- Thinning to <150um
- Uniformity to +/- 10um
- Rigid Bond line w/Pressure
- High Shear Stress
- Heat Resistance
- Vibration Resistance

Single Wafer Grinder
Strasbaugh
San Luis Obispo, CA
## Step 2 - Wafer Thinning

<table>
<thead>
<tr>
<th>Adhesive</th>
<th>Manufacturer</th>
<th>Form</th>
<th>Softening Temp. (°C)</th>
<th>Physical Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ablefilm WF5801</td>
<td>Ablestik</td>
<td>Dry Film</td>
<td>120</td>
<td>Ductile</td>
</tr>
<tr>
<td>Staystik 432</td>
<td>Alpha Metals - Cookson</td>
<td>Dry Film</td>
<td>130</td>
<td>Ductile</td>
</tr>
<tr>
<td>Staystik 336T</td>
<td>Alpha Metals - Cookson</td>
<td>Thick Liquid</td>
<td>110</td>
<td>Ductile</td>
</tr>
<tr>
<td>Crystalbond 509</td>
<td>Aremco</td>
<td>Resin Stick</td>
<td>105</td>
<td>Brittle</td>
</tr>
<tr>
<td>Pentalyn-H</td>
<td>Hercules</td>
<td>Rosin Pellet</td>
<td>95</td>
<td>Brittle</td>
</tr>
<tr>
<td>GenTak 230</td>
<td>General Chemical</td>
<td>Thin Liquid</td>
<td>130</td>
<td>Rigid w/Relief</td>
</tr>
</tbody>
</table>
Step 3 - Backside Processing

Etch and Metal Deposition

a) Define Photoresist Mask
b) Plasma Etch Vias
c) Metal Seed Deposition by Sputtering or Electroless.
d) Electrolytic Gold.

## Step 3 - Backside Processing

<table>
<thead>
<tr>
<th>Adhesive</th>
<th>Resist Strip Safe</th>
<th>Proc. Chem. Safe</th>
<th>Via Clean Safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ablefilm WF5801</td>
<td>N-NMP &amp; Acetone</td>
<td>N-Acids &amp; Oxidizers</td>
<td>N</td>
</tr>
<tr>
<td>Staystik 432</td>
<td>N-NMP &amp; Acetone</td>
<td>Y-Acids &amp; Oxidizers</td>
<td>N</td>
</tr>
<tr>
<td>Staystik 336T</td>
<td>N-NMP &amp; Acetone</td>
<td>Y-Acids &amp; Oxidizers</td>
<td>N</td>
</tr>
<tr>
<td>Crystalbond 509</td>
<td>N-NMP &amp; Acetone</td>
<td>Y-Acids &amp; Oxidizers</td>
<td>N</td>
</tr>
<tr>
<td>Pentalyn-H</td>
<td>Y-NMP &amp; Acetone</td>
<td>Y-Acids &amp; Oxidizers</td>
<td>N</td>
</tr>
<tr>
<td>GenTak 230</td>
<td>Y - GenSolve</td>
<td>Y-Acids &amp; Oxidizers</td>
<td>Y - U/S Process</td>
</tr>
</tbody>
</table>
Step 3 - Backside Processing

Veils - Resist Removal and Smoothing

Via Cleaning

Walls & Bottom Resist and Particulate Removal
**Step 3 - Backside Processing**

**Backside Via Cleaning**

35 um

**Veil Smoothing**

**Process (<10 min.):**

a) Clean - Immersion + Sonicated Agitation
b) Pre-Rinse - Low ST Particulate Lifting
c) Rinse - DI Flush
Step 4 - Demount and Clean

- Immersion Solvent System
- Temperature Near Adhesive SP
- Agitation Using Sonication
- Pre-Rinse @ Low ST
- Rinse in DI Flush
Step 4 - Demount and Clean

Resin Solubility Using Cloud Point

Cloud Point Temp (°C)

Resin Conc (wt %)

General Chemical
Electronic Chemicals Group
Step 4 - Demount and Clean

Debond Performance vs Agitation & Temperature

- GenTak Adhesive
- Static Conditions
- GaAs Wafer 6” Mounted to Non-Perf Sapphire
- Agitation via Ultrasonic 170 KHz
Debond Time vs Polymer Loading

GCC Std Debond Method
Urethane Adhesive

Debond/Clean (min)

Urethane Loading (% w/w)

GenSolve 5X Loading

NMP
Post-Demount Rinsing

Surface Tension (Dynes/cm$^2$) vs. % DI Water

- NMP
- GenSolve
Demount & Clean Process

Demount Tank
GenSolve >130C/Sonics

Cleaning Tank
GenSolve >130C Sonics

Pre-rinse Tank
GenClean 5% in DI Water >55C Sonics

Rinse Tank
DI Water Flush Rinse

Product

Demount

Clean

Pre-Rinse

Rinse

Waste

Fresh

Chemistry
Summary

- Spin-On Adhesive - Uniformity & Planarization
- Via Cleaning - Quick and Effective
- Demount - Solvent Match for Good Performance & Bath Life
- Pre-Rinse - Minimize Redeposition and Facilitate DI Flush