Material Specifications

Specifications are offered as an assistance to engineers and purchasing professionals in the design and procurement of thin-film circuit substrates.

Properties	Units	Polished High Density 996 Aluminum Oxide	Asfired Superstrate 996 Aluminum Oxide	Superstrate TPS	Beryllium Oxide	Aluminum Nitride	Fused Silica Quartz	Sapphire (Crystalline)	Polished Titanates	Ferrites & Garnets
Chemical Composition		Al_2O_3	Al_2O_3	Al_2O_3	BeO	AlN	SiO_2	A/C plane – Al_2O_3		
Purity	%	99.6	99.6	99.6	99.5	98	100	100		
Color		White	White	White	White	Tan	Transparent	Transparent	Cream	Gray
Nominal Density	g/cm^3	3.87	3.87	3.95	2.85	3.28	2.2	3.97		
Surface Finish (Polished) CLA	µ-inches (nm)	< 1.0 (25nm)	n/a	< 1.0 (25nm)	2.0–4.0 (50–100nm)	< 2.0 (50nm)	60/40 Optical	< 1.0 (25nm) CLA	< 3.0 (76nm)	< 16.0 (400nm)
Surface Finish (Asfired) CLA	µ-inches (nm)	n/a	3–4 (76–101 nm)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Camber	inch / inch	0.0003"–0.0005"	0.002"	n/a	0.0003"–0.0005"	.0.0003"–0.0005"	0.0003"–0.0005"	0.0003"–0.0005"	0.002"	0.002"
Camber	nm / nm	76nm / 152nm	0.0508mm	n/a	76nm / 152nm	76nm / 152nm	76nm / 152nm	76nm / 152nm	0.0508mm	0.0508mm
Thickness	inches (mm)	0.004"–0.080" (0.100–2.0mm)	0.005"–0.025"* (0.127–0.635mm)	n/a	0.005"–0.025"* (0.127–0.635mm)	0.004"–0.080" (0.100–2.0mm)	0.004"–0.025"* (0.100–0.635mm)	0.004"–0.025"* (0.100–0.635mm)	0.005"–0.025"* (0.127–0.635mm)	0.010"–0.025" (0.254–0.635mm)
Thickness Tolerance (±)	inches (nm)	0.0005 (0.0127mm)	0.001 (0.0254mm)	n/a	0.0005 (0.0127mm)	0.0005 (0.0127mm)	0.0005 (0.0127mm)	0.0005 (0.0127mm)	0.0005 (0.0127mm)	0.0005 (0.0127mm)
Process Sizes (L&W)	inches (mm)	1.0"–4.0" (25.4–101.6mm)	1.0"–6.0" (25.4–152.4mm)	n/a	1.0"–4.00" (25.4–101.6mm)	1.0"–4.00" (25.4–101.6mm)	1.0"–3.00" (25.4–76.2mm)	1.0"–2.25" (25.4–57.15mm)	1.0"–2.25" (25.4–57.15mm)	1.0"–2.25" (25.4–57.15mm)
Coefficient of Thermal Expansion (CTE)	10–6	7.0–8.3 (25–1000°C)	7.0–8.3 (25–1000°C)	8.2 (25–1000°C)	9.0 (25–1000°C)	4.6 (25–300°C)	0.55 (20–320°C)	A plane @ 25°C–5.3		
Thermal Conductivity	Watts/m°K	26.9	26.9	35	270	170	n/a	n/a		
Dielectric Constant (k)	@ 1 MHz	9.9	9.9	10.0	6.5	8.6	3.826	11.5/9.3†	36–180	14.5–17.6
Dissipation Factor (Loss Tangent)	@ 1 MHz	0.0001	0.0001	0.0001	0.0004	0.001	0.000015	0.00086/0.0003†		
Dissipation Factor (Loss Tangent)	@ 10 GHz	0.0002	0.0002	0.0001						
Q	@ 1 GHz	5000	5000	5000		5000				
Hardness	Rockwell	87	87	87	45	n/a	7 Mohs	1800/2200A Knoop		
Flexural Strength	K(10-3) lbs/in^2	90	90	99	35 (3 pt. bend)	59 (4 pt. bend)	25	60		
Compressive Strength	M(10-3) lbs/in^2	54	54	n/a	n/a	n/a	161	350		
Grain Size	µm (microns)	< 1.0	< 1.0	< 1.0	9–16	5–7	Amorphous	single crystal		

* Additional thicknesses and tolerances available upon request.

† Value varies with orientation ("A" plane / "C" plane)