	1	2	3
Material	Carbon-based Aluminum Composite	Carbon-based Aluminum Composite	Metal-based Ceramics Composite
	ACM-a	**ACM-io**	**AC-Alox**
Applied as	Heat Sink for LED Heat Sink for IGBT Power Device	Semiconductor Packaging Fixture Reflow Tray Carrier Pallet	Heater <300C Furnace Component in CVD/PVD Chamber Bolt/Nut used in High Temperature
Featured Property	Excellent Heat Dissipation Low Coefficient of Thermal Expansion Lightweight	Low Coefficient of Thermal Expansion Lightweight Low Contamination Rate by Carbon Particles	Anti Corrosion against Corrosive Gas Uniformity in Thermal Conductivity Excellent Dimensional Stability at High Temperature Low Internal Void Rate
Competitor	AlN Ceramics Substrate	Carbon, SUS	Aluminum Alloy ... A1050, A5052, A6061 and etc. Nickel-based Alloy ... Inconel and etc. AlSiC
Description	ACM-a is the material in which molten aluminum alloy is infiltrated into carbon bulk. Voids in carbon bulk is infiltrated with aluminum. ACM-a enables high thermal diffusivity and conductivity. The material also has low coefficient of thermal expansion as well as durability against heat shock. It gets no crack after heat cycle test (0-400C by 100 cycles)/ This property helps solve the heat-related trouble such as the crack in solder in high power semiconductor. As well as the above, ACM-a has supreme thermal emissivity to metals like copper. It makes ACM-a the suitable material for the heat dissipating fins.	ACM-io is the material in which molten aluminum alloy is infiltrated into carbon bulk. Compared to carbon, ACM-io is mechanically stronger, has good machinability and low rate of carbon dust off the surface. The material has low coefficient of thermal expansion. Plating and coating can be applied for ACM-io - Nickel, Au Strike, Iridium, TiAlN, and such. Its application is fixtures and trays used in semiconductor packaging/assembly process. Also, the material is an excellent candidate if very precise design is required. ACM-io is favored to replaces carbon, SUS, magnesium.	AC-Alox is the composite of alluminum alloy and aluminum-oxide(Alumina). The composite properties can be arranged by changing the compound recipe. For example, we can offer the property options as following -a. Alox-F ... If high tensile strength and dimensional stability at high temperature is needed. -b. Alox-P ... If resistance against damping force and high temperature is needed. Its application is heaters in semiconductor process mahine, CVD and PVD chambers. Also, AC-Alox has high resistance against chemical corrosion, thus it can be used for bolts and nuts used in the chamber filled with chemicals.
Mechanical Properties **Tensile Strength**	Z:25 MPa	70 MPa	300 MPa
Mechanical Properties **Bending Strength**	XY:19~27 Z:39~53 MPa	93 MPa	450 MPa
Mechanical Properties **Young's Modulus**	XY:1.5~2.2 Z:3.7~4.9 GPa	16 GPa	150 GPa
Mechanical Properties **Coefficient of Thermal Expansion**	6.8~7.4 ppm/K	7~8 ppm/K	11~14 ppm/K
Thermal Properties **Specific Heat (Cp)**	0.705 J/g•K	0.75 J/g•K	0.995 J/g•K
Thermal Properties **Thermal Diffusivity (α)**	XY:1.27 Z:2.44 cm2/sec	1.04 cm2/sec	0.28 cm2/sec
Thermal Properties **Thermal Conductivity (λ)**	XY:188 Z:361 W/m•K	164 W/m•K	90 W/m•K
Density(ρ)	2.1 g/cm3	2.1 g/cm3	3.2 g/cm3
Available Material Size (To be discussed)	250 x 190 x t150 mm	250 x 190 x t150 mm	250 x 200 x t10~t80 mm

4		5	6	7		
Metal-based Ceramics Composite			Metal Material			Material
AC-Alsic		AC-Albolon	AC8A (by Our Process)	ADC14 (by Our Process)		
Standard	High thermal conduction					
Heat Spreader Heatsink for IGBT MOSFET Reflow Tray		X-Y Stage for Semiconductor Production Equipment. High Speed Mobile Part Mobile Parts Requiring Precise Positioning	The Scrolling Part for Air Compressors Parts To Withstand Vibration	Sleeve Part used in Injection Molding Machine		Applied as
LHigh Thermal Conductivity High Mechanical Strength Low Coefficient of Thermal Expansion		As Robust As Cast Iron As Lightweight As Aluminum High Thermal Resistance	Extremely Low Void Rate High Mechanical Strength High Robustness	Extremely Low Void Rate High Mechanical Strength High Friction Resistance		Featured Property
Ceramics		Metal like Cast Iron and SUS	—	—		Competitor
Molten aluminum is infiltrated into SiC. SiC is known to have high mechanical strength and thermal conductivity, but is extremely hard to machine. Thus, AC-Alsic is the suitable material as heatsink for high power semiconducter. Also, our process enables to make Alsic heaters. We machine the heater pattern in SiC preform, in which the sheathed heater is placed. Molten aluminum wraps the structure to make Alsic heater.		AC-Albolon is with lightweight, high young's modulus, and good machinability. Among conventional material for robotic arms and X-Y table, steel is too heavy for the part to make high accurate positioning. Meanwhile aluminum alloy is lightweight but its young's modulus is low so that vibration in high speed movement can degrade the dimension. Ceramics are expensive to machine and easily breakable. AC-Albolon can provide the solution.	AC8A is the casting-grade aluminum alloy which has low coefficient of thermal expansion. Its alloy composition is Al-Si-Cu-Ni-Mg, and it has good resistance against high temperature and friction. Our process enables AC8A to have the furthermore densified metal tissue. The void rate is extremely low so that its mechanical strength is improved compared to general AC8A. We supply our AC8A alloy, and our customer builds up the scrolling parts for air compressors.	ADC14 is a favored material for its mechanical strength, resistance against friction. In particular, mechanical strength at high temperature is excellent. Hyper Silumin alloys, including ADC14, are in general hard to cast in the mold. Our process enables ADC14 to get the fine tissue. We can supply φ150~450(mm) of ADC14.		Description
190	— MPa	290 MPa	270～320 MPa	370 MPa		Tensile Strength	Mechanical Properties
300 ~ 350 MPa		350 MPa	— MPa	— MPa		Bending Strength	
200 ~ 240 GPa		120 GPa	81 GPa	— GPa		Young's Modulus	
8~11	6~8 ppm/K	12 ppm/K	20 ppm/K	18 ppm/K		Coefficient of Thermal Expansion	
0.8	0.8 J/g•K	0.92 J/g•K	— J/g•K	— J/g•K		Specific Heat (Cp)	Thermal Properties
0.5~0.6	1.15 cm2/sec	0.3 cm2/sec	— cm2/sec	— cm2/sec		Thermal Diffusivity (α)	
130 ~ 150	250 W/m•K	81 W/m•K	— W/m•K	— W/m•K		Thermal Conductivity (λ)	
2.9 ~ 3.0	3.0 g/cm3	2.8 g/cm3	2.7 g/cm3	2.8 g/cm3		Density(ρ)	
250 x 200 x t10~t80	250 x 200 x t10 mm	200 x 500 x t100 mm	Depending on tooling mm	Depending on tooling mm		Available Material Size (To be discussed)	

	Material Name	Copper	Aluminum	Magnesium	Steel		SUS	Titanium	Silicon	Carbon	Silicon Carbide	Silicon Nitride		Aluminum Nitride	Aluminum Oxide	
		Cu	Al	Mg	Cast Iron	Rolled Iron	SUS	Ti	Si	C	SiC	Si_3N_4		AlN	Al_2O_3	
	Density ρ * →Gross Density ** →Bulk Density g/cm3	8.9	2.70	1.77	7.30	7.8	7.93	4.5	2.3	1.8*	3.2*	-	3.2*	3.4*	3.9*	
Mechanical Properties	Tensile Strength MPa	195	75	270	245~294	400~510	520	340~510	-	27	-	-	-	-	-	Mechanical Properties
	Bending Strength MPa	-	-	-	441~539	-	-	-	120	52.3	450	750	610	310	400	
	Young's Modulus GPa	117	71	45	108~127	211	193	106	188	10.8	440	-	290	320	380	
	Poisson's Ratio	0.34	0.35	0.35	0.27	0.29	0.3	0.32	-	-	0.17	-	0.28	0.24	0.23	
Thermal Properties	Coefficient of Thermal Expansion ppm/K	17	20	26.8	11.5~12	11.7	17.6	8.4	2.4	4.5	3.7	2.5	2.6	4.6	7.2	Thermal Properties
	Specific Heat Cp J/g•K	0.39	0.92	1.04	0.50~0.54	-	0.59	0.52	0.76	0.7098	0.67	-	0.66	0.71	0.79	
	Thermal Diffusivity α cm2/sec	1.12	0.9	-	-	-	3.57	0.09	-	1.01	0.66	-	0.06	0.62	0.11	
	Thermal Conductivity λ W/m•K	390	220	77~85	48~52	-	16.7	22	168	128	200	90	20	150	34	
Electrical Properties	Dielectric Strength k V/mm	-	-	-	-	-	-	-	-	-	-	18	10	14	-	Electrical Properties
	Specific Resistance μΩ•cm	1.7	2.8	-	65~75	-	72.0	-	$4.0x10^{11}$	10	1014	$>10^{21}$	$>10^{20}$	$>10^{20}$	$>10^{20}$	
	Conductivity $\times 10^6$ $\Omega^{-1}\cdot m^{-1}$	59.6	37.7	-	-	-	-	-	-	-	-	-	-	-	-	
	Data above refers to the following materials.	C1020	A1050-O	AZ31	FC250	SS400		TP340C			SC1000		SN-220	AN216A	A-601D A-601L	