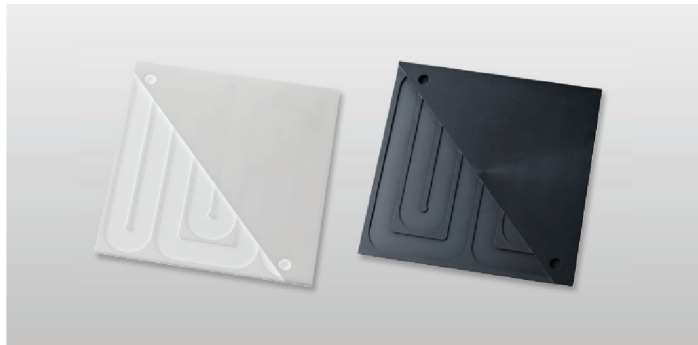


HEAT EXCHANGERS AND HEAT SINKS FOR LONG-TERM RELIABILITY

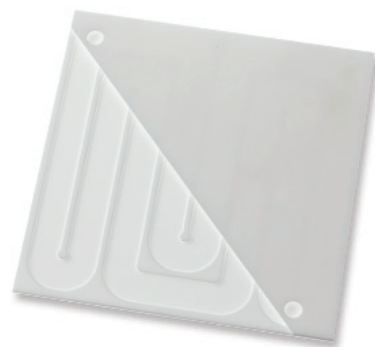


APPLICATIONS

- ▶ Heat element coolers / thermal control components
- ▶ Heat exchanger components
- ▶ Manifolds
- ▶ Micro reactors
- ▶ Thermal insulation components

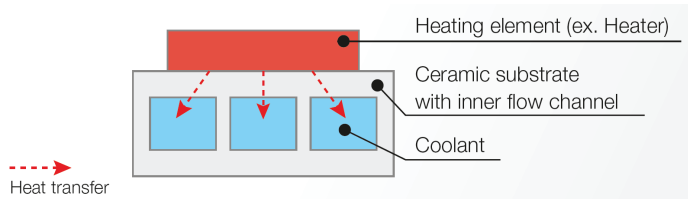
FEATURES

- ▶ Cooling or heat exchanging components made of light weight ceramic with low heat capacity provide a more efficient, energy saving system compared to metal
- ▶ Design possibility for thin wall or complex structure
- ▶ Long term, efficient cooling and temperature control
- ▶ Low maintenance cost due to superior chemical durability
- ▶ Applicational exploitation other than cooling or temperature control

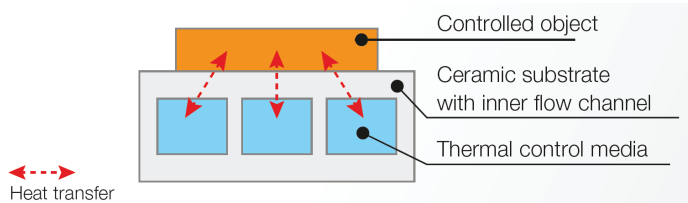


PRODUCT EXAMPLES

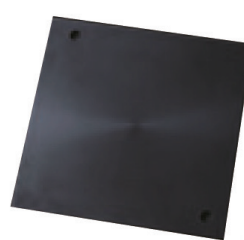
Heat element cooler



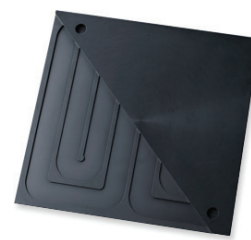
Thermal control component



Product structure example



Appearance



Product cut model

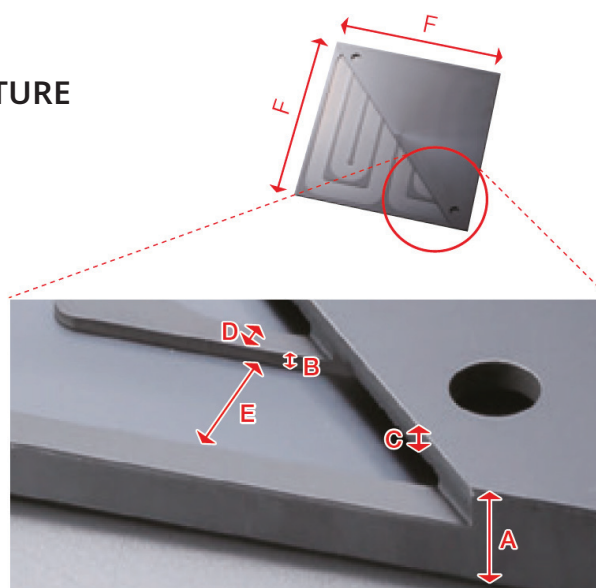
HEAT EXCHANGERS AND HEAT SINKS FOR LONG-TERM RELIABILITY

DESIGN GUIDELINE FOR FLOW CHANNEL STRUCTURE

Standard product dimensions

Unit: mm

		Minimum	Maximum
A	Product thickness	2	15
B	Channel height	0.5	10
C	Lid plate thickness	0.5	-
D	Channel wall thickness	2	-
E	Channel width	1	12
D/E	Line & space	> 0.2	
B/D	Aspect ratio	< 2.5	
F	Maximum size	600 sq.	



Material characteristics

		Unit	A476T	A479T	SC140	
Typical colour		-	White	White	Black	
Content		wt%	96	99.5	-	
Bulk density		-	3.7	3.9	3.1	
Mechanical characteristics	Vickers hardness	GPa	13.9	16.3	23	
	Flexural strength (3-point bending)	MPa	380	470	450 (4-point bending)	
	Modulus of elasticity (E-modulus)	GPa	340	380	430	
	Poisson's ratio	-	0.23	0.23	0.17	
Thermal characteristics	Thermal conductivity	W/m*K	26	30	180	
	Specific heat capacity	J/(g*K)	0.78	0.79	0.67	
	Coefficient of linear thermal expansion	40-400°C	ppm/K	7	7.6	3.7
Electrical characteristics	Dielectric strength	kV/mm	15	18	-	
	Volume resistivity	RT	Ω*cm	>10 ¹⁴	>10 ¹⁴	5.0 × 10 ⁶
		300 °C		1.0 × 10 ¹⁰	4.9 × 10 ¹⁰	-
		500 °C		1.1 × 10 ⁸	3.5 × 10 ⁸	-
	Dielectric loss angle	1MHz	3.0 × 10 ⁻⁴	1.0 × 10 ⁻⁴	-	
Dielectric constant	1MHz	9.6	10.2	-		

Values are typical data from test pieces. Other materials can also be considered upon request from prototyping.