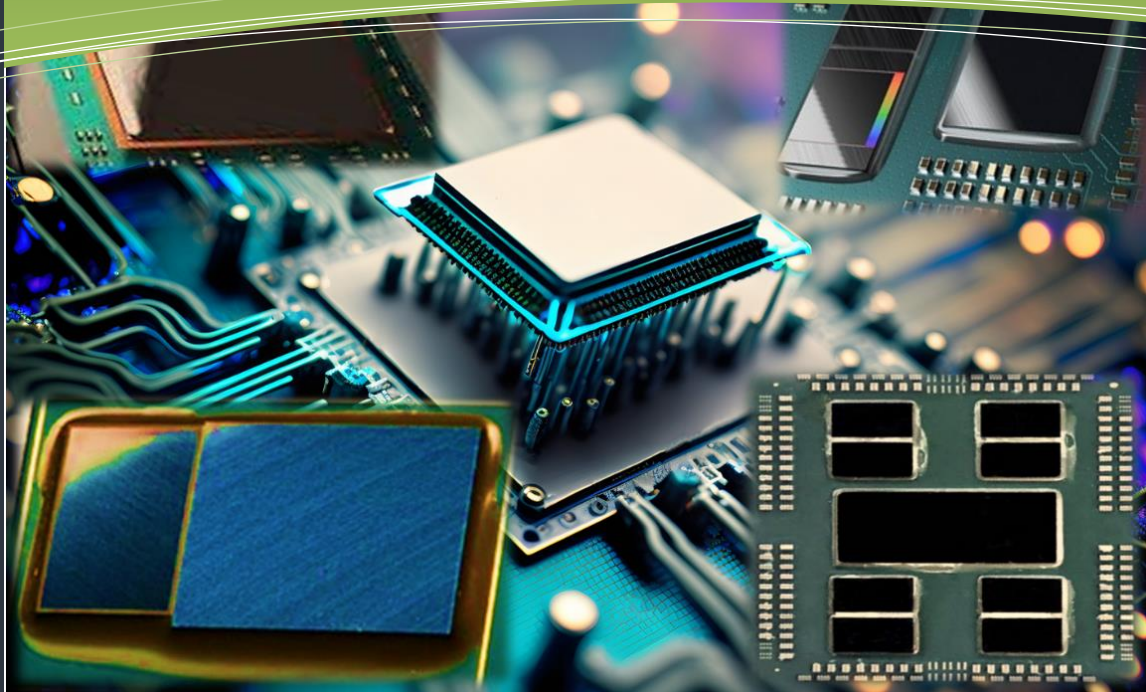


## UNDERFILL SOLUTIONS FOR FLIP-CHIP PACKAGING, CHIP AND COMPONENT ON BOARD, AND WAFER LEVEL UNDERFILL



### Innovative Underfill Films and Pastes for Flip-Chip and BGA on Board Advanced Electronic Packaging Protection

AIT's Underfills are designed with molecular structures to provide unparalleled ability to provide compressive stress for chip and component soldering interconnection while absorbing planar shear stresses during thermal cycling and operations. The designed molecular structure not only incorporated high Tg but also outstanding moisture barrier with low moisture absorption for MSL level 1 component level reliability. These capabilities are achieved with unconventional polymer engineering and designs. AIT's advanced microelectronic protection products have proven performance for military and advanced commercial devices.

### Innovative Underfill Solutions:

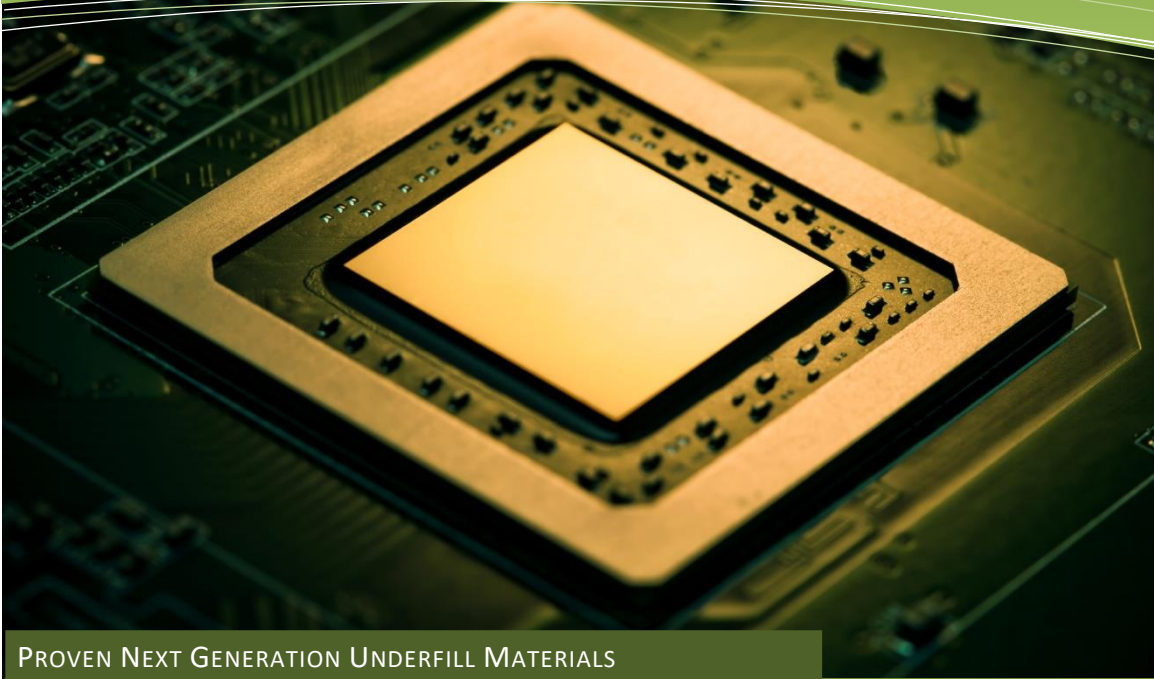
- Tg of 220°C to provide soldering-interconnection stress control.
- Molecular engineering for shear stress relaxation.
- Less than 10% moisture sensitivity in comparison to standard epoxy moisture absorption and bond strength.
- Film underfill with fiducial transparency for chip placement.
- Reworkable underfill film with the same stress management and moisture protection.

### AIT Stress Relief Liquid Capillary Underfill

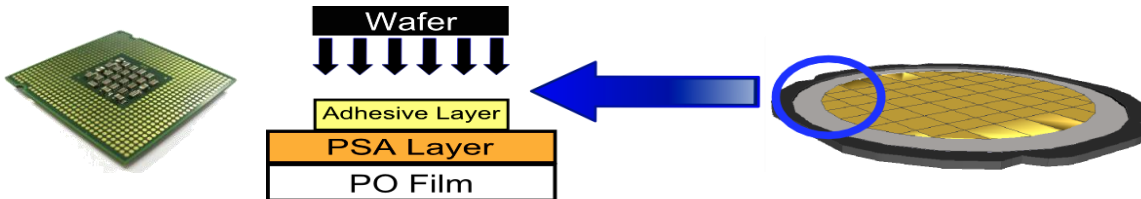
Liquid Capillary Underfill Properties	UF-MC7883-FP	UF-MC7889-FP	UF-MC7883-NP	UF-MC7883
Coefficient of Thermal Expansion (CTE, ppm/°C, 25°C to 150°C)	16-18	18-20	20-22	22-26
Filler Size Max Cut (µm)	5	5	<0.5	<20
Moisture Absorption and Retention (% , 85%RH/85°C/168hr)	<0.5	<0.5	<0.5	<0.5
HAST Reliability (85%RH/ 130°C)	336Hr, Pass	336Hr, Pass	336Hr, Pass	336Hr, Pass
Electrical Resistivity (Ω-cm)	>10 <sup>14</sup>	>10 <sup>14</sup>	>10 <sup>14</sup>	>10 <sup>14</sup>
Dielectric Strength @ 25 Micron Thickness (Volts/mil)	>1000	>1000	>1000	>1000
Dielectric Constant (D <sub>k</sub> >1 MHz)	3.2	3.6	3.2	3.2
Dielectric Loss Factor (D <sub>f</sub> >1 MHz)	<0.01	<0.01	<0.01	<0.01
Device Push-off Strength (psi)	>3000	>3500	>4000	>4500
Hardness (Type D)	90 (D)	86 (D)	90 (D)	86 (D)
Cured Density (gm/cc)	2.5	2.4	2.2	2.2
Thermal Conductivity (W/m-°K)	>1.5 W/m-°K	>8.0 W/m-°K	>1.0 W/m-°K	>1.0 W/m-°K
Modulus of Elasticity (GPa)	8	8	8	7
Maximum Continuous Operation Temp/Glass Transition Temp(°C)	>180/220	>180/220	>180/220	>180/220
Decomposition Temperature @5% weight loss (°C)	>450	>450	>450	>450
Recommended Capillary Underfilling Gap (µm)	>35	>35	>20	>150

# NEW GENERATION HIGH Tg UNDERFILL FILMS AND PASTES

WITH GLASS TRANSITION OF OVER 240°C FOR ULTIMATE FLIP-CHIP, COMPONENT INTERCONNECTION, SHEAR STRESS MANAGEMENT AND MOISTURE PROTECTION



PROVEN NEXT GENERATION UNDERFILL MATERIALS



## Underfill Film Adhesives and Solutions

FUNCTION	AIT PART#	THERMAL, ELECTRICAL, & other RELEVANT PROPERTIES
Underfill Film Adhesive for Wafer or Chip	UFF-ESP7770	<ul style="list-style-type: none"><li>Tg ~175°C to ensure minimal stresses during and post reflow soldering</li><li>High melt-flow at 80-100°C to wafer level lamination with dicing tape with 12-month ambient storage for chips with pre-applied underfill film</li><li>Outstanding fiducial transparency for ease of dicing and chip placement</li><li>High melt-flow and remaining liquidous during interconnection-soldering</li><li>Molecularly engineered for shear stress and moisture protection</li></ul>
Underfill Film Adhesive for Wafer or Chip (REWORKABLE)	UFF-RW-ESP7760	<ul style="list-style-type: none"><li>Tg ~175°C to ensure minimal stresses during and post reflow soldering</li><li>High melt-flow at 80-100°C to wafer level lamination with dicing tape with 12-month ambient storage for chips with pre-applied underfill film</li><li>Outstanding fiducial transparency for ease of dicing and chip placement</li><li>High melt-flow and remaining liquidous during interconnection-soldering</li><li>Molecularly engineered for shear stress and moisture protection</li></ul>
Underfill Film Adhesive for Wafer or Chip	UFF-CXP7880	<ul style="list-style-type: none"><li>Tg ~240°C to ensure minimal stresses during and post reflow soldering</li><li>High melt-flow at 80-100°C to wafer level lamination with dicing tape with 30-day ambient storage for chips with pre-applied underfill film</li><li>Outstanding fiducial transparency for ease of dicing and chip placement</li><li>High melt-flow and remaining liquidous during interconnection-soldering</li><li>Molecularly engineered for shear stress and moisture protection</li></ul>
Underfill Film Adhesive for Wafer or Chip (REWORKABLE)	UFF-RW-CXP7860	<ul style="list-style-type: none"><li>Tg ~240°C to ensure minimal stresses during and post reflow soldering</li><li>High melt-flow at 80-100°C to wafer level lamination with dicing tape with 30-day ambient storage for chips with pre-applied underfill film</li><li>Outstanding fiducial transparency for ease of dicing and chip placement</li><li>High melt-flow and remaining liquidous during interconnection-soldering</li><li>Molecularly engineered for shear stress and moisture protection</li></ul>

### Liquid Underfills with Ultra-high Glass Transition (Tg):

- Modified cyanate ester to balance the high Tg and high temperature capability with engineered stress absorption.
- Outstanding thermal conductivity and low thermal resistance to allow power chip to dissipate heat to both the top and bottom sides of the microelectronic package.
- Proven in some of the most stringent military applications

### High Melt-Flow Film Underfill for FOW:

- Outstanding melt-flow and wetting to flow-over-wire for stack-chip applications
- Ability to cure at lower temperature from 100-150°C for lower interfacial stresses
- Ideal for large area stack-chip and module

### High Melt-Flow Preform Film Underfills:

- Preform with specific thickness to accommodate the flip-chip or ball-grid-array parts with preformed cut-outs for solder ball arrays.
- High melt-flow to encapsulate the soldered interconnection for protection





# INNOVATIVE FILM UNDERFILL SOLUTIONS: WAFER AND BGA PANEL LEVEL

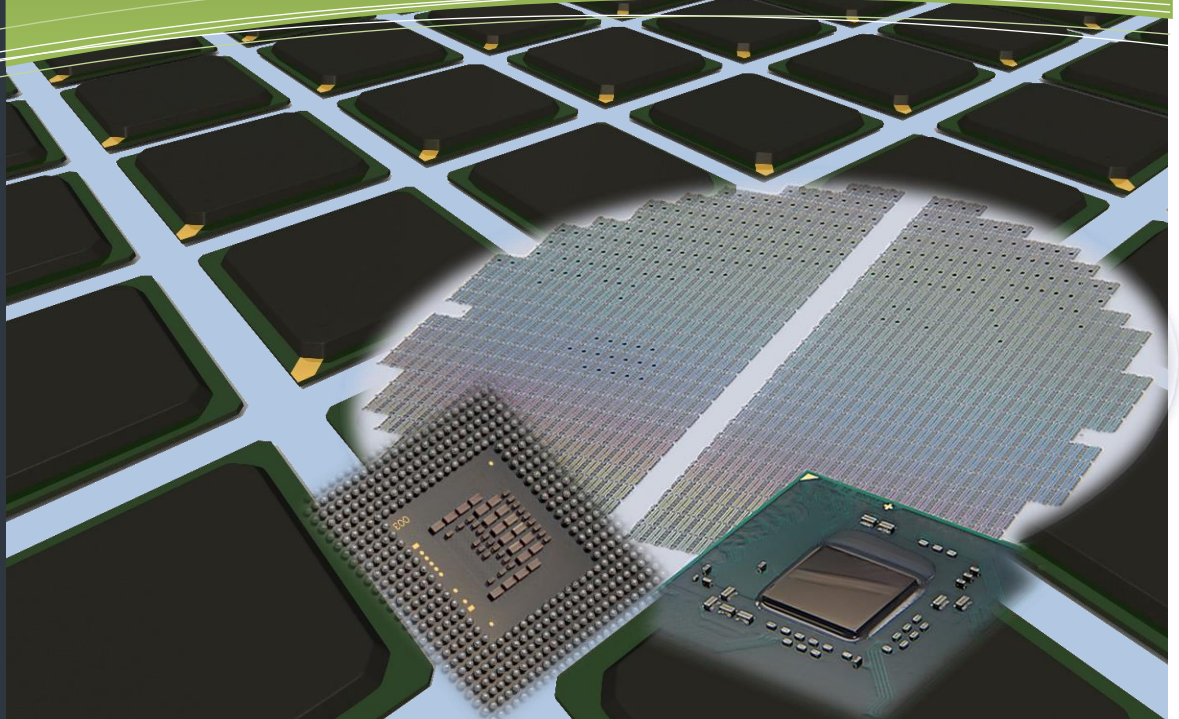
## INNOVATIVE MATERIAL SOLUTIONS FOR CHIP AND COMPONENT LEVEL UNDERFILL PROTECTION AGAINST STRESSES AND MOISTURE-INDUCED FAILURES:

Traditional epoxy liquid paste underfills have been proven to have limited applicability in the more advanced flip-chip and BGA designs with reduced bond-line thickness.

The inherent limitation of paste underfill can be overcome with film-based underfill if suitable soldering process can be achieved. AIT pioneering underfill film have been designed specifically for wafer and panel level underfill applications.

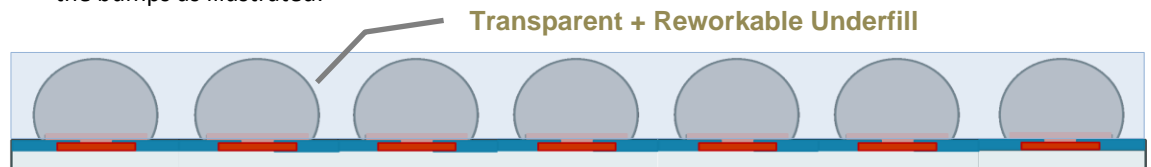
Besides unparalleled ability to absorb interconnection and shear stresses with outstanding moisture protection, AIT UFF are designed for improving productivity in underfilling operations as illustrated in processes on the right hand side.

- Instead of trying to match the CTE of 3 and 18 ppm/°C for the chip and BGA, AIT UFF adhesives have been designed with molecular structure to absorb the shear stress along with low moisture sensitivity.
- AIT UFF adhesives are also designed to have optical fiducial transparency to enable dicing and soldering placement.
- AIT UFF adhesive has extended ambient storage for ease of handling after pre-application of UFF at the wafer or chip level.
- During the soldering interconnection process, AIT UFF remains liquidous for extended time to allow solder reflowing and interconnections.
- Completion of curing at the maximum operation temperature to achieve the highest MSL level 1 reliability performance.

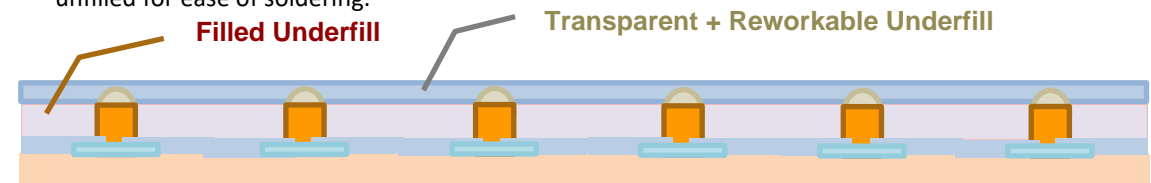


## WAFER AND PANEL LEVEL FILM UNDERFIL PROCESS AND SOLUTION:

- 1) AIT Underfill film (UFF) adhesive is applied onto the active side with the bumps in either wafer for chips or panel for BGA components. The process is similar to traditional die-attach film (DAF) but on the active side.
- 2) Lamination of AIT film underfill adhesive at temperature of 80-100°C with nominal lamination pressure of less than 15 psi in less than 5 seconds. Thickness of UFF film is recommended to cover the bumps as illustrated:



- 3) If thermal requirements are required, AIT UFF film adhesive may be used in two-layer format as illustrated below. The filled thermal underfill is translucent with the top layer being transparent and unfilled for ease of soldering.



- 4) The UFF underfills are designed to be transparent and/or translucent for ease of dicing into individual chip with UFF or BGA component with UFF.
  - 5) The transparency-translucency of the Chip or component with UFF is designed to allow direct and easy placement at interconnection temperature. UFF film adhesives are designed to remain liquidous at soldering temperature and operation.
  - 6) AIT UFF adhesives are designed to complete curing at temperature 150°C or 175°C depending on device maximum operating temperature to ensure solder-joints integrity while built-in molecular structure provide the shear stress relaxation and moisture protection.
- *Note: Wafer underfill lamination is best performed immediately upon soldering flux application*

# ADVANCED PACKAGING MATERIAL SOLUTIONS AT ALL LEVEL OF ELECTRONIC APPLICATIONS

WITH ENGINEERED MOLECULAR STRUCTURE FOR PROVEN PERFORMANCE



Amerasia  
International Tech



AI Technology, Inc. (AIT) offers one of the most comprehensive lines of advanced materials for packaging and protection from chip to board level:

- Wafer level die attach film (DAF) and dicing die-attach film adhesive for chip stacking and high-power microelectronic devices
- Die-Attach films and pastes for extreme high temperatures, stress management requirements and high-power applications
- Thermal interface materials including greases, gels, adhesives, patented compressible phase-change pads, high compressibility and conforming "gum-pads" with unparalleled performance
- EMI/RFI mitigation material solutions with conductive caulks, adhesives and coatings
- Wafer processing adhesives
- Back-grinding and dicing tapes and solutions
- Back-grinding wax films and spin-coating waxes
- Insulated metal substrate for high temperature and high-power modules
- Moisture and acid rain barrier conformal coating

AIT develops and manufactures its product in an ISO 9001:2015 certified 16 acres facility campus in Princeton Junction, NJ, USA with service centers in China and worldwide representation. In 2022, AIT expands its operation with the addition of its second headquarters in an 18 acres campus located in the adjacent town of Princeton, NJ.

AIT Product	Characteristics	Thermal Conductivity (Watt/m <sup>2</sup> -K)	Die-shear (psi)	Tg (°C)
<b>BUF 7883-FP</b> <b>Build-Up Film</b> <b>Adhesive</b>	<ul style="list-style-type: none"> <li>Controlled &lt;12 ppm/°C CTE molecular stress absorption</li> <li>Outstanding stress absorption and moisture barrier</li> <li>High melt-flow at lower pressure and temperature</li> </ul>	>1.5 (Filled)	>3,000	220
<b>GT-MC7865-S</b> <b>GT-MC7885-S</b>	<ul style="list-style-type: none"> <li>Thermally conductive <b>glob-top paste</b></li> <li>Coupling &lt;30 ppm/°C CTE molecular stress absorption</li> <li>Outstanding stress absorption and moisture barrier</li> </ul>	>1.2 (Filled)	>5,000	240
<b>WL-ESP7679-FP</b> <b>WL-ESP8660-FP</b>	<ul style="list-style-type: none"> <li><b>Wafer level die-attach film</b> with dicing tape compatible</li> <li>Proven thermal and MSL Level 1 capability</li> <li>Ultra-low thickness of less than 10µ</li> </ul>	>12.0 (Filled)	>4,000	80
<b>WL-ESP7660</b>	<ul style="list-style-type: none"> <li><b>Wafer level die-attach film</b> with dicing tape compatible</li> <li>Proven thermal and MSL Level 1 capability</li> <li>Ultra-low thickness starting at 5µ</li> </ul>	>12.0 (Filled)	>4,000	80
<b>ME8412</b> <b>ME8550</b>	<ul style="list-style-type: none"> <li>100% solid <b>conductive die-attach pastes</b></li> <li>Proven outstanding thermal and electrical conduction</li> <li>MSL Level 1 capability</li> </ul>	>12.0 (Filled)	>3,000	60/ -20
<b>SC7130-CC</b> <b>CC7130-PR</b>	<ul style="list-style-type: none"> <li>Proven water and moisture barrier <b>conformal coatings</b></li> <li>Proven performance for aeronautic electronic protection</li> <li>Spray coating with less than ½ of conventional coating thickness</li> </ul>	0.2 Transparent	N/A	-45
<b>SC7050-UVB</b> <b>SC7130-UVB</b>	<ul style="list-style-type: none"> <li><b>UV blocking and protective coating</b> for outdoor electronics</li> <li>Proven performance for moisture and oxidation discoloring</li> <li>Spray coating for controlled outdoor protection</li> </ul>	0.2 Transparent	N/A	-45