Ceramics Characteristics

Item			Unit	Material / Testing Method	Oxide Ceramics						Non-Oxide Ceramics			Zero or less Thermal Expansion Ceramics			Machinable Ceramics	Reference (Other Materials)				
					Al_2O_3					ZrO_2	Si_3N_4	SiC	AlN	ZPF	Adceram®							
					A995	A995LD	A995S	A999	AHPF /AJPF	AYZ-3	ASN-5	N-Type	N-Type	N-Type	D1	D3	Macor®	Quartz	Sapphire	Si	Al (5012)	SUS (304)
Color			-	—	White	White	White	Milky White	White	White	Gray	Black	Gray Beige	Gray	Light Yellow	White	White	Transparent	Transparent	-	-	-
Density			g/cm^3	Water displacement method	3.9	3.9	3.9	3.9	4.0	6.0	3.2	3.1	3.3	2.5	2.6	2.3	2.5	2.2	4	2.3	2.7	8.0
Water Absorption Rate			%	Water displacement method	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-
Mechanical Feature	Hardness	Vickers	GPa	JIS R 1610	16	15	15	18	20	13	14	24	13	7	4.5	4.5	-	-	23	-	-	2
	Bending Strength	20℃	MPa	JIS R 1601	450	360	230	480	550	1000	720	500	350	250	200	150	130	50	700	-	-	300
		1000℃	MPa	JIS R 1601	-	350	-	-	550	-	-	-	330	-	50	50	-	-	-	-	-	-
		1200℃	MPa	JIS R 1601	300	200	-	300	400	350	400	600	250	-	-	-	-	-	-	-	-	-
	Fracture Toughness		MPa√m	JIS R 1607	4	4	-	4	3	6	5	3	3	3	-	2	-	-	-	-	-	-
	Young's Module		GPa	JIS R 1602	380	380	370	400	400	200	290	410	320	150	110	90	67	73	470	170	71	200
	Poisson's Ratio		-	JIS R 1602	0.24	0.24	0.24	0.24	0.24	0.32	0.28	0.16	0.29	0.28	0.25	0.25	0.29	0.17	-	-	-	-
Thermal	CTE	23±3℃	1/K(X10^{-6})	Laser coefficient of thermal expansion	5.3	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-
		25～200℃	1/K(X10^{-6})	JIS R 1618	5.4	5.6	6.2	5.3	5.6	7.7	1.7	2.9	2.4	-	-	-	-	-	7.2 (//C axle)	-	-	-
		25～500℃	1/K(X10^{-6})	JIS R 1618	7.3	7.5	7.1	7.5	7.7	10.0	2.3	4.6	4.0	-	4.7 (～400℃)	0.9 (～400℃)	9.3 (～300℃)	0.5	-	-	-	-
		25～1000℃	1/K(X10^{-6})	JIS R 1618	8.0	8.2	8.0	8.6	8.6	11.0	2.8	5.0	5.2	-	5.4 (～800℃)	1.4 (～800℃)	12.6 (～800℃)	-	-	-	-	17.3
	Thermal Conductivity (20℃)		W/m·K	JIS R 1611	30	30	30	33	35	3	26	170	160	5	2.6	1.3	1.7	1	42	140	140	17
	Specific Heat		J/kg·K	JIS R 1611	800	800	840	800	800	470	630	660	740	1000	460	590	790	1050	-	690	-	880
	Thermal Fatigue (△T)		K	Water quenching method	200	200	500	200	200	280	700	450	400	-	350	700	150	-	-	-	-	-
Electronic Feature	Insulation Strength		kV/mm	Bias voltage applied LB technique	12	12	-	12	12	＞10	＞10	-	＞15	-	20	20	40	＞10	＞30	-	-	-
	Volume Resistivity (20℃)		Ω·cm	3 probes method	＞10^{14}	＞10^{14}	＞10^{14}	＞10^{14}	＞10^{14}	10^{12}	＞10^{14}	10^{6}	10^{14}	10^{12}	10^{12}	10^{10}	10^{16}	＞10^{14}	＞10^{14}	-	-	-
	Dielectric constant (25℃)	1MHz	-	Bridge method	10	10	10	10	10	35	8	-	9	-	7.5	7.5	6	4	11.5 (//C axle)	-	-	-
		3GHz	-	Dielectric resonator method	10	10	10	10	10	40	8	-	8	-	-	-	-	-	-	-	-	-
	Dielectric Loss (25℃)	1MHz	X10^{-4}	Voltammeter method	＜300	＜5	＜300	7	1	20	3	-	10	-	35	35	50	1	-	-	-	-
		3GHz	X10^{-4}	Dielectric resonator method	＜30	1	＜30	-	＜1	10	90	-	130	-	-	-	-	-	＜1	-	-	-
Feature					Possible for huge size, Relatively-low cost	Low dielectric constant, Possible for huge size, Relatively-low cost	High fracture toughness, High thermal shock resistance, Possible for huge size,Relatively-low cost	Possible for huge size	Pore free (Dense), High chemical resistance, Low dielectric constant	High strength, High fracture toughness, Low thermal conductivity, High wear resistance	High fracture toughness, Low thermal expansion, High thermal shock resistance, High wear resistance	High hardness, High stiffness, High thermal conductivity, High chemical resistance	High thermal conductivity, High plasma resistance, Suitable for ESC	Zero thermal expansion, High stiffness comparing to glass material, Pore free	High strength comparing to glass material, Low thermal conductivity	Low thermal expansion, High thermal shock resistance	Short lead-time, High machinability, High electric insulation, Low thermal conductivity					
					High strength, High wear resistance, High chemical resistance, High electric insulation																	

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