TOTAL THERMAL MANAGEMENT MATERIAL SOLUTIONS

- Rapid Curing Modified Electro-thermal Die-Attach
- Instant Bonding Thermal Film Adhesive for Module Sub-Mounting
- Compressible, Conformal Phase-Change Thermal Interface Pad
- Insulated Metal Thermal Substrate with 2X Thermally Conductivity

THERMAL MANAGEMENT FOR LED LIGHTING

Low LED Temperature for Higher Brightness:

Management of heat dissipation in LED is critical for highest brightness and long-term performance. AIT has dedicated product developments with patented technologies that have proven to achieve the lowest thermal resistance from chip to heat-sink. The total material solutions help to have the lowest LED device temperature from die-attach to module sub-mounting and heat-sink interface.

With over 30 years of experience in inventing and formulating specialty adhesives for electronic applications, AIT provides one of the most comprehensive thermal interface solutions that are engineered to facilitate manufacturability and throughput:

- Rapid curing electro-thermal die-attach pastes
- Compressible pressure sensitive thermal film that is industry best to provide instant bonding and lowest thermal resistance for large area sub-mounting
- Melt-bonding thermal adhesive that can be pre-applied for module sub-mounting and achieving full curing in-situ without applied pressure
- Conformal compressible phase change or pressure sensitive thermal interfaces for modules to heat-sink for largest displays

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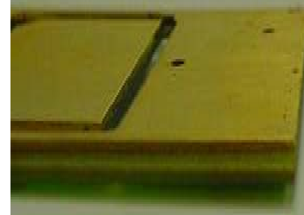
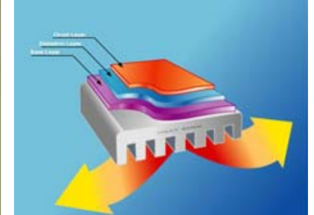
Rapid Curing Electro-thermal Die-Attaches

Sub-Mount Melt-Bonding or Pressure Sensitive Thermal Adhesives



Conformal & Compressible Phase-Change or Pressure Sensitive Thermal Interface



Insulated Metal Thermal Substrate for Large Area LED

What distinguishes AIT LED total thermal management material solutions besides the unparalleled and proven low thermal resistance in the die-attach, sub-mount and heat-sink are the long-term reliability and consistent performance after years of thermal shock and cycling with the build-in stress relief, and molecular structures that are engineered to prevent "drying" or cracking inside the materials and along the interface surfaces.

1. Ultra-low electrical and thermal resistance between LED dies and sub-mount or substrate. High mechanical strength and glass transition temperature to enable fast wiring bonding as high as 275°C.
2. For sub-mounting, molecular flexibility is specifically engineered in the thermal adhesive to provide stress absorption even in the most mis-matched CTE substrates and surfaces that extend to below -55°C. Depending on the assembly process, LED sub-mounting has a choice of novel and the only proven pressure sensitive thermal adhesive or a melt-bonding thermal adhesive film.
3. In the heat-sink interface layer, AIT provides the patented and proven compressible and conformable interface pad to eliminate trapped air and accommodate irregularity in gap that need to be filled.
4. Ultra-low moisture absorption and sensitivity
5. RoHS, REACH and WEEE compliant that meets UL94V-0 rating.

Electro-Thermal and Dielectric-Thermal Die-Attach

- Low Thermal Resistance for Higher Brightness
- Modified Epoxy for Rapid Curing at Temperature of 150-175°C
- Maintain Stable Bond Strength for Extreme Thermal Shock and Cycling

LOWEST POSSIBLE DIE-ATTACH TEHRMAL INTERFACE IS THE FOUNDATION OF LED TEHRMAL MANAGEMENT:

Die-Attach thermal management is the first and most critical layer of the thermal stacks in a LED module device. Highest thermal conductivity with thin and void-free bond-line of the die-attach adhesive is critical in dissipating the heat quickly to the broader sub-mount and eventually to the heat-sink.

- ME8512 is a popular choice of void-free die attach with low electrical and thermal resistance.
- ME8638-UT represents the ultimate die-attach adhesive that enables one of the highest thermal conductivity and lowest thermal resistance interface between the die and sub-mount.
- ME7519-LB is thermally conductive and electrically insulating die-attach adhesive.
- For dielectric die-attach, ME7635-LED has been engineered to have both high thermal conductivity and dielectric strength.

THERMAL CONDUCTIVE ADHESIVES

Properties of COOL-BOND™ Die-Attach for LED Applications

PROPERTY/PARAMETER	ME 8512	ME 8638-UT	ME 7519-LB
Electrical Resistivity	<0.0003 ohm-cm	<0.0003 ohm-cm	>10^{14} ohm-cm
Viscosity @5.0 rpm/Thixotropic Index	10,000 cps/4.0	10,000 cps/4.0	20,000cps/>3
Glass Transition Temperature (°C)	52	90	52
Device Push-off Strength (psi)	>3000	>3000	>3000
Hardness (Type)	~ 80	~ 90	~ 85
Cured Density of Conductive Adhesive Portion (gm/cc)	4.0	4.6	2.5
Thermal Conductivity	> 12.0 W/m-°K	> 12.0 W/m-°K	> 12.0 W/m-°K
Linear Tab-Composite Thermal Expansion Coefficient (ppm/°C)	40 (X-Y=Z, Isotropic)	38 (X-Y=Z, Isotropic)	45 (X-Y=Z, Isotropic)
Maximum Continuous Operation Temperature (°C)	> 180	> 180	> 180
Decomposition Temperature @5% weight loss (°C)	>450	>450	>450
Recommended Curing Temperature/Time (°C/min.)	>175/10	>175/10	>175/10

Extreme Thermal Adhesive for Module Sub-Mounting

- Instant Bonding Compressible Pressure Sensitive Adhesive Pad
- Melt-tacking and In-situ Curable Low Thermal Resistance Film Adhesive
- Proven Lower LED Junction and Device Temperature for Higher Brightness

Module Sub-Mounting Thermal Adhesives

PROPERTY/PARAMETER	RTK 7555	RTK 7554	ME 7519-LB
Thermal Conductivity	> 0.2 W/m-°C	> 0.2 W/m-°C	> 0.2 W/m-°C
Dielectric Strength (Volts/mil)	>550	>300	>750
Device Push-off Strength (psi)	>1000	>1000	>1000
Cured Density (gm/cc)	2.5	2.5	2.5
Thermal Conductivity	> 3.0 W/m-°C	> 8.0 W/m-°C	> 12 W/m-°C
Maximum Continuous Operation Temp. (°C)	> 150	> 150	> 150
Electrical Resistivity	>10^{14} ohm-cm	>10^{14} ohm-cm	>10^{14} ohm-cm

Other AIT Thermal Interface Materials for HB LED Applications

FUNCTION	AIT PART #	THERMAL, ELECTRICAL AND OTHER RELEVANT PROPERTIES
Compressible Phase-Change	COOL-SILVER™ PAD CPR8850-LB	• Lowest thermal resistance, electrically non-conductive interface pad • Compressible, phase-change interface pad (US patented)
Compressible Phase-Change	COOL-SILVER™ G3 PAD	• Lower cost version of the lowest thermal resistance pad • Compressible, phase-change interface pad (US patented)
Compressible Phase-Change	COOL-PAD™ CPR7158	• Modified aluminum nitride filled with one of the lowest thermal resistance • Compressible, electrically insulating phase-change pad (US patented)
Compressible Phase-Change	COOL-PAD™ CPR7155-LB	• Modified aluminum oxide filled with one of the lowest thermal resistance • Compressible, electrically insulating phase-change pad (US patented)
Gap-Filling Thermal Pad	COOL-GAPFILL™ DT, TT	• Gap filling compressible thermal pad with the lowest thermal resistance • One-side tacky (DT) or both side tacky (TT) for different applications
Compressible Gel-Film	COOL-GELFILM™ SZ	• Thin compressible gel like film • Non-curing thin bond-line thermal interface
Thermal Grease	COOL-SILVER™ G3 Grease	• Non-curing, electrically non-conductive interface grease • Lowest thermal resistance, non-silicone, proven long-term stability
Thermal Grease	COOL-GREASE™ CGR7559-LB	• Lowest thermal resistance, electrically insulating interface grease • Non-curing, non-silicone, proven long-term stability
Thermal Gel	COOL-SILVER™ G3 Gel	• Non-curing, electrically non-conductive interface gel forming paste • Non-silicone grease, proven thermal stability similar to thermal pad
Electro-Grease	COOL-GREASE™ CGR8550	• Non-curing, electrically conductive interface grease for moving parts • Lowest thermal resistance non-silicone grease, proven long-term stability

Compressible Thermal Gap Pad Thermal Interface

- Compressible and conformal
- Proven for large area requiring thermal filling into height gaps of different components
- Ideal for large area display and module to device enclosure
- Proven and used for most critical thermal challenges with military grade reliability
- Non-silicone and non-contaminating
- Available with different thickness with one-side or both side pressure sensitive

Compressible Phase-Change Thermal Interface Pads

- Compressible and conformal couples with phase change to allow elimination of voids
- Proven for most stringent applications including military applications
- US patented innovation
- Non-silicone and non-contaminating

Insulated Metal Thermal Substrate and Pre-Preg Thermal Film Adhesive for LED Sub-Mounting & Module:

- Measured 2x thermal conductivity to that of traditional insulated metal substrates
- Notable improvements in the reliability of such larger area LED panel

About AI Technology, Inc.
Since pioneering the use of flexible epoxy technology for microelectronic packaging in 1985, AI Technology has been one of the leading forces in developing advanced materials and adhesive solutions for electronic interconnection and packaging.

Besides pioneering the use of "phase-change" materials (PCM) as thermal interface materials (TIM), AIT has provided the microelectronic packaging industries with its flexible epoxy thermal adhesives. By managing interfacial stress induced by differential coefficient of thermal expansion between bonding adherents, these thermal management materials have found extensive use and success in critical military and aerospace applications.

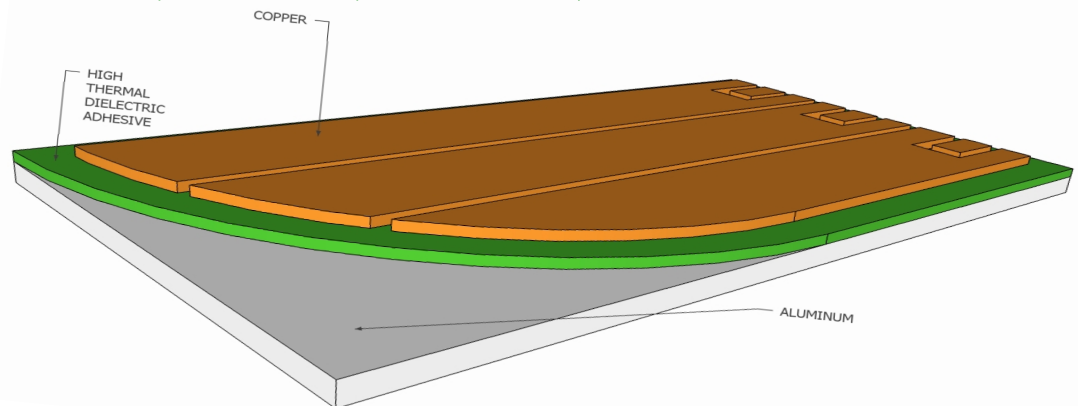
The same stress-free dielectric adhesives are now adapted for use in insulated metal substrates with copper and aluminum clad. The key advantage of these thermal management materials is the unparalleled long-term reliability attributed to its ability to withstand repeated thermal cycling and stress-free bonding between the heat-spreader plate and the circuit layer. AIT also offers the same flexible epoxy pre-preg with high thermal conductivity for the more advanced multilayer insulated metal substrate circuits and modules. This novel class of thermal management materials provides a platform and infrastructure for large area thermal management of power modules such as solar cells, LED panels, etc.

AIT has a full line of die and substrate attach films and pastes, thermal interface materials, (EMI/RFI) mitigation material solutions, conductive caulks and adhesives, and advanced flexible and Insulated Metal Circuit Substrates.

The company has an ISO9001:2000 certified manufacturing and R&D facility on a 16-acre campus in Princeton Junction, NJ. Sales support includes company direct offices in Shenzhen-HK China and sales reps in Europe and Asia.

AIT patented thermal management technologies (US patent# 7,154,046; 6,717,819; 6,580,035; 6,581,276; 6,108,210; 6,297,564; 6,665,193; 6,973,716) give unparalleled thermal and reliability performance, and is different from the traditional insulated metal substrate in the following :

- Instead of a rigid fiberglass thermally conductive epoxy laminate, we use our proprietary self-supporting thermal dielectric insulating layer resulting in stress-free and warp-free thermal copper-clad laminates.
- Unparalleled thermal conductivity in the insulating layer by eliminating the fiberglass fabrics.
- High temperature stability to withstand soldering at 300°C.
- Multi-layer capability with the same flexible dielectric copper-clad pre-preg that can be laminated at less than 15 psi pressure and at 125°C or higher.
- Base metal plates with choice of aluminum and copper thicknesses.
- Thinner insulated metal substrate and pre-preg are available in rolls of 12-24-inch width.
- Thicker insulated metal substrate and pre-preg are available in sheets of 24-inch or wider.
- Unparalleled adhesion to copper and aluminum even without chemical etching or treatment.
- Ideal for power and LED components, modules and panels.



Insulated Metal Thermal Substrate for Sub-Mounting

PROPERTY/PARAMETER	COUPLER™	PRE-PREG
Thermal Conductivity	> 3.2 W/m-°C	> 3.2 W/m-°C
Dielectric Strength (Volts/mil)	>750	>750 V
Linear Thermal Expansion Coefficient (ppm/°C)	35 (X-Y=Z, Isotropic)	40 (X-Y=Z, Isotropic)
Maximum Continuous Operation Temp. (°C)	> 175	> 175
Electrical Resistivity	>10^{14} ohm-cm	>10^{14} ohm-cm