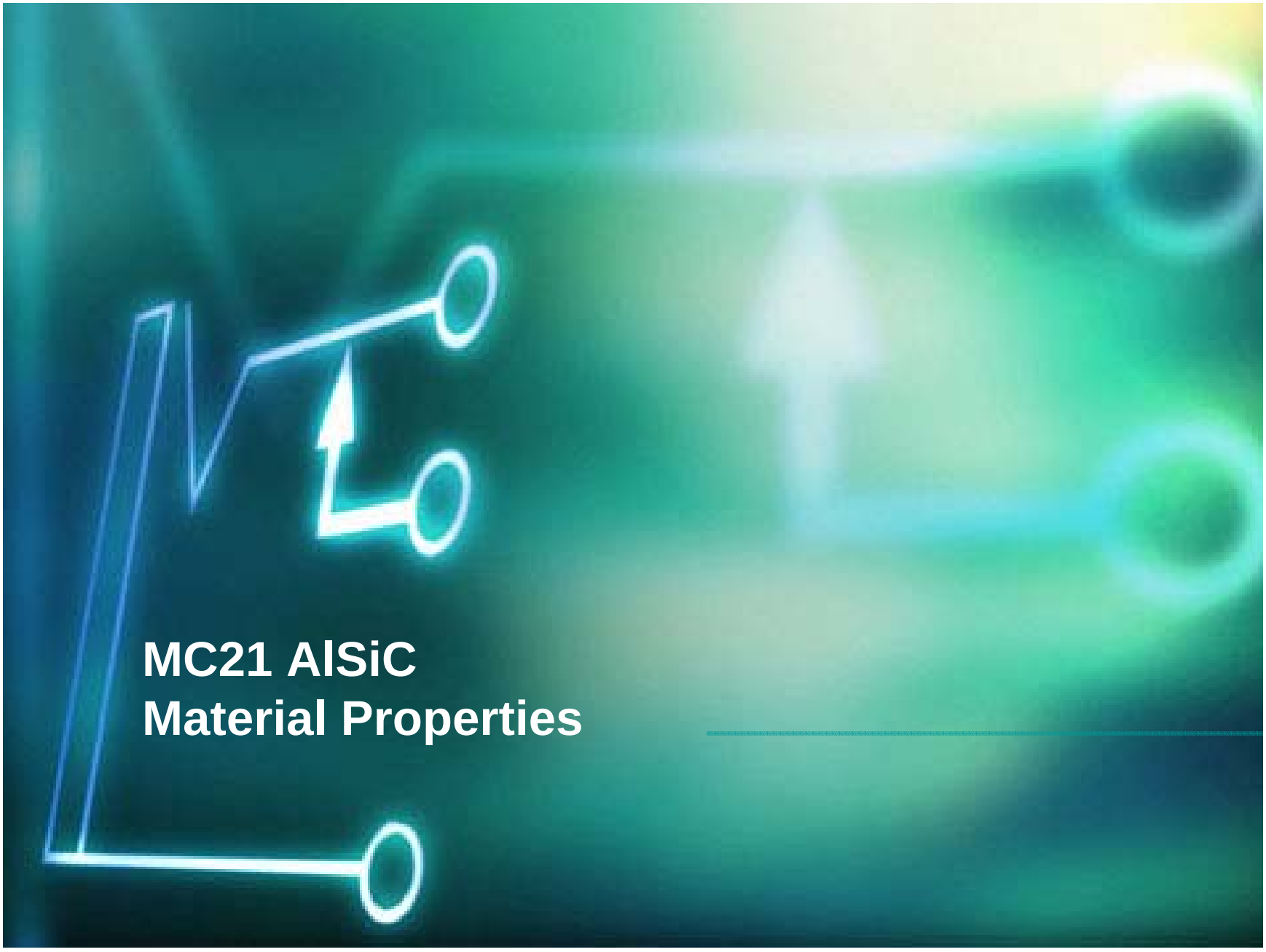
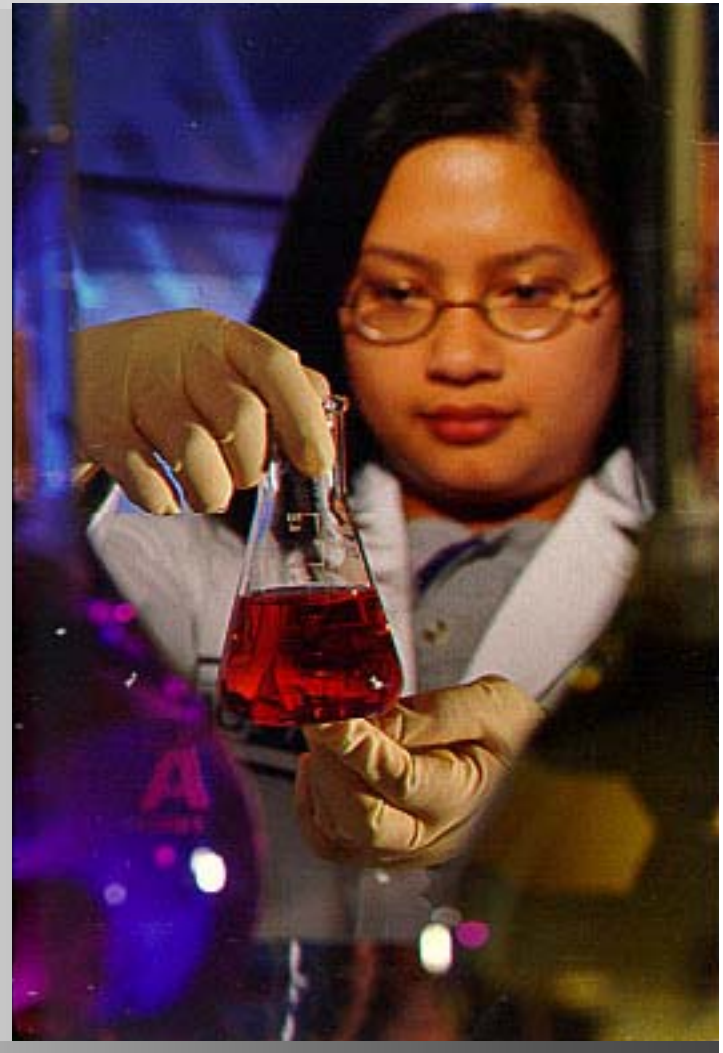

MC21 AlSiC
Material Properties

MC21 MMC
AlSiC MMC: PRODUCT ADVANTAGES

- **Light weight**
  Similar specific gravity as aluminum alloy.
  - **Density 2.7 ~ 2.9 g/cc**
- **High Rigidity**
  1.3 - 2.4 times stiffer than high-strength aluminum alloy.
  - **Young's modulus 100 ~ 175 GPa**
- **High Thermal Conductivity**
  Same thermal conductivity as high thermal conductive aluminum alloy.
  - **Thermal Conductivity 150 ~ 180 W/mK**
- **Low Coefficient of Thermal Expansion (CTE)**
  45 – 70% lower CTE than aluminum
  - 10.4 – 16.4 ppm/ ° C
- **Excellent Wear Resistance**
  - **Over 500X longer than aluminum alloy**



MC21 MMC
AlSiC MMC: MATERIAL CHARACTERISTICS

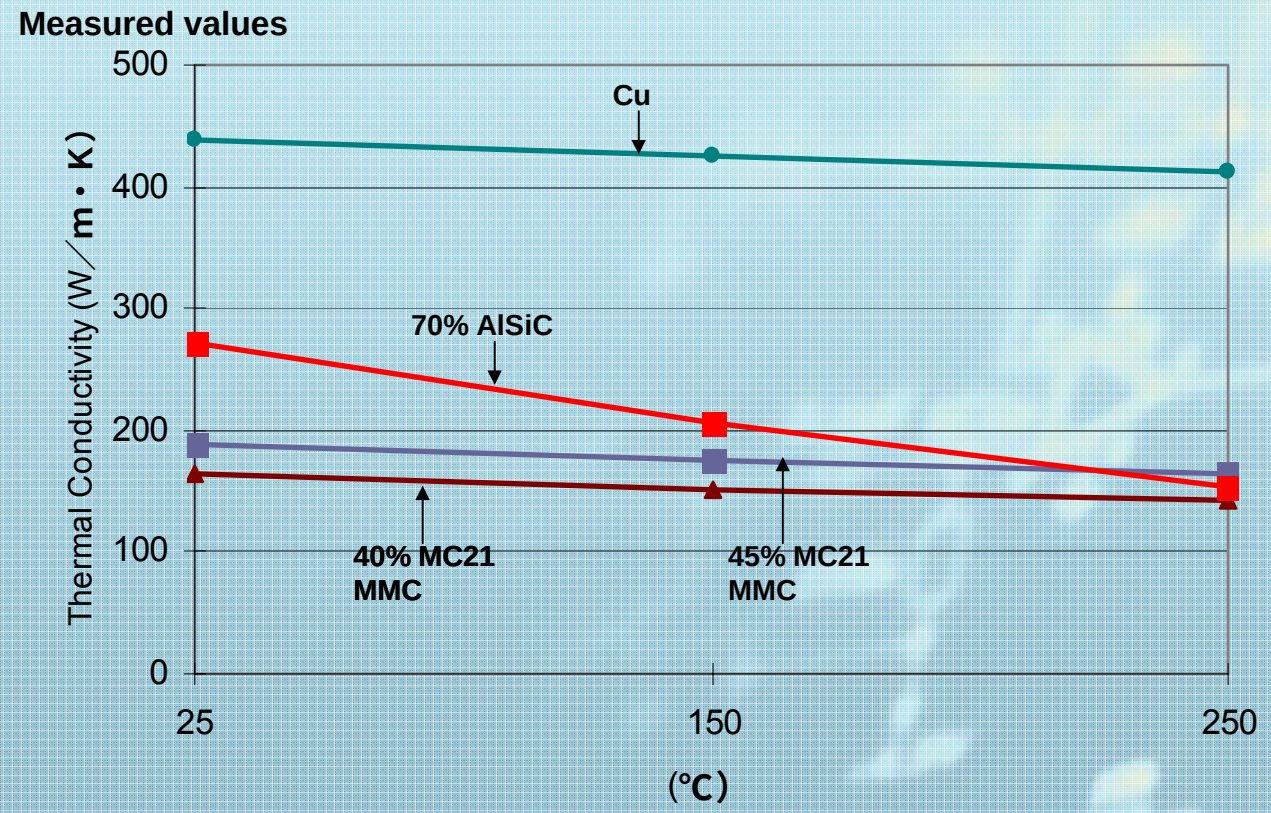
	MC21 MMC20		MC21 MMC30		MC21 MMC40	MC21 MMC45	MC21 MMC45E
SiC volume fracture vol%	20		30		40	45	45
Products	Sheets	Ingots	Sheets	Ingots	Ingots	Ingots	Ingots
Density g/cm^3	2.72		2.80		2.87	2.90	2.90
Tensile strength Mpa	175 (310)		325		225	180	180
0.2% Yield strength MPa	160 (255)		275		n.d.	n.d.	n.d.
Elongation %	5 (5)		4		2	–	–
Young's modulus Gpa	100		115		150	175	175
C.T.E. (50-150 ℃) ppm	16.4		14.4		12.4	11.4	10.5
Thermal Conductivity W/mK	150		160		180	180	180
Electric Conductivity IACS%	30		–		–	–	–

- T6 heat treatment values are shown in brackets.
- Mechanical data of **MC21 MMC**20 and **MC21 MMC**30 were measured with rolling sheets. Others with die-cast plate.
- Data is typical.

MC21 MMC
AlSiC MMC: COMPETITIVE MATERIALS

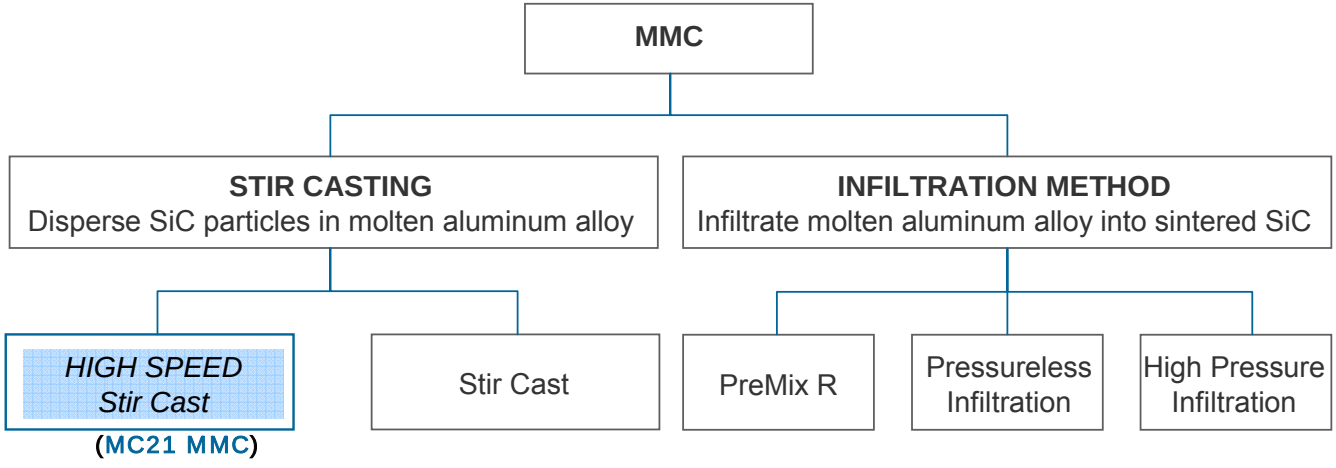
	MC21 MMC20 (T6)	MC21 MMC45E	Pure-Al 1050 (H)	Al-Mg alloy 6063 (T6)	Duralumin 2219 (T6)	Dei casting Al alloy ADC-12 (F)	Copper
Density g/cm^3	2.72	2.90	2.71	2.69	2.84	2.70	8.9
Tensile strength Mpa	310	–	120	90	415	295	–
Young's modulus GPa	100	175	–	68	74	–	130
C.T.E ppm/**°C**	16.4 (50-150)	10.5 (50-150)	24 (20-100)	23.4 (20-100)	22.5 (20-100)	21 (20-200)	17 (20-150)
Thermal conductivity W/mK	150	180	231	218	130	92	392

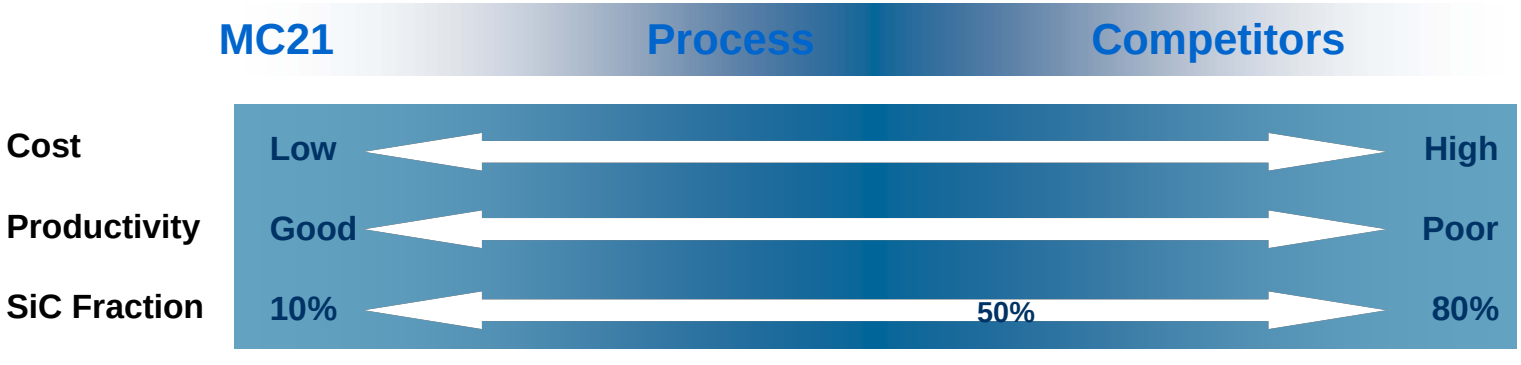
MC21 MMC ELEVATED TEMPERATURE DATA



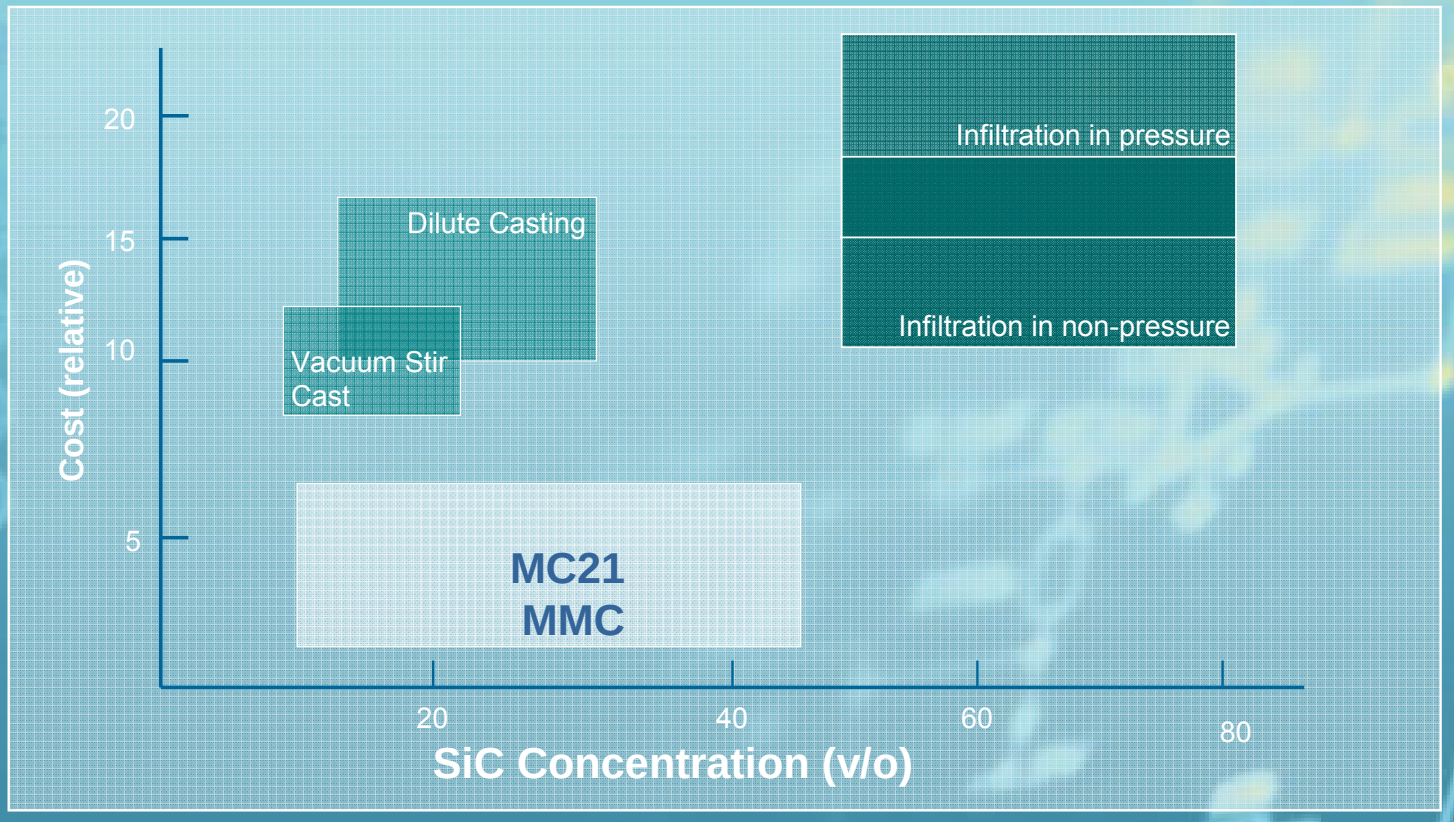
MC21 MMC has consistent thermal conductivity over broad temperature range!

MC21 MMC
AlSiC MMC: MANUFACTURING METHODS





MC21 MMC
AlSiC MMC: COST ANALYSIS



Cost comparison of various AlSiC manufacturing methods versus SiC concentration.
Final part cost depends upon shape, SiC concentration and specifications.

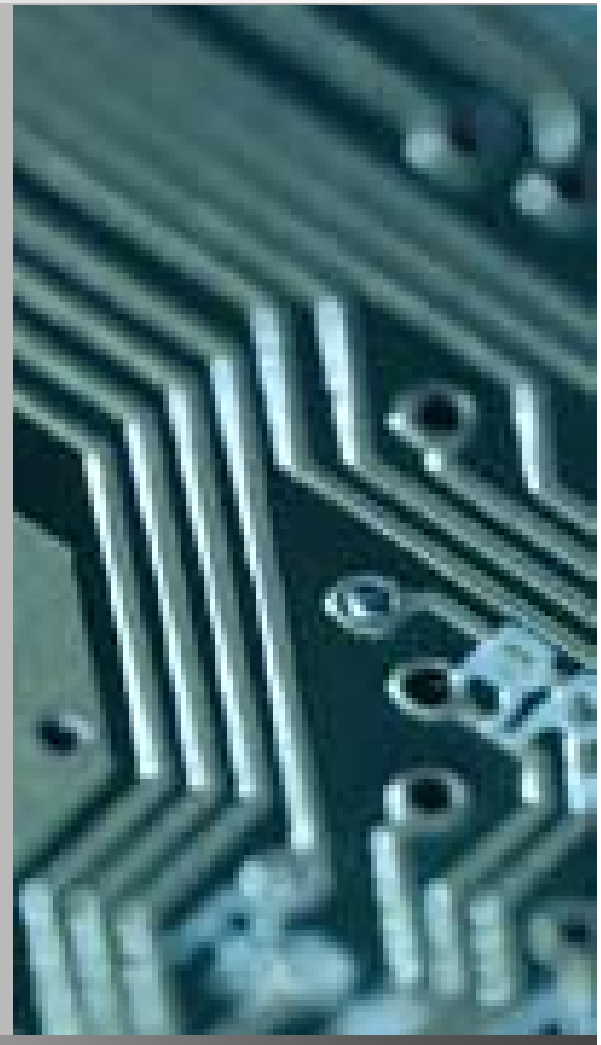
MC21 MMC
AlSiC MMC: APPLICATION EXAMPLE

Applying High Thermal Conductivity and Low C.T.E.

- Audio Speaker Power Amplifiers
- Portable Audio Electronics
- Electronic Packaging Heat Spreaders

Applying High Stiffness

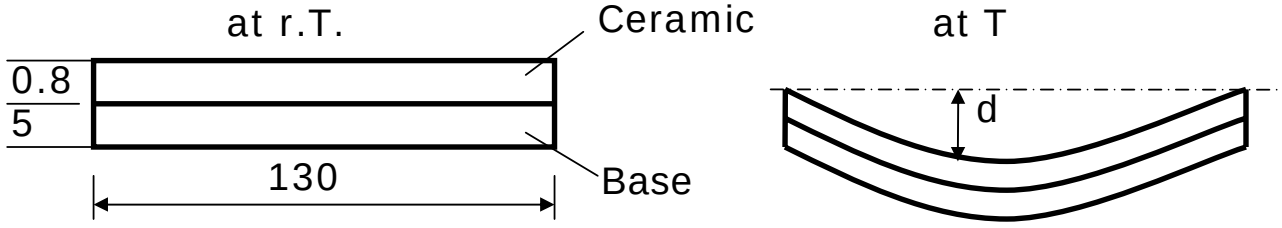
- Amplifier Housing
- Speaker Support Structures
- Dampening Components
- Speaker Housings
- Portable Audio Electronics



MC21 MMC
AlSiC MMC: SIMULATION OF IGBT BASE BOWING

AlSiC versus Bimetal Standard Structure

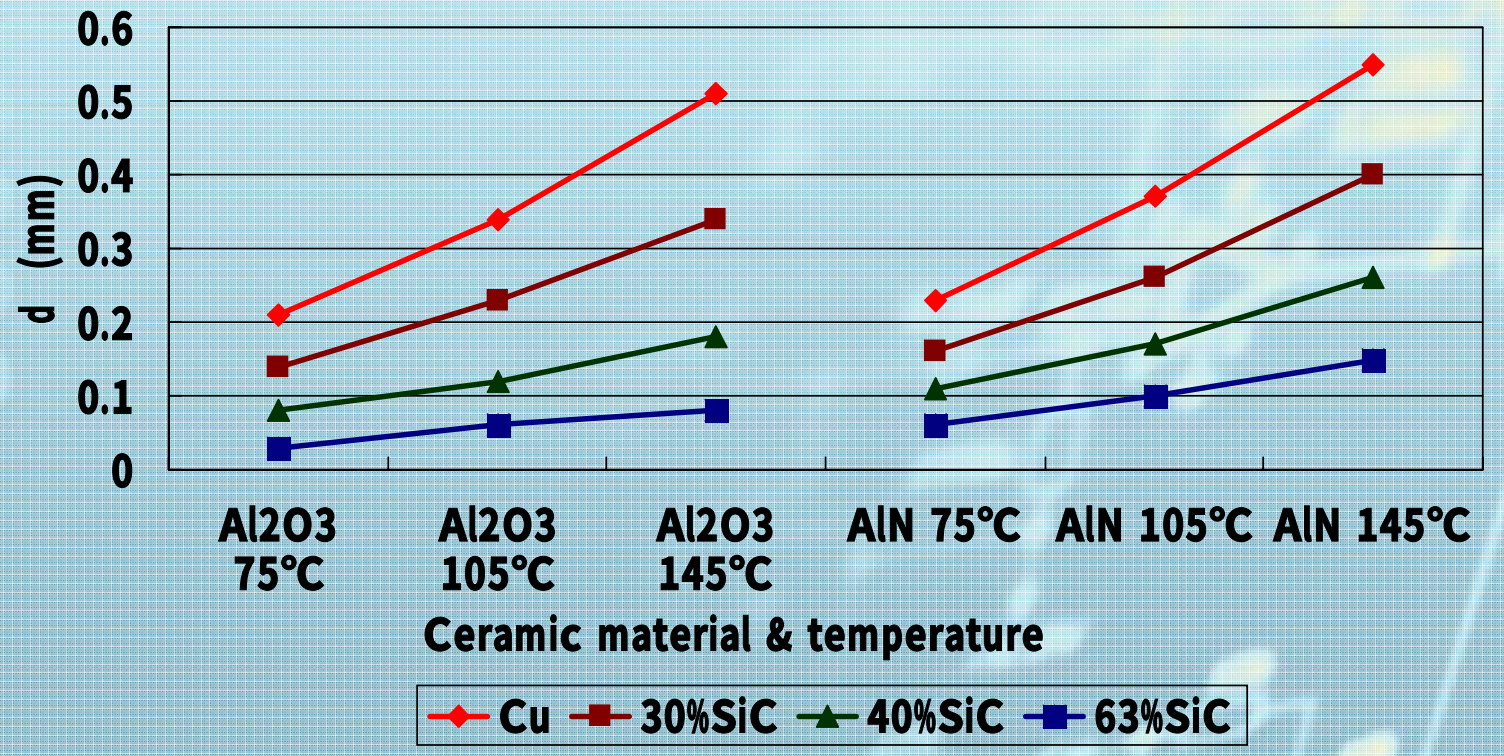
Approximation Assumptions



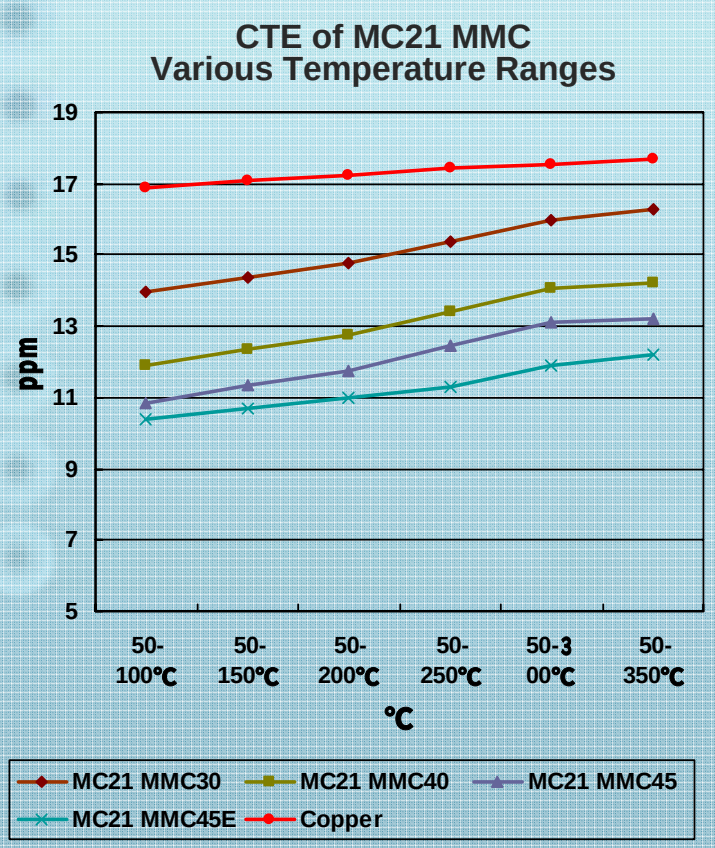
Material	Young's modulous(GPa)	CTE(ppm/℃)
AL2O3	390	6.7
AlN	285	4.5
30%SiC MMC	130	14.0
40%SiC MMC	165	11.0
63%SiC MMC	188	8.8
(from C company's catalogue)		
Cu	110	17.0

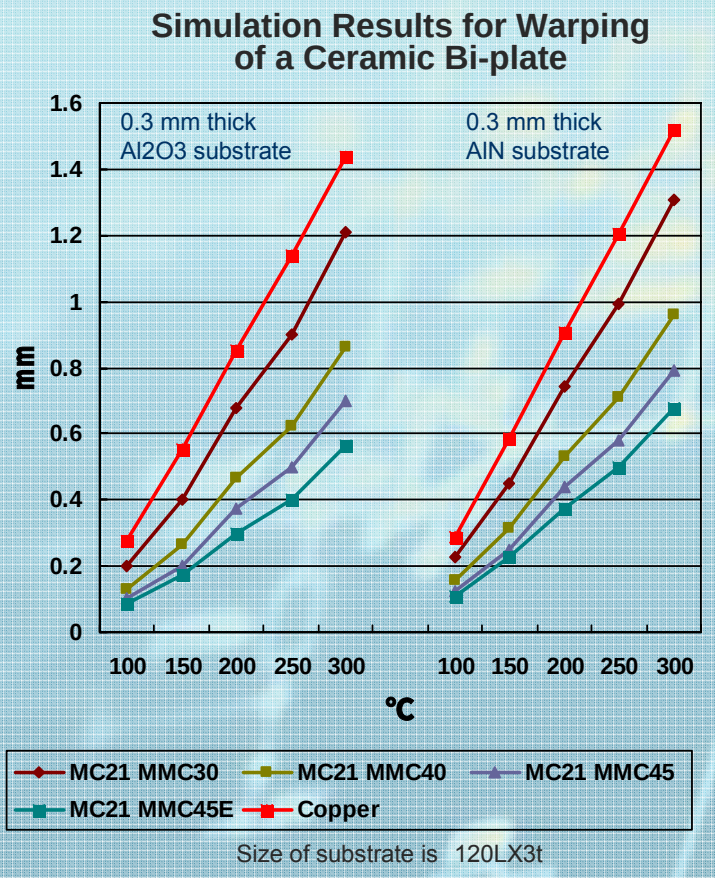
AlSiC MMC: SIMULATION OF IGBT BASE BOWING

AlSiC versus Bimetal Standard Structure



MC21 MMC
AlSiC MMC: SIMULATION FOR WARP OF BI-PLATE





Size of substrate is 120LX3t

MC21 MMC increases reliability for modules.