WAFER PROCESSING TEMPORARY ADHESIVES

- 5, 10, 20, 40 and 200 Micron Films or Spin-Coating Solutions
- 0% Residual Peel-Release Adhesive on Polyimide Carrier (Replacing Glass) for Up to 280°C
- Non-Polar Adhesive for High Temperature Processing Up to 320°C for 30 Minutes or More
- Modified Cyanate Ester for High Temperature Processing up to 330°C for 30 Minutes or More
- Heat-Sliding and/or Laser Ambient Temperature Separation Between Device and Carrier Wafer

Temporary Bonding Solutions for Device Wafer Processing

Adding to the proven AIT high temperature and low thermal resistance bonding material solutions in CMP, PVD, and wafer processing:

In addition to our proven record of achieving unparalleled feats of high vacuum, high temperature and low thermal resistance interface bonding media, AIT temporary bonding adhesive solutions are the most comprehensive material solutions innovated and manufactured in the United States.

(The Microlab at Berkeley and SPTS both use AIT solutions:
http://microlab.berkeley.edu/labmanual/chap1/MOD35.pdf
http://www.spts.com/)

With some of the most advanced material scientists and experienced chemists formulating and customizing temporary bonding materials and solutions for critical semi-conductor and microelectronic operations of thinning and 3D wafer processing for superior performance, AIT is now the first in the world in providing a family of wafer processing adhesives in film besides spin coating. They are proven for high temperature (>330°C), high vacuum operations that are removable by heat-sliding, solvent, and/or laser assisted separation.

What distinguishes AIT temporary wafer processing bonding adhesive solutions?

Temporary wafer bonding for thin wafer processing is one of the key technologies of 3D system integration. AIT is proud to add to its wafer processing materials solutions with an innovative family of temporary bonding film and spin coating solutions for temporary bonding of silicon device wafers to carrier wafers using traditional low temperature and low pressure thermo-compression process.

AIT is the first known to provide a film format of its high temperature temporary bonding adhesives for thin wafer processing. Leveraging its expertise of film adhesive manufacturing for the semiconductor industry for more than 30 years, AIT's wafer processing adhesives are available from 5 micron to 80 micron for device wafers up to 450mm with and without topography. AIT high temperature capable wafer processing adhesives can all be removed with heat-sliding and solvent assisted release separation process with the adhesive on device and carrier wafers removed without additional cleaning in most applications. The WPA-TL 330 can also be removed with laser assisted process.

AIT temporary bonding wafer processing adhesives are thermally stable to 280-330°C and compatible with bonded compound wafers for standard WLP process equipment and for backside processing of 3D TSV wafers. High integrity in bond strength enables ease in back grinding to a thickness of 50 µm. Other device wafer processing such as dry etching, wet etching, CMP, PVD, solvent based spin coating of resists and polymers, lithography, electro plating and other elevated temperature processing up to 280-330°C for at least 30 minutes under high vacuum are built in to the novel thermally and chemically stable novel polymers.

Besides being the first to make available film formats of high temperature wafer processing adhesives, AIT WPA-TS-320, WPA-TS-300 and WPA-TL-330, in comparison to traditional and polyimide based temporary handling solutions, also offers one of the highest temperature and time of processing windows for thin wafer processing as well as ease of removal and cleaning.

AIT invented the first peel-release adhesive, WPA-PR-280 on Polyimide for processing up to 280°C with proven 0% residual. It is engineered to replace the costly glass carrier and the messy time consuming cleaning process.

Some distinguishing characteristics:

- Innovative proven 0% residual wafer processing adhesive on Polyimide (instead of expensive glass) for simple peel release after exposure to temperature of up to 280°C.
- Industry first of 3, 5, 10, 20, 40, 80micron film for ease of application besides traditional spin coating.
- Enabling material technologies for different wafer processing requirements with different wafer separation and de-bonding including heat-sliding or laser ablation followed by or directly with solvent assisted, benefiting as a soaked and removed film rather than total dissolution needing second rinsing.
- RoHS, REACH, and WEEE compliant and silicone-free.
- AIT's team of engineers, chemists, and material scientists stand ready to help select and customize a temporary bonding solution for your specific processing parameters.

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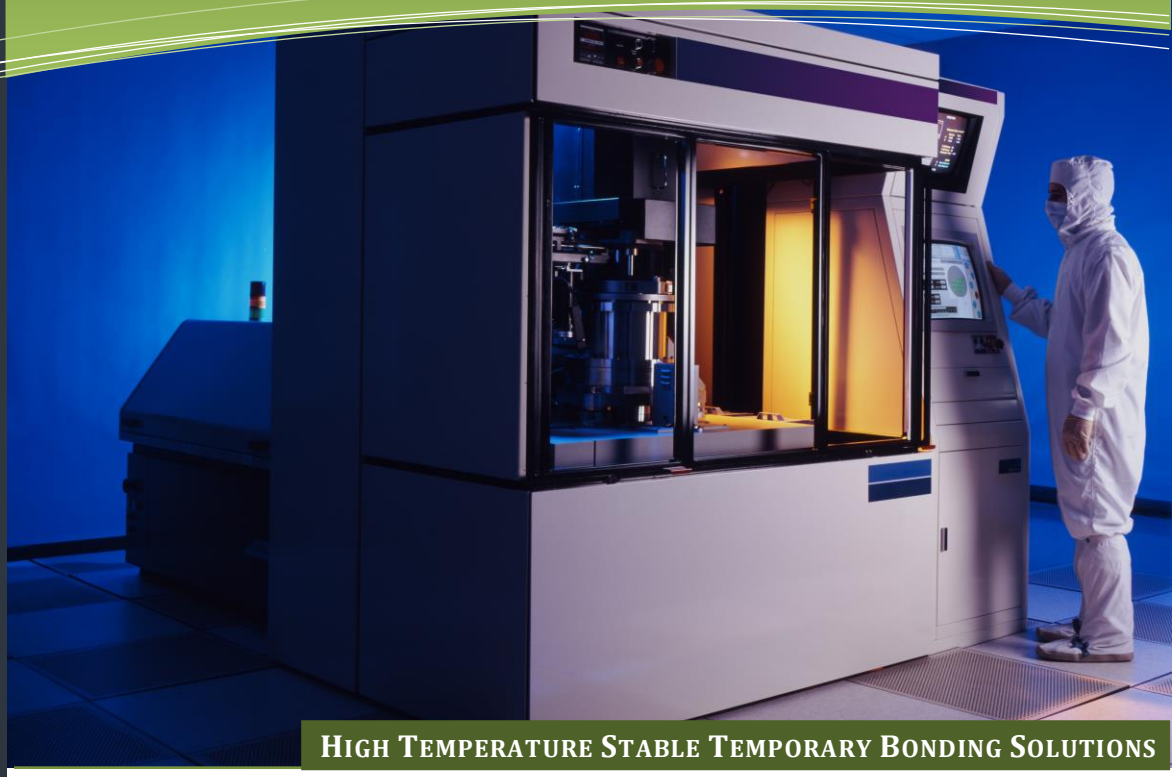
WAFER PROCESSING ADHESIVES THAT ENABLE:

- 5-200 Micron and Thinner Film That Enables Much Thinner and Exact Wafer Processing
- The Only Non-Polar Adhesive for Stress-Free Temperature Processing Up to 320°C
- Modified Cyanate Ester for High Stress-Free Temperature Processing up to 330°C
- Industry First: No Clean, Peel-Release 0% Residual on Disposable High Temperature Capable Carrier Film Based to Replace Traditional Wafer Carrier



High Temperature Stable Temporary Bonding Solutions

TEMPORARY BONDING FOR WAFER THINNING AND PROCESSING OF THIN WAFERS

- Outstanding shear stress support for wet mechanical grinding and dry etching
- Unparalleled thermal stability for extended high temperature oxide deposition up to 280-330°C

TEMPORARY BONDING FOR THIN WAFER BUMPING AND ASSEMBLY OF THIN ICS

- Outstanding molecular stability having 0% weight loss for void free bonding at temperatures up to 280-330°C
- High temperature dimension stable stress-absorbing adhesive for solder bump reflow that can be separated or removed with solvent or laser assisted de-bonding

TEMPORARY BONDING FOR HIGH TOPOGRAPHY THIN WAFER PROCESSING

- Film adhesive of the same spin coating solution in any thickness besides standard 5, 10, 20, 40 and 200 micron
- Outstanding degree of planarization with vacuum lamination at melt-flow temperature of 150°C

PEEL RELEASE TEMPORARY BONDING FOR WAFER PROCESSING

- Outstanding thermal stability for extended high temperature oxide deposition up to 280°C
- High temperature capable PI carrier with dimensional stability to replace glass and wafer carrier
- 0% residual even after exposure to high temperature
- Disposable to minimize cleaning cost and time for higher productivity

Properties of AIT Wafer Processing Adhesives for 3D-TSV Integration:

- First in melt-flow bonding film for 60 micron and thicker for high topography wafer processing
- Short bonding time of seconds at moderate temperature of 150°C so as not to induce undue internal stress
- Cured for cross-linked adhesive strength and stability for mechanical wafer grinding thinning
- Molecular thermal stability and compressive strength for 3D processing at temperature of 300-330°C without degradation in bond strength or generating any outgassing to cause voids

PARAMETER	WPA-TS-320/WPA-TS-300	WPA-TL-330	WPA-PR-280
Release-Separation Mechanism	• Heat-Sliding • Solvent Assisted	• Heat-Sliding • Solvent, Laser Assisted	• Peel Release • 0% Residual
Supplied Formats and Bonding	• Film on release liner for melt-bonding on carrier wafer • Liquid for spin coating onto carrier wafer-substrate • Vacuum melt-bonding at temperature of 150°C		• Film on PI carrier • PI carrier replaces wafer carrier
Thickness Availability	• 5, 10, 20, 40, 80 micron film with other thicknesses available in release liners • 1,200 cps for spin coating with typical thickness of 10 micron (may be diluted for thinner film)		• 5, 10, 20, 40, 200 micron adhesive-buffer layer
Polymer and Temperature Capability	• Non-Polar Polymer • 320°C for over 30 min with 0.0 % weight loss	• Modified Cyanate Ester • 330°C for over 60 min with 0.0 % weight loss	• 280°C for 30 min with 0% weight loss • Slightly polar
Separation-Release Temperature and Cleaning	• Heat-Sliding >180°C with vacuum chuck, or peel with solvent assisted removal	• Heat-Sliding >300°C with vacuum chuck • Heat or Laser De-polymerization >450°C	• Peel release at ambient temperature • 0% residual, requires no cleaning
Chemical and Acid-Base Compatibility	• Withstand most solvents and water for typical cleaning • Not affected by acid or base solutions for electro-plating, etc.		
Etching and Other Processes	• Dry and wet etching, CMP, and PVD • Outstanding bonding and withstand 30 minutes or more up to the designed temperature range as specified for 280°C, 300°C, 320°C and 330°C without any weight loss or outgassing		

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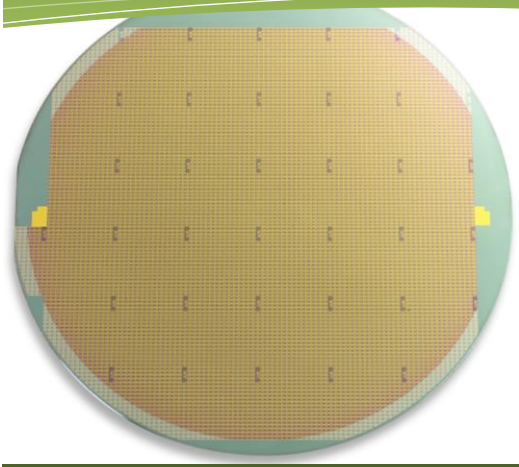
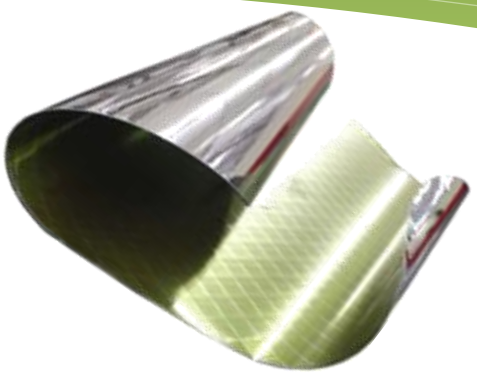
Stress-Free Wafer Processing:

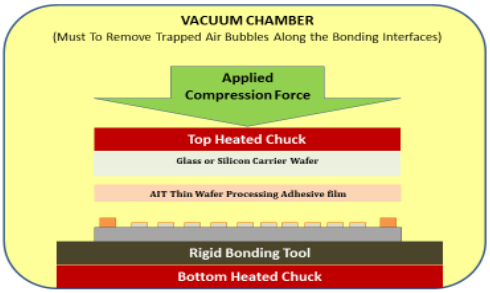
- Maintaining Adequate Bonding for Stress-Free Vigorous Processing at 320°C and 330°C
- Choices of Non-Polar and High Temperature Polar Temporary Bonding Adhesives
- Choices of Using Film Vacuum Lamination or Spin Coating with Vacuum Lamination
- More Choices in Separation (De-Bonding) between Device and Carrier Wafer post processing
- WPA-PR-280 Peel Releasable with 0% Residual after High Temperature Processing to 280°C



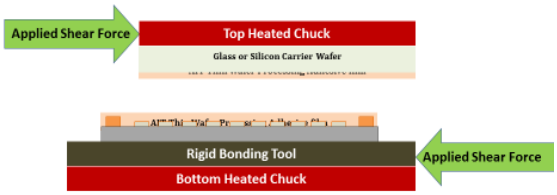


Wafer Thinning, Bumping, 3D TSV and Thin Wafer Processing with Different Topography

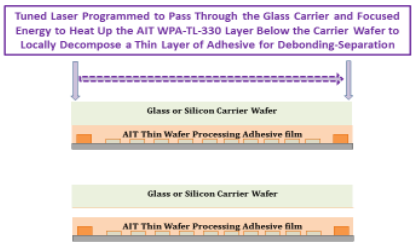
Compression Bonding Process Under Vacuum is the Same with the Use of AIT Thin Wafer Processing Film Adhesive



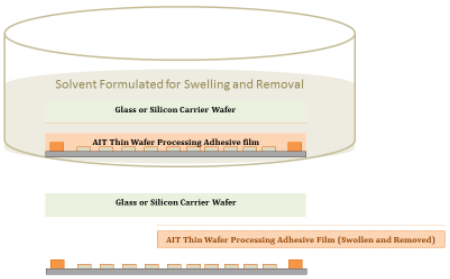
WPA-TS-320, WPA-TS-300 and WPA-TL-330 Support Heat-Sliding Separation-Debonding at 250-300°C with Shear Forces



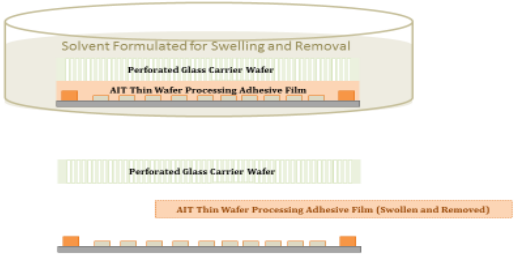
AIT WPA-TL-330 Thin Wafer Processing Film Adhesive May be Decomposed with Tuned Laser to Allow Ease of Debonding-Separation Between Device and Carrier Wafer



Residual Layers of AIT WPA-TL-330 Thin Wafer Processing Film Adhesives May be Swollen and Removed with Specially Formulated Solvent Solution



AIT WPA-TL-330, WPA-TS-300 and WPA-TS-320 Thin Wafer Processing Film Adhesives May be Swollen and Removed with Specially Formulated Solvent Solution to Debond and Separate the Device and Carrier Wafers

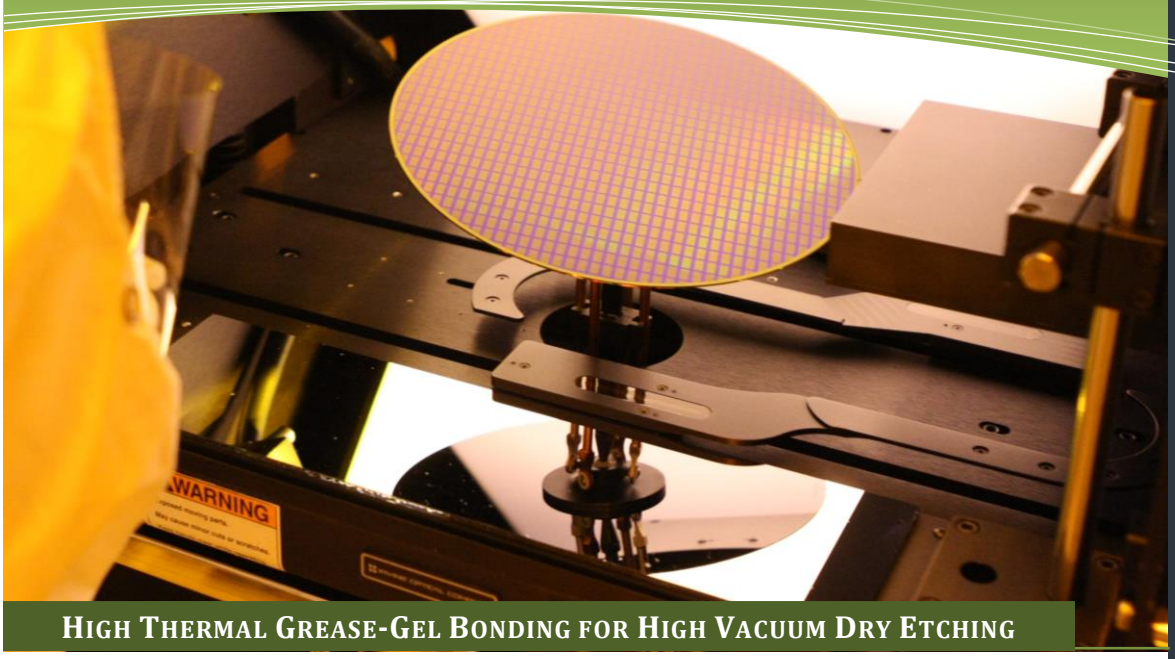


In wafer processing for TSV, in step 1, the device wafer is bonded onto the carrier wafer creating a compound wafer with a temporary bonding adhesive must be melt-bonded to conform and fill in and "planarize" to provide a void free bonding to accommodate and compatible with the features of the device wafer like surface topography, surface material, constraints in process temperature and pressure etc. Spin coating process is the established industry standard in putting on thin temporary bonding film onto carrier wafer. AIT wafer processing adhesive technologies besides offering the spin coating, is the first in the industry to provide a thin film adhesive application process that allow much higher flexibility and ease in customizing the required adhesive thickness from feature rich device wafer requiring 60 microns. With the available of film adhesive, the size of wafer that can be used is no longer limited to 200mm, 300 and even 450mm can be processed the same way.

Step 2 of the TSV process involves the thinning and subsequent backside processing of the device wafer to 60 micron or less. Depending on the particular application, many different processes are used to create the backside structure. Besides mechanical back grinding, processes like CMP, dry etching, CVD, lithography, PVD, wet etching and electro-plating with acid or base solutions are performed. AIT wafer processing adhesives are tested to be fully compatible with all these processes and bonding remains stable even under severe process of temperature higher than 320°C.

The next critical requirements of the wafer processing temporary bonding adhesive is in the step 3 of de-bonding or separation of the carrier wafer from the processed thin device wafer. WPA-TS-320, WPA-TS-300 and WPA-TL330 adhesive solutions are engineered to allow traditional heat-sliding at relatively comfortable temperatures of 160-300°C and solvent assisted separation. The WPA-TL330 adhesive solution can also be separated with the more advanced laser assisted method. Residues, mostly in semi-film, from the temporary adhesive are removed with designed stripping solvent solutions.

- **Wafer-Substrate Thinning Spin Coatings and Films**
- **Wafer Grinding Tapes with and without Buffer Layer**
- **High Vacuum Dry Etching Thermal Interface Materials**



High Thermal Grease-Gel Bonding for High Vacuum Dry Etching

High Vacuum Dry Etching Temporary Bonding Thermal Adhesives

- High Thermal Grease-Gel Bonding in High Vacuum Etching Chamber
- High Thermal Bonding Pad for High Vacuum Etching Chamber

PROPERTY/PARAMETER	CGR7016/CGR7018	CGR8150/CGL8150
Bond Strength (Operation)	Capillary, 10 psi shear	Capillary, 10 psi shear
Removal (Method)	IPA with/without Heat	IPA with/without Heat
Vacuum Capability	10^{-12} pressure	10^{-12} pressure
Chemical & Etching Tolerance	Proven, Outstanding	Proven, Outstanding
Dielectric Strength (Volts/mil)	>250	>300
Device Push-off Strength (psi)	>10	>1000
Density (gm/cc)	2.5	2.5
Thermal Conductivity	> 4.0 W/m-°C	> 8.0 W/m-°C
Maximum Continuous Operation Temp. (°C)	> 150	> 150
Electrical Resistivity	$>10^{14}$ ohm-cm	$>10^{14}$ ohm-cm

Properties of AIT Back-Grinding & Thinning "WAX" and Tapes

- Spin Coating IPA Soluble Wax and Film for Wafer and Substrate Thinning
- Back Grinding for Wafer with Flip-Chip Bumps and Substrate with Solder Bumps

PARAMETER	BGL-7090, BGF-7090	BGL-7160, BGF-7160	GD-CR-xxxM, GD-HP-xxxM,
Operational Temperature Capability	• Up to 75°C	• Up to 125°C	• Up to 280°C • 0% Residual
Thickness of Temporary Bonding Layer	• Spin coating • 5, 10 micron films	• Spin coating • 5, 10 micron film	• Compressible buffer-adhesive on PET or PI
Die-Shear Bond Strength	• >500 psi	• >500 psi	• Peel-Releasable
De-Bonding Temperature and Mechanism	• >120°C with vacuum chuck sliding	• >180°C with slipping push	• Peel release at ambient • Disposable PI carrier replaces glass carrier
Water Jet Resistance	Outstanding	Outstanding	Outstanding
Cleaning Media	Iso-propanol (IPA)	Iso-propanol (IPA)	• No cleaning required • 0% residual

Spin-Coating and Film Temporary Bonding Media

- 50% solid version (BGL7090) for 5-15 micron spin coating
- 25% solid version (BGL7090) for 2-10 micron spin coating
- BGF7090 film version is available in 5 and 10 micron
- Ideal for precision thickness wafer and substrate thinning
- IPA soluble and carrying solvent for safe and convenient operation
- Water resistance enables cooling for high pressure
- Non-silicone and non-contaminating

Dicing Tapes on Polyolefin (PO) Carrier and Grinding Tapes with or without Buffer Layers

- Dicing tapes with 15 and 30 micron thick residual free pressure-sensitive adhesive on PO carrier film
- Peel strength from 100 to 1000 gram per inch
- Back grinding tapes with or without compliant buffer to accommodate the flip-chip or solder bumps on PET or Polyimide carrier film

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