EXPRESS ELECTRONICS

MATERIAL DATASHEET

YSZ EE-YSZ

DESCRIPTION

Yttria-Stabilized Zirconia (YSZ) is a ceramic material comprising zirconium dioxide (ZrO_2) stabilized in its cubic crystal structure by the addition of yttrium oxide (Y_2O_3). This stabilization process prevents the destructive phase transitions that pure zirconia undergoes during heating and cooling, resulting in a material with exceptional mechanical strength, fracture toughness, and thermal stability.

KEY FEATURES:

- High Fracture Toughness & Strength
- Excellent Thermal Shock Resistance
- Low Thermal Conductivity
- High Oxygen Ion Conductivity
- Good Wear and Corrosion Resistance
- High Hardness
- Biocompatible (specific grades)

LIMITATIONS & CONSIDERATIONS

- **Cost:** Raw material and processing costs are higher than those for many other ceramics and metals.
- **Brittleness:** It is inherently brittle and can fail catastrophically under tensile or impact loading if not properly designed.
- **Aging at Low T:** In humid environments at low temperatures (200-400°C), some YSZ grades (especially 2-3 mol%) can undergo a slow, time-dependent transformation from the tetragonal to the monoclinic phase on the surface, potentially leading to micro-cracking and a degradation of mechanical properties. Higher Yttria content grades (e.g., 8YSZ) are immune to this.
- **Design Sensitivity:** Account for ceramic's low tensile strength and brittleness, avoiding sharp corners and stress concentrators.

APPLICATIONS:

APPLICATION AREA	EXAMPLE OF USE
STRUCTURAL & INDUSTRIAL	Cutting tools, wire drawing dies, grinding media, wear-resistant parts, thread guides, knife blades, pump seals, bearings.
ENERGY & ELECTROCHEMICAL	Solid Oxide Fuel Cell (SOFC) electrolytes, oxygen sensors, electrolysis cells, thermal barrier coatings (TBCs) for gas turbine blades and engine components.
BIOMEDICAL	Dental crowns & bridges, orthopaedic implants (e.g., hip & knee ball heads), bone screws.
CONSUMER GOODS	Watch cases, bracelets, precision blades (e.g., for scissors and razors).
OTHER	Crucibles for melting superalloys, labware, furnace elements.

PROPERTIES:

*Please note that all values quoted are based on test pieces and may vary according to component design. These values are not guaranteed in anyway whatsoever and should only be treated as indicative and for guidance only.

PROPERTY	UNIT	TYPICAL VALUE / RANGE
Physical Properties		
Density	g/cm^3	5.9 - 6.1
Crystal Structure	-	Cubic / Tetragonal
Color	-	White / Off-White
Mechanical Properties		
Vickers Hardness (HV)	GPa	12 - 14
Flexural Strength	MPa	800 - 1,500
Fracture Toughness (K_1c)	$MPa \cdot m^{1}/^{2}$	4 - 10
Young's Modulus	GPa	200 - 210
Poisson's Ratio	-	0.30 - 0.32
Thermal Properties		
Melting Point	°C	~2,700
Max. Use Temperature (Air)	°C	2,200 - 2,400 (Short Term)
Thermal Conductivity	W/m·K	2.0 - 3.3
Coefficient of Thermal Expansion (CTE)	$10^{-6}/K$	9.5 - 11.0
Thermal Shock Resistance	ΔT °C	Very High
Electrical Properties		
Ionic Conductivity (σ)	S/cm	~0.1 S/cm
Activation Energy (E_a)	eV	~1.0
Dielectric Constant (ε_r)	-	25 - 30
DC Volume Resistivity	Ω·cm	$>10^{10}$ at 25°C
Other Properties		
Biocompatibility	-	Excellent