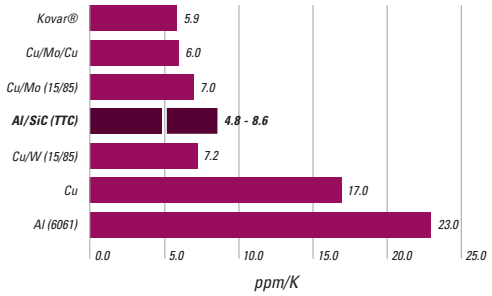
Thermal Transfer Composites, LLC
"Cool Products for Hot Applications"

PRIMEX™
COMPOSITES

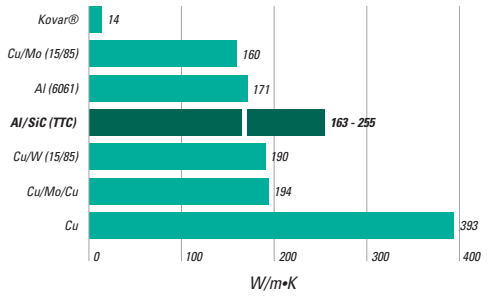
TTC's reinforced Al/SiC composites provide a unique combination of properties ideal for many electronic thermal management, packaging, and structural applications. The following data and information are provided to assist you in choosing the appropriate material for your application.

Coefficient of Thermal Expansion



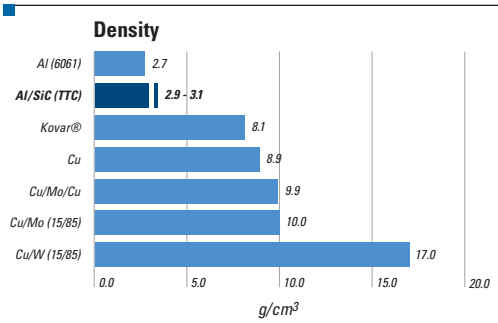
One key property to consider in high performance design is the coefficient of thermal expansion or CTE. By matching the CTE's of the materials in an electronic assembly, stresses developed between them during power cycling are minimized. Lower stress means less fatigue in the bond joint between the assembly layers, resulting in a significant improvement in the long-term reliability of the system. With CTE values ranging from 4.8 to 8.6 ppm/K, TTC's PRIMEX™ Al/SiC composites* provide an excellent match to most ceramic and semiconductor materials, including: Alumina, Aluminum Nitride, Beryllia, Silicon Nitride, Silicon, Gallium Arsenide, and Gallium Nitride.

Thermal Conductivity



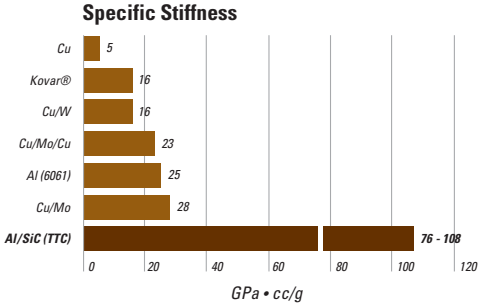
For applications where heat dissipation is a critical requirement to maintain system performance and reliability, the thermal conductivity of the heat sink materials is one of the first design parameters to be considered. With thermal conductivity values ranging from 163 to 255 W/m•K, TTC's PRIMEX™ Al/SiC composites* are an ideal choice for most high performance applications where the combination of CTE and thermal conductivity are primary system design drivers.

Density



The density of all of TTC's PRIMEX™ Al/SiC composites closely matches that of aluminum alloys commonly used in electronic assemblies. When compared to many other thermal management materials, weight savings of as much as 80% can be realized. For applications where weight and thermal performance are important, TTC's PRIMEX™ based Al/SiC composites are prime candidates.

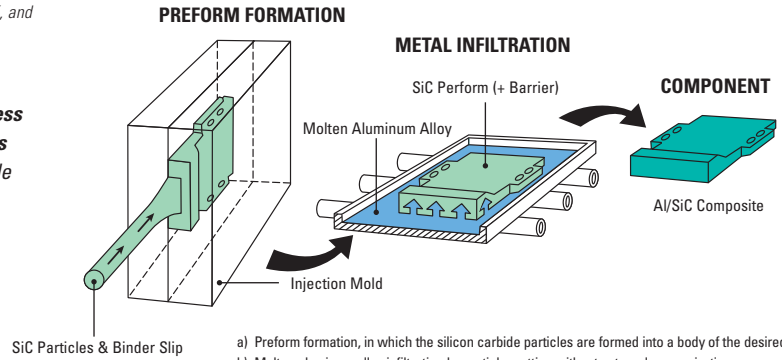
Specific Stiffness



For electronic systems operating in severe vibration environments, a high natural frequency is desired for long-term mechanical reliability. Since the natural frequency of a structure is proportional to the square root of its specific stiffness, this property becomes important in such applications. All of TTC's PRIMEX™ Al/SiC composites* combine high elastic modulus with low density to provide some of the highest specific stiffness values currently available for electronic

*Note: PRIMEX Ultra™ Composites are for high performance applications requiring a thermal conductivity in excess of 200 W/m•K, thermal expansion 4 to 7 ppm/K, and Young's modulus up to 350 Gpa.

The PRIMEX™ Pressureless Metal Infiltration Process *infiltrates ceramic particle preforms with molten aluminum to produce components typically ranging from 55 to over 80 volume percent silicon carbide.*



a) Preform formation, in which the silicon carbide particles are formed into a body of the desired shape;
b) Molten aluminum alloy infiltration by particle wetting without external pressurization or vacuum assist; and
c) Matrix solidification and part recovery.

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298B Churchmans Rd.
New Castle, DE 19720

Telephone: 302-328-3231
Fax: 302-328-3460

www.thermaltc.com

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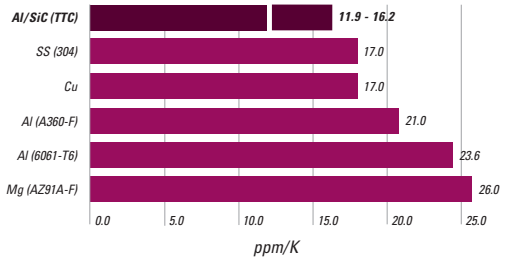
PRIMEX Cast™ COMPOSITES

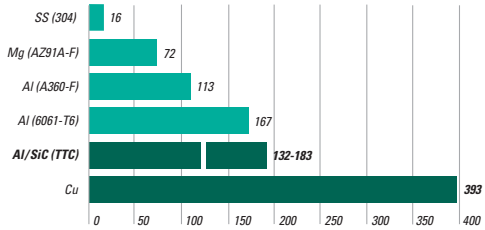
All of TTC's PRIMEX Cast™ materials may be used for a variety of thermal management and structural applications. Please contact TTC for assistance in identifying the material and casting method that best meets your performance and volume requirements.

Coefficient of Thermal Expansion



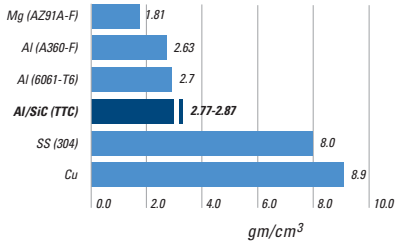
One key property to consider in high performance design is the coefficient of thermal expansion or CTE. By matching the CTE's of the materials in an electronic assembly, stresses developed between them during power cycling are minimized. Lower stress means less fatigue in the bond joint between the assembly layers, resulting in a significant improvement in the long-term reliability of the system. With CTE values ranging from 11.9 to 16.2 ppm/K, TTC's PRIMEX Cast™ Al/SiC composites provide the systems engineer with a degree of flexibility unavailable from monolithic materials.

Thermal Conductivity



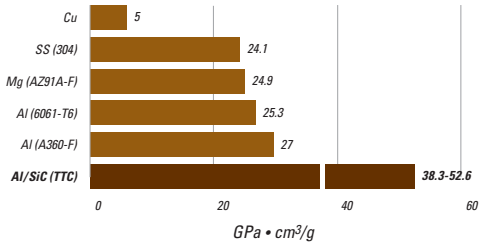
For applications where heat dissipation is a critical requirement to maintain system performance and reliability, the thermal conductivity of the heat sink and/or heat spreader material is one of the first design parameters to be considered. With thermal conductivity values ranging from 132 to 183 W/m•K, TTC's PRIMEX Cast™ Al/SiC composites are an ideal choice for most high performance applications where the combination of CTE and thermal conductivity are primary system design drivers.

Density



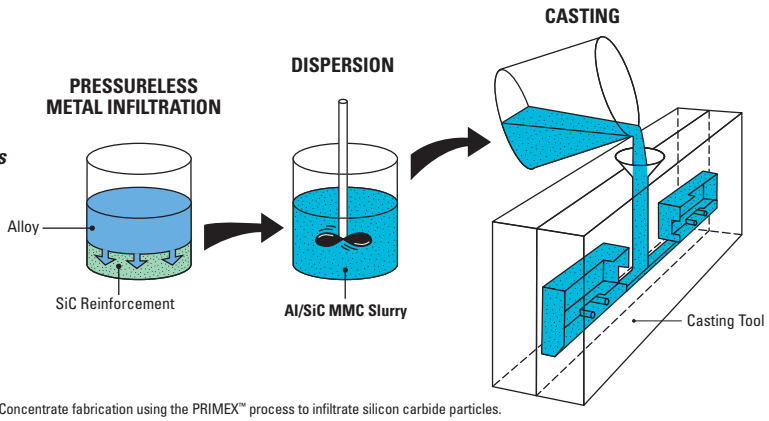
The density of all TTC's PRIMEX Cast™ based Al/SiC composites closely matches that of aluminum alloys commonly used in electronic assemblies. When compared to many other thermal management materials, weight savings of as much as 70% can be realized. For applications where weight and thermal performance are important, TTC's PRIMEX Cast™ Al/SiC composites are prime candidates.

Specific Stiffness



For electronic systems operating in severe vibration environments, a high natural frequency is desired for long-term mechanical reliability. Since the natural frequency of a structure is proportional to the square root of its specific stiffness, this property becomes important in such applications. All of TTC's PRIMEX Cast™ Al/SiC composites combine high elastic modulus with low density to provide some of the highest specific stiffness values currently available for electronic structures.

The PRIMEX Cast™ Composite Casting Process *uses conventional aluminum casting processes to produce components ranging typically from 20 to 40 volume percent silicon carbide.*



a) Concentrate fabrication using the PRIMEX™ process to infiltrate silicon carbide particles.
b) PRIMEX Cast™ alloy is prepared by diluting the concentrate with excess alloy to form molten Al/SiC slurry.
c) Component fabrication is performed by casting the Al/SiC slurry using standard aluminum casting processes.

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