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Tyranno Fiber[®]

UBE INDUSTRIES, LTD.

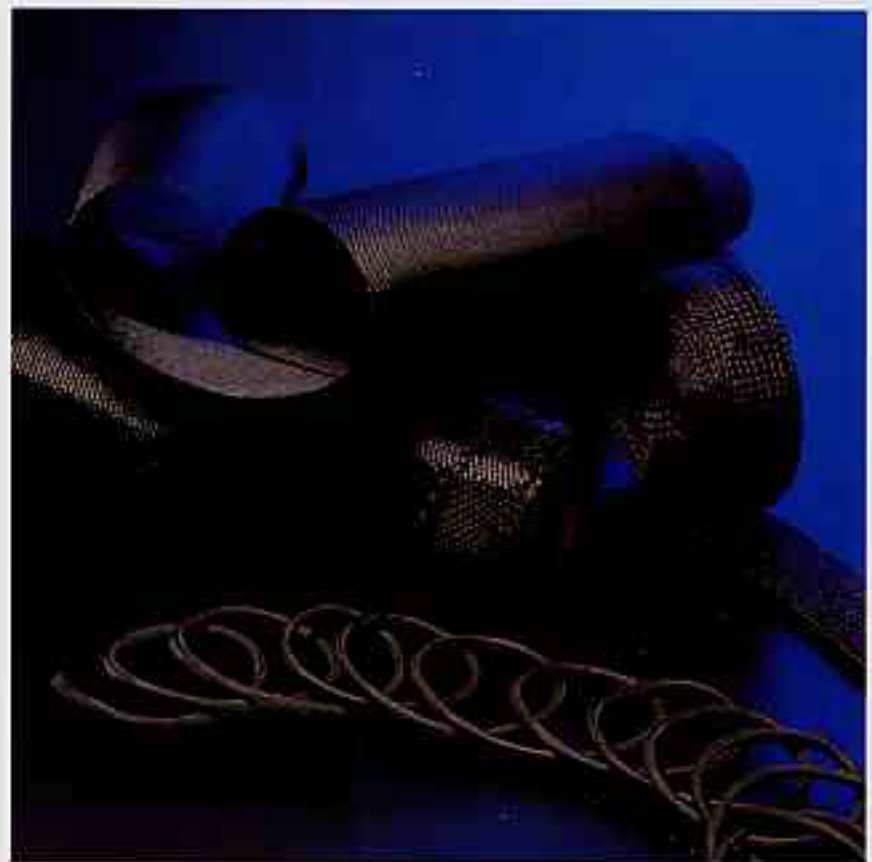
Tyranno Fiber[®]

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Developed using our unique technology, Tyranno Fiber is a continuous ceramic fiber comprising of Si, Ti or Zr, C and O. Advanced composites reinforced by Tyranno Fiber are expected to play an important role in future environmental fields such as ultra high speed transportation, energy efficiency, CO₂ and NO_x reduction, and purification of exhaust fumes.

Reinforcing fibers for these applications require high temperature stability, high strength, and high reliability under extreme environments. Tyranno Fiber possesses excellent properties and is extending its applicability into many areas.

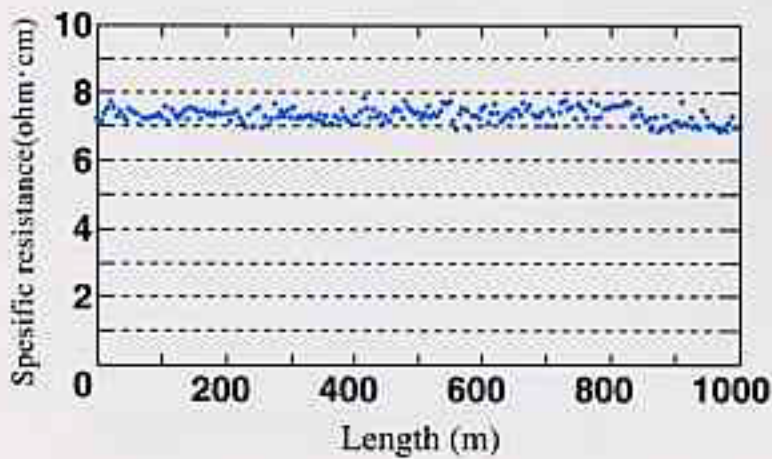


■ Semi-conductive grade

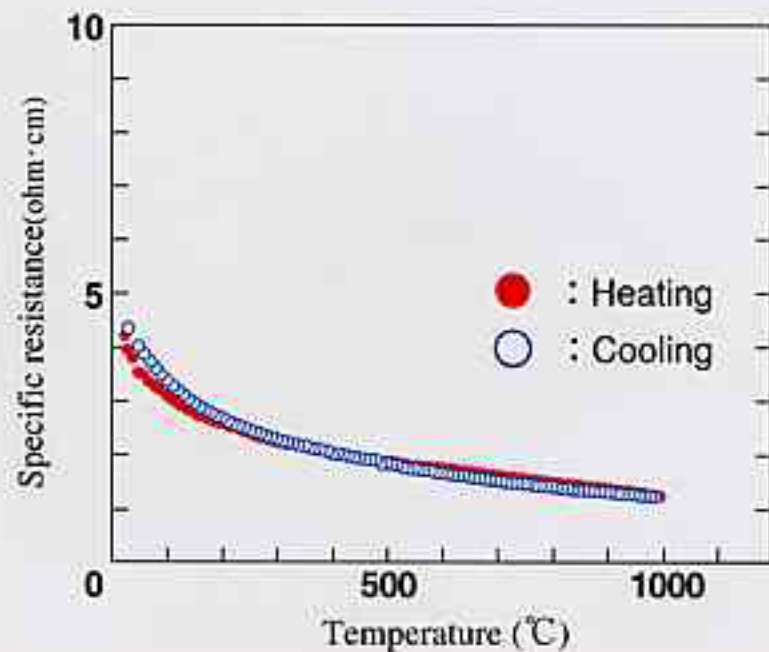
Tyranno Fiber is essentially a semi-conductive material and its specific resistance can be controlled from 10^6 to 10^{-1} ohm·cm. In addition, the specific resistances of G-grade and H-grade fibers can be controlled within $\pm 10\%$ tolerance.

Properties of Tyranno Fiber(Semi-conductive grade).

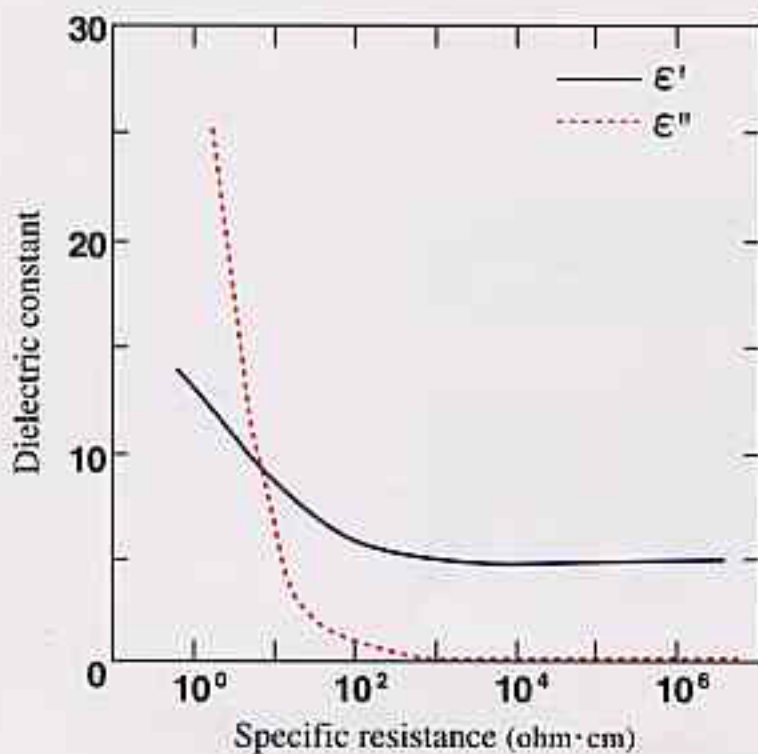
Property	A	C	D	F	G	H
Specific resistance (ohm·cm)	10^6	10^4	10^3	10^1	10^0	10^{-1}
Fiber diameter (μm)		8.5, 11				
Number of filaments (fil./yarn)		1600,800				
Tex (g/1000m)		220(8.5 μm ,1600fil./yarn)				
Tensile strength (GPa)	3.3	3.3	3.3	3.0	2.8	2.8
Tensile modulus (GPa)	170	170	170	170	180	180
Elongation at break (%)	1.9	1.9	1.9	1.8	1.6	1.6
Density (g/cm^3)	2.29	2.35	2.35	2.40	2.43	2.43



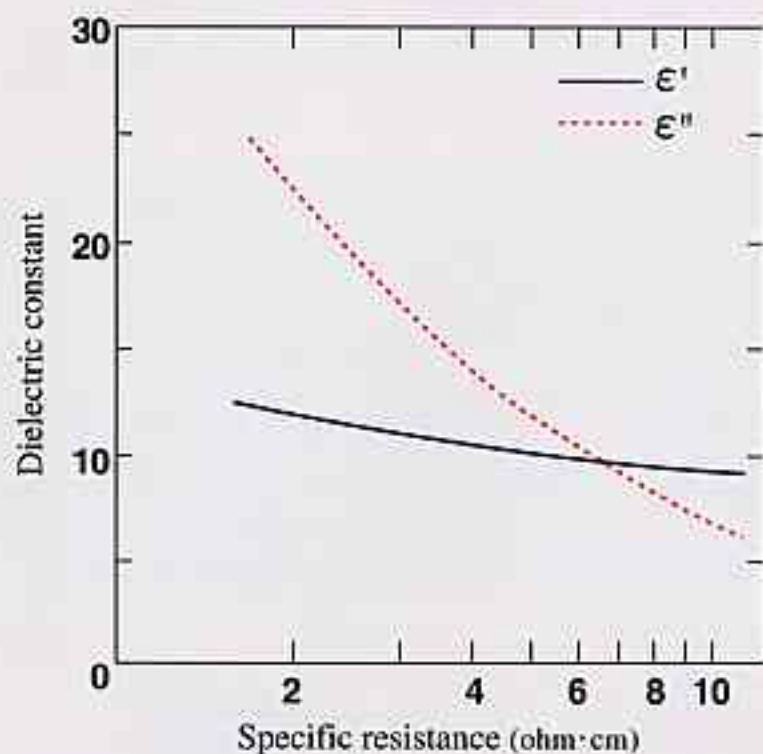
Deviation of specific resistance in a roll of Tyranno Fiber.



Temperature dependence of the specific resistance of the Tyranno Fiber and the temperature.



Dielectric constants of the Tyranno Fiber reinforced epoxy resin composite(10GHz).



High temperature grade

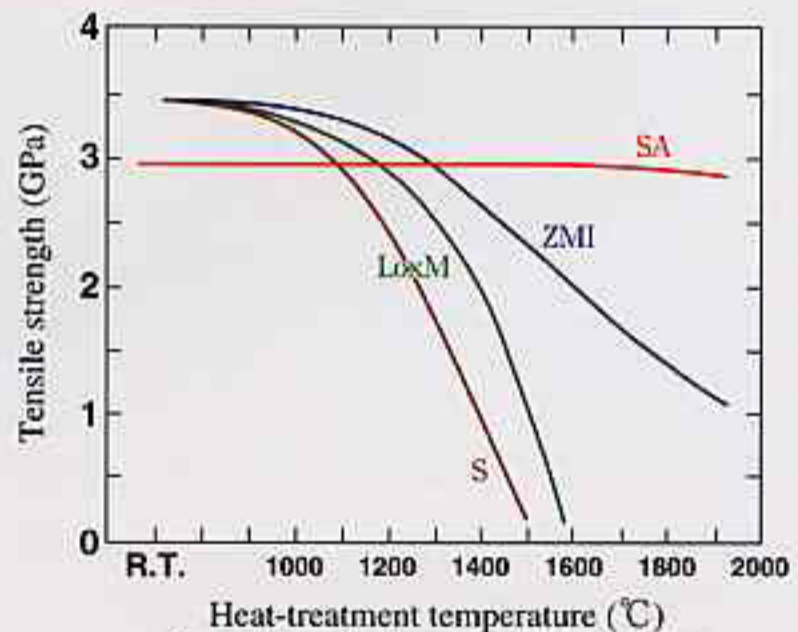
One of the great features of the Tyranno Fiber is its high strength and high temperature stability. ZMI grade fiber which contains Zirconium has drastically improved their stability and oxidation resistance at high temperatures compared with ordinary type of Tyranno Fibers which contain Titanium. Tyranno Fiber SA is a polycrystalline SiC fiber containing small amount of Aluminum. The initial strength of SA grade is maintained after heat treatment even at 1800°C.

Properties of Tyranno Fiber(High temperature grade).

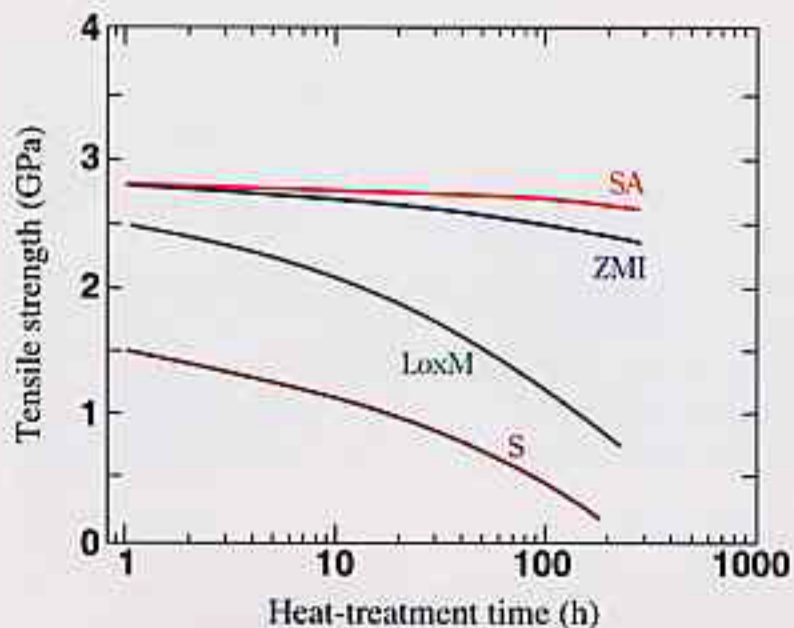
Property	S	LoxM	ZMI	SA
Fiber diameter (μm)	8.5	11	11	10, 7.5
Number of filaments (fil./yarn)	1600	800	800	800, 1600
Tex (g/1000m)	220	200	200	180, 190
Tensile strength (GPa)	3.3	3.3	3.4	2.8
Tensile modulus (GPa)	170	187	200	380
Elongation at break (%)	1.9	1.8	1.7	0.7
Density (g/cm ³)	2.35	2.48	2.48	3.10
Contents (wt.%)	Si	50	55	67
	C	30	32	31
	O	18	11	9
	Ti	2	2	-
	Zr	-	-	1
Coefficient of thermal expansion ($10^{-4}/\text{K}$)	3.1 (RT-500°C)	-	4.0 (RT-1000°C)	4.5 (RT-1000°C)
			Al	-
Thermal conductivity (W/m K)	1.0	1.4	2.5	65



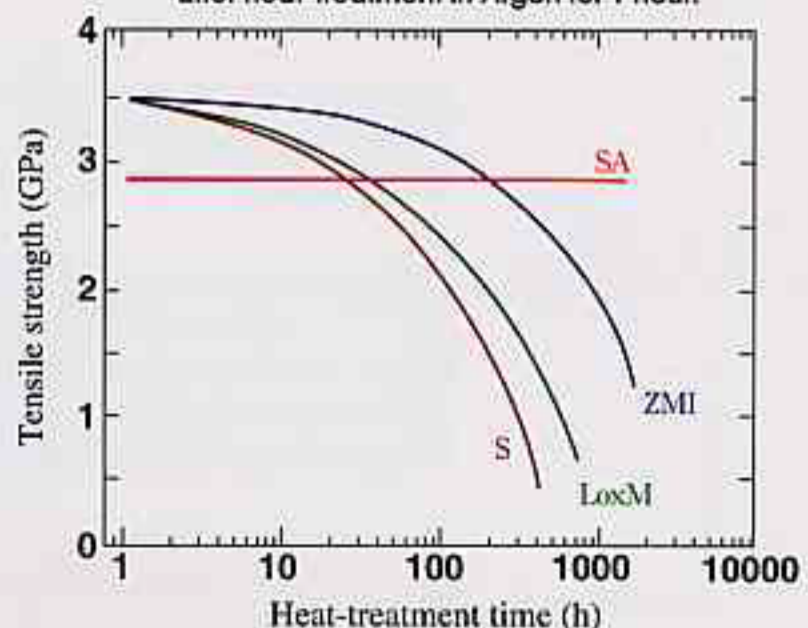
Tyranno Fabric (SA grade)



Residual tensile strength of Tyranno Fibers after heat-treatment in Argon for 1 hour.



Residual tensile strength of Tyranno Fibers in Argon at 1300°C.

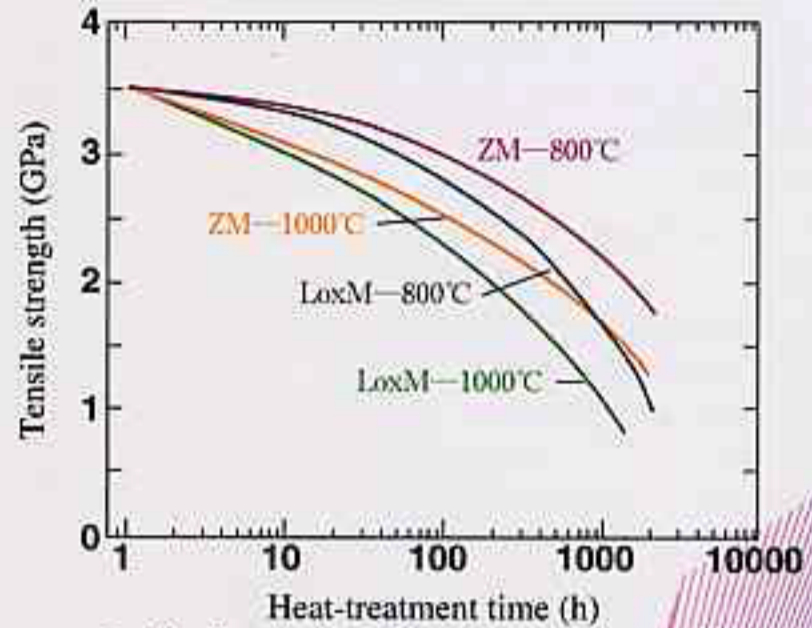


Residual tensile strength of Tyranno Fibers in Air at 1000°C.

■ Secondary products

It is possible to supply Tyranno Fibers in the various forms such as webs, chopped fibers, felts, and ceramic papers, etc.

□ Chopped Tyranno Fibers

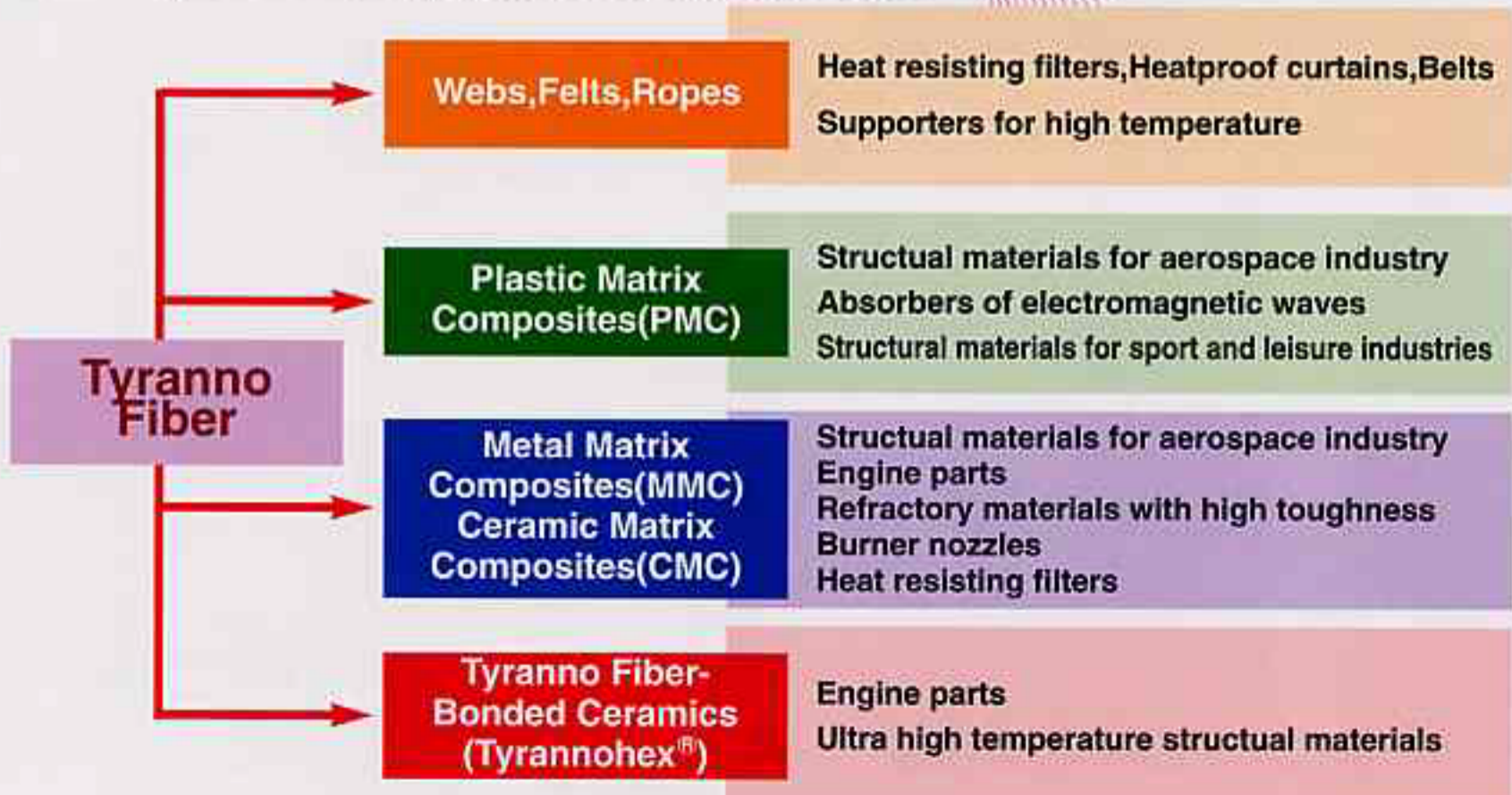


Residual tensile strength of chopped Tyranno Fibers after heat-treatment in air at various temperatures.

□ Tyranno Felts



□ Examples of the application for Tyranno Fiber





(TyrannoHex[®])

Tyranno Fiber-bonded ceramics with high temperature stability and high toughness

UBE INDUSTRIES, LTD.

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