



Ceramics for 3D printing

Typical characteristics of ceramic
materials after sintering

Important information - Non-contractual data

The technical data and values presented in this document are provided for information purposes only.

They are based on tests performed using 3DCeram machines and internal processes. Results may vary depending on specific manufacturing conditions, particularly the debinding and sintering temperatures and profiles, as well as the geometry of the printed parts. These data do not constitute a contractual commitment and do not engage the responsibility of 3DCeram. It is the user's responsibility to validate the final properties within the context of their own process and intended application.

Regarding medical applications:

The use of these materials for medical purposes is subject to the regulations in force in each country. Regulations and standards may vary from one country to another. It is the user's responsibility to ensure that all materials and parts comply with applicable regulatory requirements and to obtain all necessary approvals from the relevant authorities prior to any use in a medical device.

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Alumina

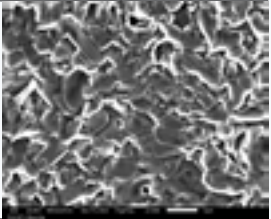
Properties

- Good mechanical strength
- Good thermal conductivity
- High electrical resistivity
- High hardness
- Good wear resistance
- Chemically inert

Application

- Electrical insulators
- Laboratory devices
- Telecommunication equipment
- Electronical devices
- Spatial
- Optical instruments



Microstructure		Values
Density	g/cm ³	3,9
SEM picture		
Mechanical properties		
4-pt bending strength	MPa	300-350
Weibull modulus		14.9
Theoretical young modulus	GPa	300
Vickers hardness	GPa	16.4
Fracture toughness	MPa.m ^{1/2}	4
Thermal properties		
Thermal conductivity at RT	W/m.K	23.3
Thermal expansion coef.	at -50°C	3.74
	at 20°C	4.98
	at 60°C	5.51

Zirconia 3Y

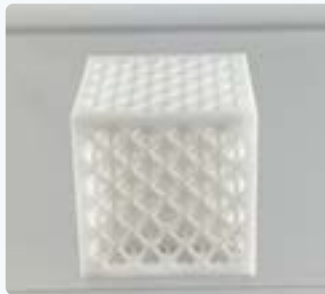
Thermo structural applications

Properties

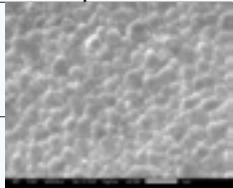
- Excellent mechanical properties
- Chemical inertness
- High hardness

Application

- Dental & orthopedic implants
- Cutting tools
- Luxury (jewels, watches, etc...)
- Fuel cells (SOFC, SOEC)
- Fiber optic connector
- Electronic equipment



Available on C101 EASY, C900 FLEX,
C1000 FLEXMATIC

Microstructure		Values
Densification rate	%	99.5
Density	g/cm ³	5.95
SEM picture		
Mechanical properties		
4-pt bending strength	MPa	950
Weibull modulus		9
Theoretical young modulus	GPa	200
Vickers hardness	GPa	12.6
Shear modulus	GPa	79.8
Compressive strength	MPa	2070
Thermal properties		
Thermal conductivity at RT	W/m.K	3.3
Thermal expansion coef.	at -50°C	8.59
	at 20°C	9.10
	at 60°C	9.34

Non contractual data for reference only - V17092025

Zirconia 8Y

Properties

- High oxygen ion conductivity
- High thermal conductivity
- High aging resistance
- High thermal stability

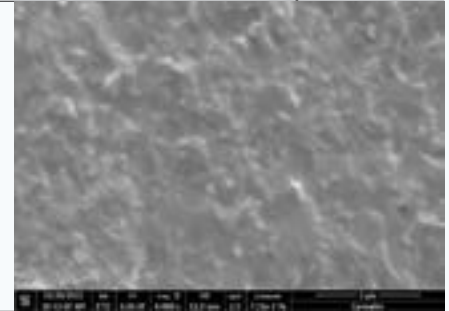
Application

- Fuel cell (SOEC, SOFC, Electrolyte)
- Oxygen sensor
- Thermal applications



Microstructure		Values
Densification rate	%	99
Density	g/cm ³	5.79

SEM picture



General properties

Ionic conductivity	$\sigma T = 17 \text{ S.cm}^{-1}.\text{K}$ ($T = 800^\circ\text{C}$)
	$\sigma T = 3 \text{ S.cm}^{-1}.\text{K}$ ($T = 600^\circ\text{C}$)

Hydroxyapatite

Properties

- Biocompatibility
- Excellent bioactivity
- Good osseointegration

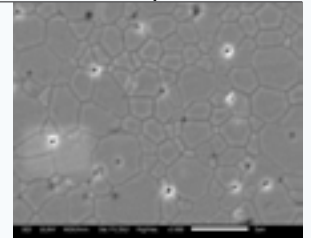
Application

- Tibial osteotomy wedges
- Intervertebral cages
- Cranial implants
- Bone substitute
- Spine implants
- Orthopedic implants



Microstructure		Values
Densification rate	%	96
Density	g/cm ³	1.5
Grain size after sintering	μm	2

SEM picture



Mechanical properties at RT

4-pt bending strength	MPa	107
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General properties

Ca/P ratio		1.65 to 1.82
Foreign phases (CaO, TCP alpha, TCP beta, TTCP)	%	5
Cristallinity	%	95
Heavy metals	ppm	30

Tricalcium phosphate

Properties

- Biocompatible
- Bioresorbable

Application

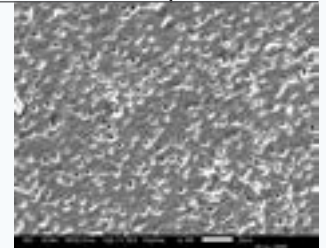
- Bone substitute



Available on C101 EASY, C900 FLEX

Microstructure		Values
Densification rate	%	80.7
Density	g/cm ³	2.47
Grain size after sintering	μm	2.8

SEM picture



General properties

- Presence of hydroxyapatite measured by X ray diffraction between 0% and 5%.
- No calcium pyrophosphate seen by infrared analysis.
- Ca/P ratio = 1.503

Density can be adjusted according to customer's needs

Alumina toughened zirconia

Properties

The ceramic ATZ combines both Alumina (20%) and Zirconia (80%) ceramics in one. The mix of these two combined offers several properties:

- Great hardness and tenacity
- Biocompatibility
- Resistance to wear and thermal shock

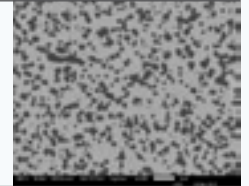
Application

- Biomedical applications
- Industry



Microstructure		Values
Densification rate	%	99
Density	g/cm ³	5.2
Grain size after sintering	μm	0.5

SEM picture



Mechanical properties

4-pt bending strength	MPa	1094
Weibull modulus		5.8
Theoretical young modulus	GPa	220

Thermal properties

Thermal conductivity at RT	W/m.K	5.4
Thermal expansion coef.	at -50°C	7.50
	at 20°C	7.94
	at 60°C	8.33

Cordierite

Properties

The cordierite is a magnesium alumina silicate material and has different properties:

- Low CTE
- Low thermal conductivity
- Wear resistant
- Good for vacuum application

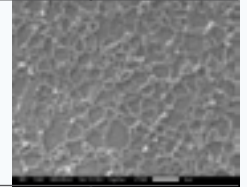
Application

- Optical components for aerospace



Microstructure		Values
Densification rate	%	98
Density	g/cm ³	2.5
Grain size after sintering	μm	0.89

SEM picture



Mechanical properties		
4-pt bending strength	MPa	150
Weibull modulus		6.5
Theoretical young modulus	GPa	140

Thermal properties		
Thermal conductivity at RT	W/m.K	3.8
Thermal expansion coef.	at -50°C	-0.87
	at 20°C	-0.10
	at 60°C	0.22

Silicore DS/SX

Investment casting

Properties

- High mechanical resistance
- Porous ceramic, good leachability
- Very stable at high temperature
- Compatible with complex shapes like cores
- Used with all alloys except cobalt

Application

Ceramic cores for lost wax foundry process.

These ceramic cores present a good behaviour during the casting of super alloys.

The material is suitable for DS and SX castings with continuous and low thermal expansions at high temperature.



Microstructure		Values
Silica/Zircon		90/10
Porosity	%	30
Mechanical properties at RT		
MOR 20°C	MPa	10
Impregnated MOR	MPa	22
General properties		
Cristobalite content	%	
As fired:		10
After 1530°C:		60
Roughness (Ra)	μm	3
Thermal expansion	20 - 1000°C	0.2%
	20 - 1525°C	0.4%
Leachability		± 80 min

Aluminium Nitride

Properties

- High thermal conductivity
- Electrical insulation
- Good mechanical strength

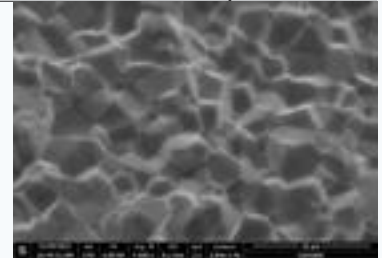
Application

- Electronics substrate
- Heat exchanger
- Semiconductor
- Thermal chucks
- Scientific instrumentation
- Heat sink



Available on C101 EASY, C900 FLEX,
C1000 FLEXMATIC

Microstructure		Values
Densification rate	%	98
Density	g/cm ³	3.22



SEM picture

Mechanical properties		
4-pt bending strength	MPa	270
Theoretical Young modulus	GPa	368
Thermal properties		

Thermal conductivity at RT	W/m.K	180
Thermal conductivity at 300°C	W/m.K	90

Thermal expansion coef.	at -50°C	10 ⁻⁶ .K ⁻¹	1.84
	at 20°C		2.89
	at 60°C		3.38

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Silicon Nitride

Silicon nitride is one of the hardest and most resistant ceramics.

Properties

- Good resistance to thermal shocks
- Good resistance to wear
- High mechanical properties
- Low density
- Good electrical insulation
- Resistance to corrosion (liquids and gas)

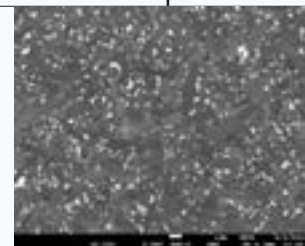


Application

- Semi conductor
- Thermostructural parts: space, semiconductor, automobile
- Thermal exchanger
- Biomedical



Microstructure		Values
Densification rate	%	98
Density	g/cm ³	3.13



SEM picture

Mechanical properties

4-pt bending strength	MPa	750
Weibull modulus		11
Theoretical Young modulus	GPa	290

Thermal properties

Thermal conductivity at RT	W/m.K	23.6
Thermal expansion coef.	at -50°C	0.67
	at 20°C	1.23
	at 60°C	1.52



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