Shonan-AML, Inc.

Low-cost Machinable CMCs

KEY TECHNOLOGY

The key point of this fabrication method is that the SiO_2-B_2O_3-based glass powder is previously mixed with Al_2O_3 powder to be dispersed in the slurry, in order to lower the sintering temperature and thus to avoid the oxidation and degradation of fibers during the sintering process. This fabrication concept can be applied to various fiber/matrix systems.

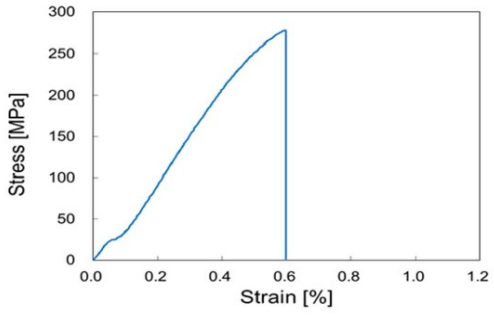
ORIGINALITY AND UNIQUENESS

- The developed heat-resistant composites are manufactured by our cost-effective unique technologies and do not use complex processes and expensive facilities, and thus very cost-effective, in comparison to conventional ceramic matrix composite made by the method such as chemical vapor infiltration (CVI) or melt infiltration (MI).
- The new ceramic composite materials retain excellent mechanical properties as well as high fracture toughness at temperatures for which CFRP cannot even be considered.
- The most interesting advantage of our CMC materials is that it exhibits excellent machinabilities (drilling, cutting, grooving and so on) unlike the conventional brittle ceramics.
- Promising Alternative Materials for Ni-based Super Alloys which are widely used at medium high temperature range (600℃-1000℃).

Representative Characteristics

Type of CMC	Fiber Architecture	Density	Flexural Strength	Fracture Toughness	Expansion Coefficient	Thermal Conductivity
		g/cm^3	MPa	$MPa \cdot m^{1/2}$	$x10^{-6}/K$ 30～450℃	W/m/K
$SiC^{\#1}/Al_2O_3$ **(#1: Tirano Fiber)**	UD	1.8-2.5	$570^{\#2}$ $310^{\#3}$	20	4.8	3.2
	Fabric (Twill woven)	2.4	130	-	-	2.7
Al_2O_3 /Al_2O_3	Fabric (Satin woven)	2.4	120	-	6	4.0

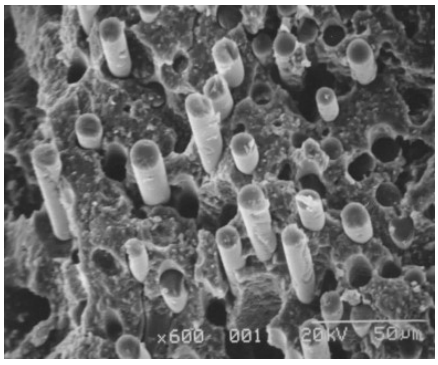
NOTICE: We developed two originally different compositions of SiO_2-B_2O_3-based glass powder corresponding to each design requirement. (#2: High Strength TYPE #3: Heat Resistant TYPE)



Strain

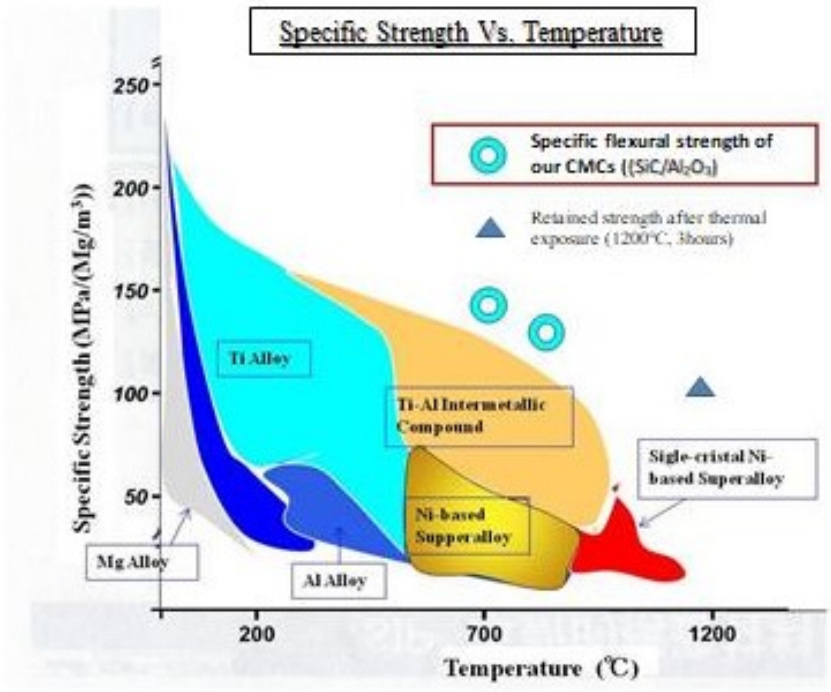
Flexural Stress-Strain Diagram (UD SiC/Al_2O_3)

Environmental Temp.: 800℃ in Air



Fracture Surface

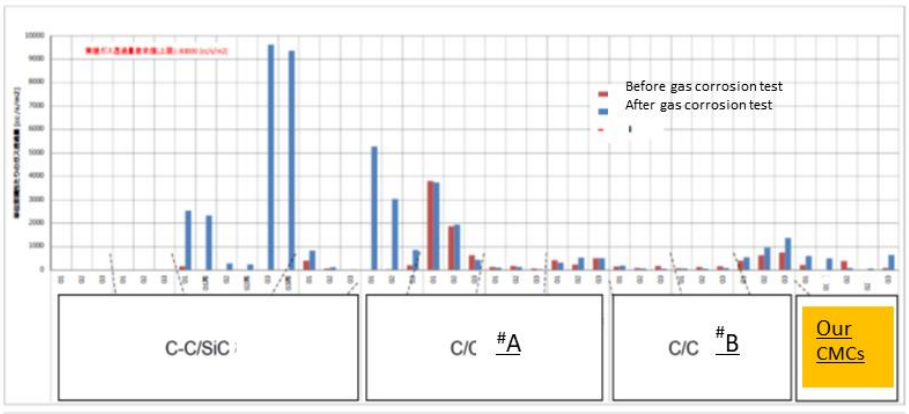
Comparison of Specific Strengh among Different Heat-resistant Materials
(Specific Strength Vs. Temperature)



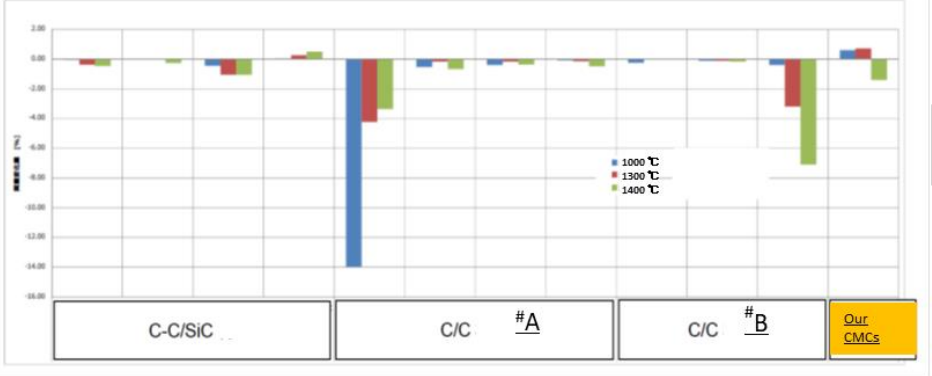
Durability Confirmation of our CMCs under Exposure to High Temperature Steam

Helium gas transmittance of our CMCs (SiC/Al_2O_3) after one-hour exposure to high temperature steam at 1000℃, 1300℃and 1400℃ has been measured, as shown in the figure below.

As a result of comparison, the transmittance values measured for our "Low-cost CMCs (SiC/Al_2O_3) " were almost equivalent to or lower than that of other well-known temperature-resistant materials, such as C-C/SiC and C/C composites.

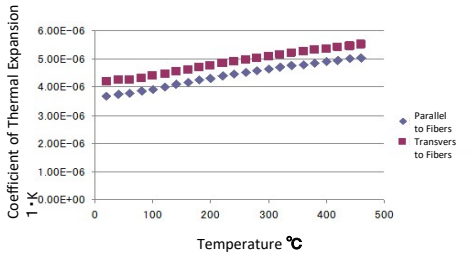


Helium gas transmittance per cross-sectional area after one-hour exposure to the steam at temperatures of 1000℃(#01), 1300℃(#02) and 1400℃(#03).

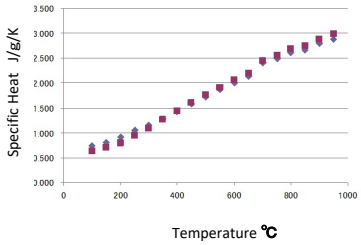


Mass change due to helium gas corrosion

Measurements of CTE and Specific Heat



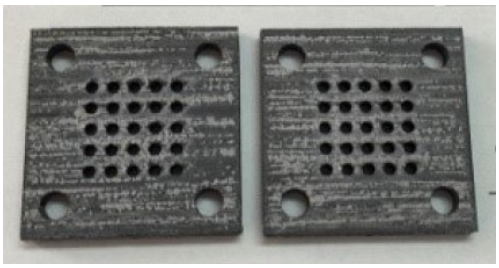
CTE Vs. Temperature



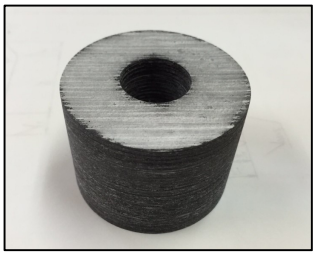
Specific Heat Vs. Temperature

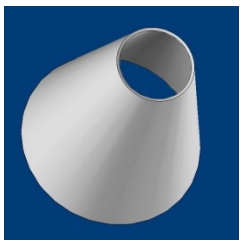
Production Examples of Machinable CMCs

(1) SiC-fiber /Al_2O_3

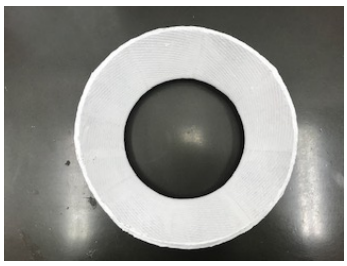


Thick CMCs
Cross-ply ([0/90])
No. of Plies: 108 layers



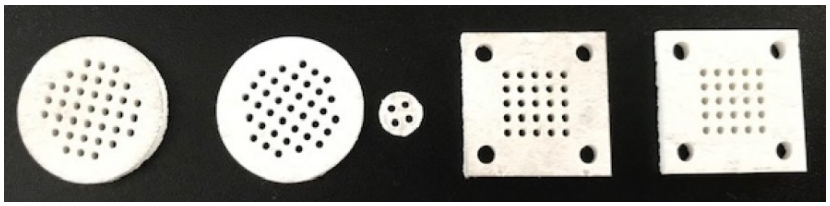


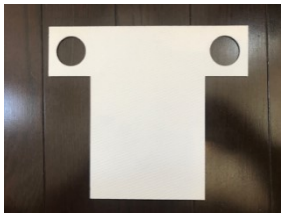
Conical Nozzles

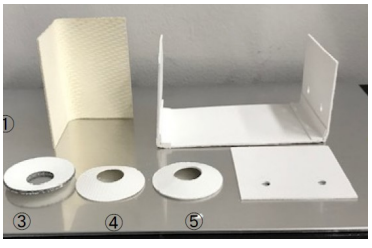


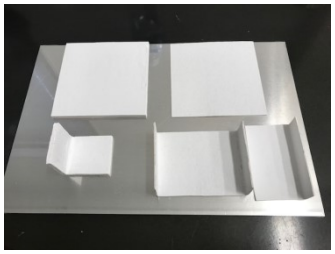
(2) Al_2O_3-fiber/Al_2O_3

Filter









Deformed Materials
(Satin woven CMCs, Mat CMCs)