

# 3D CERAM

## 3DMIX, ceramics for 3D printing Technical datasheets



The leading Ceramics Additive Manufacturer

27 rue du Petit Theil - 87280 LIMOGES

Tél. +33 (0) 5 55 04 10 90 - [info@3dceram.com](mailto:info@3dceram.com)

# **Alumina toughened Zirconia (ATZ)**

## **✓ 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

## **✓ Applications**

- ✓ Implants
- ✓ Teeth

- ✓ Wear resistant parts



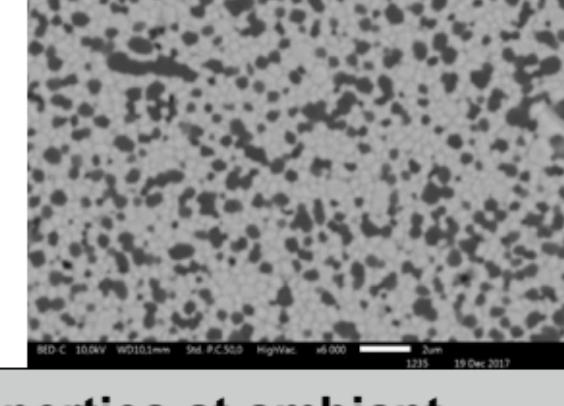
# Alumina toughened Zirconia (ATZ)

Values

## Microstructure

Densification rate	%	>99
Density	g/cm <sup>3</sup>	>5,2
Size of grains after sintering	µm	<0,5

SEM picture



## Mechanical properties at ambient temperature

Flexural strength	MPa	1094
Weibull modulus		5,8
Theoretical Young modulus	GPa	220

## Thermal properties from -50°C to 60°C

Thermal conductivity at ambient T	W/m/K	5,4
Thermal expansion coefficient ( $10^{-6}$ )	at -50°C	7,50
	at 20°C	7,94
	at 60°C	8,33

Non contractual data for reference only - V19102018

# 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

## ✓ Applications

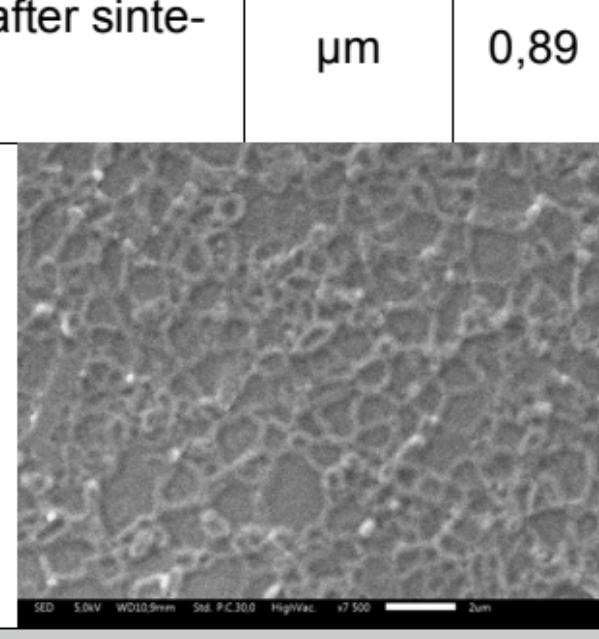
- ✓ Optical parts for aerospace

- ✓ Metrology



# Cordierite

Values

Microstructure		
Densification rate	%	>98
Density	g/cm <sup>3</sup>	>2,5
Size of grains after sintering	µm	0,89
SEM picture	 SED 5.0kV WD10.9mm Std. P.C.30.0 HighVac. v7.500 2µm	

## Mechanical properties at ambient temperature

Flexural strength	MPa	150
Weibull modulus		6,5

## Theorical Young modulus

Theirical Young modulus	GPa	140
-------------------------	-----	-----

## Thermal properties from -50°C to 60°C

Thermal conductivity at ambient temperature		W/m/K	3,8
---	--	-------	-----

Thermal expansion coefficient ( $10^{-6}$ )	at -50°C	K <sup>-1</sup>	-0,87
	at 20°C		-0,10
	at 60°C		0,22

Non contractual data for reference only - V19102018

# Zr8Y

For non medical use

## Properties

- ✓ Ionic conductivity

## Applications

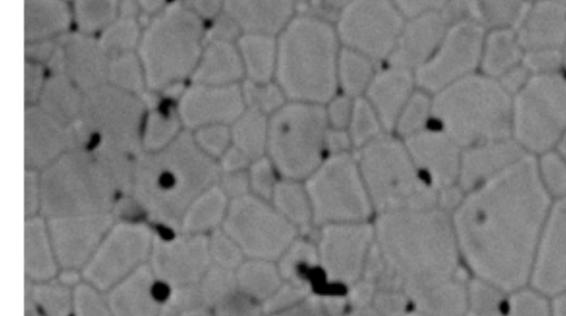
- ✓ Fuel cell

Values

### Microstructure

Densification rate	%	>99
Density	g/cm <sup>3</sup>	5,79
Size of grains after sintering	µm	0,73

SEM picture



### Analysis

Ionic conductivity	$\sigma \cdot T = 17 \text{ S} \cdot \text{cm}^{-1} \cdot \text{K}$ ( $T = 800^\circ\text{C}$ ) $\sigma \cdot T = 3 \text{ S} \cdot \text{cm}^{-1} \cdot \text{K}$ ( $T = 600^\circ\text{C}$ )
Non contractual data for reference only - V19102018	

# TCP

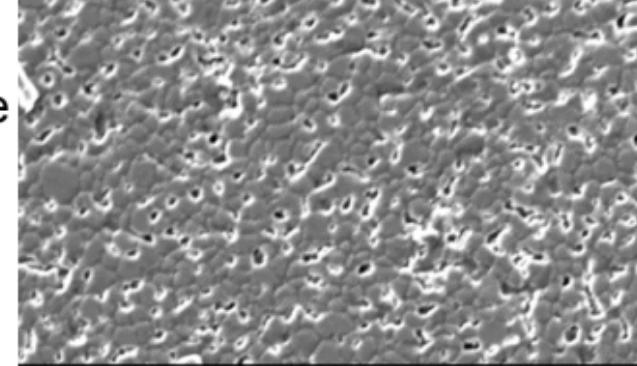
## Tricalcium phosphate

### Properties

- ✓ Biocompatible
- ✓ Bioresorbable

### Applications

- ✓ Implants

		Values
<b>Microstructure</b>		
<i>Density can be adjusted accordingt to customer's needs</i>		
Densification rate	%	80,7
Density	g/cm <sup>3</sup>	2,47
Grain size after sintering	µm	2,8
SEM picture	 The SEM image displays a highly porous microstructure of Tricalcium Phosphate (TCP). The surface is covered with a dense network of interconnected pores of varying sizes, creating a sponge-like appearance. The pores are irregularly distributed across the field of view. Technical parameters at the bottom of the image indicate: SED, 10.0kV, WD10.0mm, High P.C.50.0, HighVac., x1 300, 10µm scale bar, and 06 Apr 2018 date.	

### Analysis

- presence of hydroxyapatite measured by X ray diffraction bewteen 0% and 5%
- no calcium pyrophosphate seen by infrared analysis
- Ca/P ratio =1,503

Non contractual data for reference only - V19102018

# FUSED SILICA

## Properties

- ✓ Good leachability

## Applications

- ✓ Foundry cores

Microstructure			Values
<i>Porosity can be adjusted according to customer's needs</i>			
Densification rate	%	60	
Density	g/cm <sup>3</sup>	1,36	
SEM picture	 Scanning Electron Microscopy (SEM) image showing a granular microstructure of fused silica. The image displays numerous small, irregularly shaped particles of varying sizes, indicating a porous or partially dense material. Technical parameters at the bottom of the image include: SED, 10.0kV, WD 0.2mm, Std. PC 50.0, HighVac., x1 000, and 50µm scale bar.		

## Mechanical properties at ambient temperature

Flexural strength	MPa	16,7
-------------------	-----	------

## Analysis

% cristobalite (mass)	%	2
Roughness (Ra)	µm	1,28
Shrinkage	Dilatation TR -1150°C	0,07
	before stage	-4,61
	At stage	-0,11

Non contractual data for reference only - V19102018

# ZIRCONIA

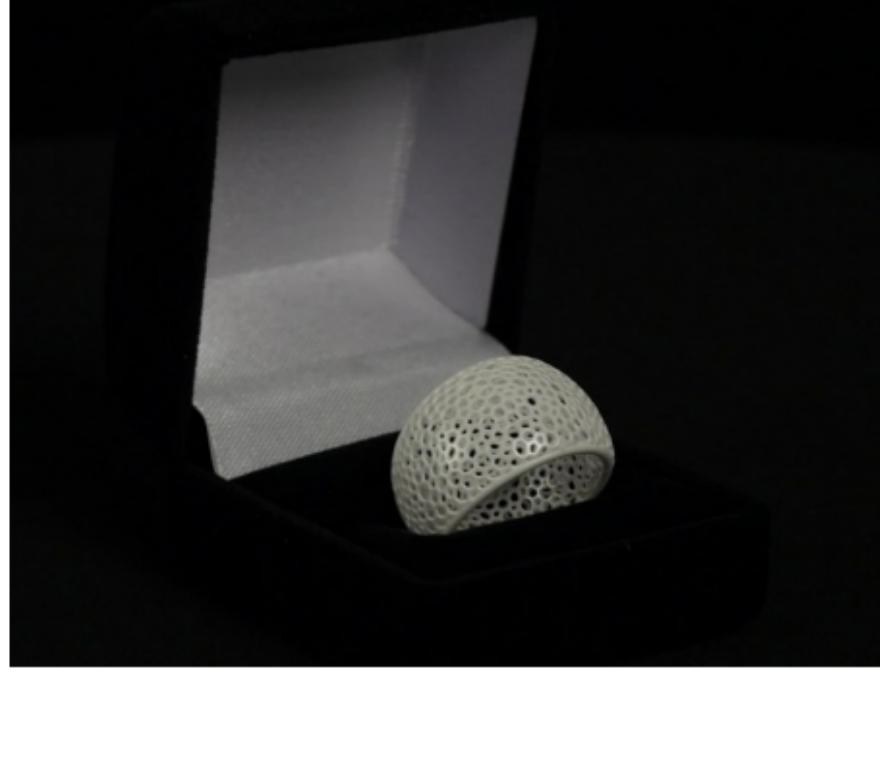
For non medical use

## ✓ Properties

- ✓ Excellent mechanical properties
- ✓ Chemical inertness
- ✓ High hardness

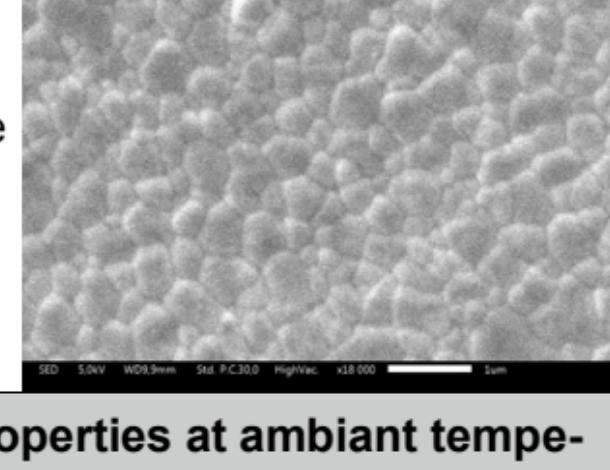
## ✓ Applications

- ✓ Jewelry
- ✓ Watches
- ✓ Biomedical devices
- ✓ Biomedical implants
- ✓ Electronic equipment



# ZIRCONIA

## For non medical use

			Values
<b>Microstructure</b>			
Densification rate	%	>99,5	
Density	g/cm <sup>3</sup>	>5,95	
Grains' size after sintering	µm	<0,5	
SEM picture	 SED 5.0kV WD9.9mm Std. P.C.30.0 HighVac. x18 000 1µm		
<b>Mechanical properties at ambiant temperature</b>			
Flexural strength	MPa	950	
Weibull modulus		9	
Therical Young modulus	GPa	200	
Vickers hardness	GPa	12,6	
Shear modulus	GPa	79,8	
Compressive strength	Mpa	2070	
<b>Thermal properties from -50°C to 60°C</b>			
Thermal conductivity at ambient T	W/m/K	3,3	
Thermal expansion coefficient (10 <sup>-6</sup> )	at -50°C	K <sup>-1</sup>	8,59
	at 20°C		9,10
	at 60°C		9,34
Non contractual data for reference only - V19102018			

# HAP

## Hydroxyapatite

### ✓ Properties

- ✓ Biocompatibility
- ✓ Excellent bioactivity
- ✓ Good osseointegration

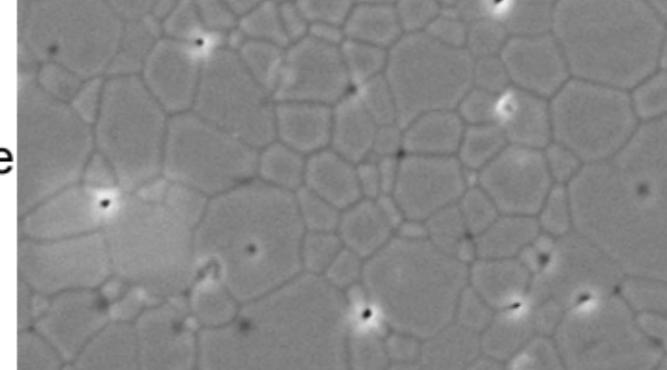
### ✓ Applications

- ✓ Tibial osteotomy wedges
- ✓ Intervetebral cages
- ✓ Cranial implants
- ✓ Bone substitute
- ✓ Spine implants
- ✓ Orthopedic implants



# HAP

## Hydroxyapatite

			Values
<b>Microstructure</b>			
Densification rate	%	>96	
Density	g/cm <sup>3</sup>	1,5	
Grains' size after sintering	µm	2	
SEM picture			<small>SED 10,0kV WD9,9mm Std. P.C.50,0 HighVac. x5 000 5um</small>
<b>Mechanical properties at ambiant temperature</b>			
Flexural strength	MPa	107	
<b>Analysis</b>			
Ca/P ratio		1,65 to 1,82	
Foreign phases (CaO, TCP, alpha, TCP beta, TTCP)	%	≤5	
Cristallinity	%	>95	
Heavy metals	ppm	<30	

Non contractual data for reference only - V19102018

# ALUMINA

## ✓ Properties

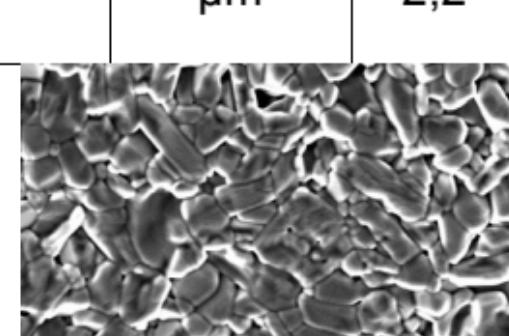
- ✓ Good mechanical strength
- ✓ Good thermal conductivity
- ✓ High electrical resistivity
- ✓ High hardness
- ✓ Good wear resistant
- ✓ Chemically inert

## ✓ Applications

- ✓ Electrical insulators
- ✓ Laboratory devices
- ✓ Telecommunication equipment
- ✓ Electronical devices
- ✓ Spatial
- ✓ Foundry cores
- ✓ Optical instruments



# ALUMINA

			Values
<b>Microstructure</b>			
Density	g/cm <sup>3</sup>	>3,9	
Grains' size after sintering	µm	2,2	
SEM picture	 IED 30kV WD10.0mm SAM PC580 HighVac. x1000 Scale		
<b>Mechanical properties at ambiant temperature</b>			
Flexural strength	MPa	397	
Weibull modulus		14,9	
Theorical Young modulus	GPa	300	
Vickers hardness	GPa	16,4	
Fracture toughness	MPa.m <sup>1/2</sup>	4	
<b>Thermal properties from -50°C to 60°C</b>			
Thermal conductivity at ambient T	W/m/K	23,3	
Thermal expansion coefficient ( $10^{-6}$ )	at -50°C	$K^{-1}$	3,74
	at 20°C		4,98
	at 60°C		5,51
Non contractual data for reference only - V19102018			

# OUR SERVICES



© 2015 3D Systems Corporation. All rights reserved.

## AEROSPACE



## FOUNDRY CORES



## BIOMEDICAL