



Semiconductor Oxides Material Properties

| | | | High-Purity Aluminas | | | | | | | | | Other Oxides | | | | |
|-------------------------|--------------------------------------|----------------------|---------------------------------|---|---|---|--|--|--|--|---|---|---|--|--|---|
| PROPERTIES* | | | UNITS | TEST | ADS-11 Min. 99.5% Al ₂ O ₃ | ADS-12 Min. 99.5% Al ₂ O ₃ | AD-995-I2 Nom. 99.5% Al ₂ O ₃ | AD-995-LT Nom. 99.5% Al ₂ O ₃ | AD-995-I4 Min. 99.5% Al ₂ O ₃ | AD-996-SI Min. 99.5% Al ₂ O ₃ | PLASMAPURE™ AD-998-I2 Min. 99.8% Al ₂ O ₃ | PLASMAPURE-UC™ SA-999-I Min. 99.9% Al ₂ O ₃ | SAPPHAL™ Min. 99.9% Al ₂ O ₃ | STATSAFE™ ADC-92 Nom. 92% Al ₂ O ₃ | FUSED QUARTZ Min. 99.99% SiO ₂ | EXYRA™ BULK YTTRIA Min. 99.9% Y ₂ O ₃ |
| GENERAL | Bulk Density | | g/cm ³ | ASTM-C20 | 3.90 | 3.90 | 3.90 | 3.90 | 3.90 | 3.90 | 3.92 | 3.92 | 3.98 | 3.85 | 2.20 | 4.95 |
| | Minor Chemistry in Sintered Material | Total | ppm weight | Glow Discharge Mass Spectroscopy (GDMS) | 3000 ① | 3000 ① | 3000 ① | 3000 ① | 2500 ① | 2500 ① | 500 | 400 | 500 | 2500 ① ② | 30 | 500 |
| | | Si | | | 50 | 50 | 800 | 800 | 400 | 500 | 60 | 30 | 15 | 400 | Matrix | 100 |
| | | Na | | | 750 | 750 | 250 | 250 | 200 | 75 | 10 | 7 | 50 | 200 | <1 | 1 |
| | | Fe | | | 50 | 50 | 80 | 80 | 60 | 100 | 60 | 40 | 10 | 60 | <1 | 2 |
| Mg | | 2000 | | | 2000 | 800 | 800 | 500 | 500 | 250 | 200 | 400 | 500 | <1 | 1 | |
| Grain Size | Average | μm | ASTM-E112 | 4 | 8 | 6 | 6 | 6 | 36 | 6 | 3 | 20 | 6 | NA | 30 | |
| | Range | | | 0.5 - 35 | 1 - 40 | 0.7 - 35 | 0.7 - 35 | 0.5 - 35 | 0.5 - 35 | 3.90 | 0.4 - 32 | 2.0 - 50 | 1.0 - 40 | NA | 10 - 70 | |
| Flexural Strength (MOR) | 3-Point | MPa ^a | ASTM-C1161 | 400 | 375 | 379 | 379 | 380 | 380 | 390 | 400 | 350 | 300 | 128 | 140 | |
| | 4-Point | | | 350 | 300 | 300 | 300 | 320 | 320 | 320 | 360 | 285 | 230 | 104 | 100 | |
| Fracture Toughness | K (I c) | MPa m ^{1/2} | KNOOP 1000 gm | 4 - 5 | 4 - 5 | 4 - 5 | 4 - 5 | 4 - 5 | 4 - 5 | 4 - 5 | 4 - 5 | 4 - 5 | 3 - 4 | 1.1 | 1.2 | |
| Hardness (Vickers) | 500g | GPa | ASTM-C1327 | 17 | 17 | 16 | 16 | 16 | 16 | 18 | 18 | 18 | 12 | 6 | 7 | |
| | 1000g | | | 17 | 16 | 16 | 16 | 16 | 16 | 17 | 17 | 17 | 12 | 5 | 6 | |
| Elastic Modulus | | GPa | ASTM-C848 | 380 | 380 | 370 | 370 | 380 | 380 | 380 | 386 | 390 | 370 | 72 | 170 | |
| Poisson's Ratio | | — | ASTM-C848 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.24 | 0.23 | 0.16 | 0.28 | |
| THERMAL | Coefficient of Thermal Expansion | RT-400°C | PPM/°C | ASTM-C372 | 7.1 | 7.1 | 7.4 | 7.4 | 7.0 | 7.0 | 7.0 | 6.9 | 7.0 | 7.5 | 0.7 | 7.0 |
| | | RT-800°C | | | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.1 | 0.5 | 7.7 | |
| | | RT-1000°C | | | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.3 | 8.3 | 0.4 | 7.9 | |
| Thermal Conductivity | 25°C | W/m-K | ASTM-C408 | 30 | 30 | 30 | 30 | 30 | 30 | 31 | 33 | 35 | 25 | 1.3 | 15 | |
| Specific Heat | 25°C | J/kg-K | ASTM-E1269 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 750 | 450 | |
| Dielectric Strength | 1mm | ac-volt/mil | ASTM-D116 | 425 | 400 | 400 | 400 | 400 | 400 | 420 | 470 | 470 | NA | 800 | 420 | |
| Dielectric Constant | 1 MHz | | ASTM-D150 | 9.9 | 9.9 | 9.7 | 9.8 | 9.8 | 9.8 | 9.8 | 9.8 | 10 | NA | 3.8 | 11.5 | |
| | 5 GHz | | TE ₀₁₁ Resonant Mode | 9.9 | 9.9 | 9.8 | 9.8 | 9.8 | 9.8 | 9.8 | 9.8 | 10 | NA | 3.8 | 11.5 | |
| Dielectric Loss (tan δ) | 1 MHz | | ASTM-D150 | 3 x 10 ⁻⁴ | 3 x 10 ⁻⁴ | 1 x 10 ⁻⁴ | <1 x 10 ⁻⁴ | 2 x 10 ⁻⁴ | <1 x 10 ⁻⁴ | <1 x 10 ⁻⁴ | <1 x 10 ⁻⁴ | 1 x 10 ⁻³ | NA | <1 x 10 ⁻⁴ | <1 x 10 ⁻⁴ | |
| | 5 GHz | | TE ₀₁₁ Resonant Mode | 5 x 10 ⁻⁴ | 5 x 10 ⁻⁴ | 1 x 10 ⁻⁴ | 6.5 x 10 ⁻⁵ | 2 x 10 ⁻⁴ | 5 x 10 ⁻⁵ | 2 x 10 ⁻⁵ | 1 x 10 ⁻⁵ | 1 x 10 ⁻³ | NA | 6 x 10 ⁻⁵ | 1.5 x 10 ⁻⁵ | |
| ELECTRICAL | Volume Resistivity | 25°C | Ω-cm | ASTM-D1829 | >10 ¹⁴ | >10 ¹⁴ | >10 ¹⁴ | >10 ¹⁴ | >10 ¹⁴ | >10 ¹⁴ | >10 ¹⁴ | >10 ¹⁵ | >10 ¹⁵ | 1 x 10 ⁸ | >10 ¹⁴ | >10 ¹⁴ |
| | | 300°C | | | 5 x 10 ¹² | 5 x 10 ¹² | 2 x 10 ¹² | 2 x 10 ¹² | 5 x 10 ¹² | 5 x 10 ¹² | 1 x 10 ¹³ | 5 x 10 ¹³ | 1 x 10 ¹³ | NA | 6 x 10 ¹² | 1 x 10 ¹² |
| | | 500°C | | | 3 x 10 ¹⁰ | 2 x 10 ¹⁰ | 2 x 10 ¹⁰ | 2 x 10 ¹⁰ | 1 x 10 ¹¹ | 1 x 10 ¹¹ | 2 x 10 ¹¹ | 1 x 10 ¹² | 8 x 10 ¹¹ | NA | 3 x 10 ¹¹ | 1 x 10 ⁹ |
| | | 600°C | | | 2 x 10 ⁹ | 2 x 10 ⁹ | 1 x 10 ⁹ | 1 x 10 ⁹ | 2 x 10 ⁹ | 2 x 10 ⁹ | 1 x 10 ¹⁰ | 5 x 10 ¹¹ | 5 x 10 ¹¹ | NA | 1 x 10 ¹¹ | 1 x 10 ⁷ |
| | | 1000°C | | | 1 x 10 ⁷ | 1 x 10 ⁷ | 2 x 10 ⁶ | 2 x 10 ⁶ | 1 x 10 ⁷ | 1 x 10 ⁷ | 2 x 10 ⁷ | 1 x 10 ⁸ | 1 x 10 ¹⁰ | NA | 9 x 10 ⁹ | 4 x 10 ⁵ |

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Notes:
① THE GDMS method is not optimized for analysis of compositions with individual secondary phase constituents at levels
② Matrix composition contains nominal 7.5% TiO₂

*The chart is intended to illustrate typical properties. Property values vary with method of manufacture, size, and shape of part. Data contained herein is not to be construed as absolute and does not constitute a representation or warranty for which CoorsTek assumes legal responsibility. Close control of values of most properties can be maintained if specified.

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